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Effects of Bad Debt Adjustment on Repayment: Evidence from the KR&C Data Set in South Korea*

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This study investigates the effects of debt adjustment for bad debts on repayment and discusses the optimal principal reduction rate. We use a logit model and propensity score matching, particularly employing a unique data set of creditors' ledgers, debt adjustment information, and debtors' characteristics from Korea Resolution & Collection, which manages bad debts in South Korea. We classify debtors into beneficiaries and non-beneficiaries of the debt adjustment program and find that beneficiaries have larger repayment amounts than non-beneficiaries. An appropriate reduction rate is derived from a quadratic function consisting of expected repayment and reduction rates. This function is postulated to explore moral hazards that may arise from the expansion of the principal reduction rate. We find that if reduction rate is expanded from 60% to 70%, then it does not reach the maximum repayment rate but maintains the debt adjustment system's effectiveness and the fund's stability.

JEL Classification: D1, G2, G5, H0
Keywords: Bad Debt Adjustment, KR&C, Moral Hazards, Principal Reduction Rate, PSM

I. Introduction

South Korea's household debt increased rapidly from approximately KRW 1,500 trillion in 2019 to KRW 1,682 trillion by the third quarter of 2020. Although the growth rate of the household debt had decreased to 3.9% in the third quarter of 2019 compared with the same period in 2018, it increased to about 7% in the third

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quarter of 2020. In addition, the share of high-risk households increased from 2.7% in 2018 to 5.7% in June 2019 and 6.3% in September 2021. The share of financial liabilities of high-risk households increased from 5.4% in 2018 to 13.1% in June 2019 (Financial Stability Report by the Bank of Korea, June 2019).[1] The increase in household debt inevitably expanded during the COVID-19 pandemic. Financial support packages—including emergency funding for business operations, low-interest rate loans, special guarantees for SMEs and small business loans, debt deferrals, and temporary suspension of interest payments—were provided to mitigate the economic impact of the COVID-19 outbreak and have generally contributed to household debt expansion. Once the government's financial support ceases resulting from the suppressed spread of COVID-19, the potential insolvency of households is likely to increase if those who have received support fail to recover their repayment capabilities.

Debt repayment ability would decrease significantly for households with a high proportion of financial liabilities and those who work in contact sectors, where market activity involves exposure to COVID-19. In particular, the elderly and low-income households would have a large burden of repayment at the end of financial support.[2] Although the gradual termination of financial support can provide a soft landing and partially resolve the realization of potential risks, troubled debtors with potential insolvency cannot be disregarded. If insolvency becomes a reality, then the government would be required to provide debtors with opportunities for rehabilitation through a debt adjustment plan. Against this backdrop, a debatable aspect is whether or not a debt adjustment plan that may cause moral hazard problems is effective in terms of repayment performance and stability of funds.

To support low-income vulnerable groups among troubled debtors, Korea Resolution & Collection (KR&C), which manages and recovers bad debts by taking over and transferring contracts, operates a debt-adjustment program. In February 2019, this program increased the principal reduction rate from 60% to 70% in accordance with the Financial Services Commission's "Improvement plan of credit

[1] A high-risk household is defined as a risk household meeting the following conditions: its debt-to-service ratio (DSR) is over 40% and its total liabilities are higher than total assets. Moreover, a risk household refers to a household with a Household Default Risk Index (HDRI), introduced by the Bank of Korea, of over 100. The share of high-risk households in September 2021 is calculated based on the estimated DSR criterion (45.9%). The criterion is determined by the extent to which it restricts household consumption based on the household debt database (Financial Stability Report by the Bank of Korea, December 2021).

[2] According to the financial stability report (2019), from 2012 to the third quarter of 2019, the size of loans for vulnerable borrowers under 50s remained at the level of 22.5%–28.5%, while those in their 60s and over and over 70s increased to 8.5%–14.5% and 3.0%–6.6%, respectively. Compared with the decrease in the number of vulnerable borrowers under 50s, the number of vulnerable borrowers in their 60s and over doubled from 79,000 to 162,000. Furthermore, Table 3 shows that the average age of KR&C's troubled debtors is approximately 53 years, thereby indicating many elderly vulnerable borrowers.

recovery support system for individual debtors." The biggest controversy involving the debt adjustment plan involves a moral hazard problem, creating delayed repayments and excessive loans. Furthermore, considerable principal reduction or exemption for debtors benefiting from the debt adjustment program can exacerbate the moral hazard. However, given that debtors in the KR&C data set are at the bottom of the income bracket and have minimal ability to repay their debt, an increase in the principal reduction rate may not necessarily raise the problem of a moral hazard.[3] In a situation where there will be more debtors with an extremely low repayment capacity owing to the COVID-19 pandemic—likely increasing the insolvency of individual households and self-employed people—some of them will require debt adjustment at the end of the government's financial support.

This study investigates the effect of KR&C's debt adjustment program on the repayment performance of the beneficiaries of debt adjustment, and examines the appropriate level of the principal reduction rate by discussing moral hazard issues that may arise with an increase in the reduction rate.[4] Comparing beneficiaries with non-beneficiaries would lead to a selection bias or endogeneity because they are not randomly selected.[5] In view of this problem, we use a logit model and propensity score matching (PSM) method, employing a unique data set of debt ledgers, debt adjustment information, and debtor-specific characteristics of bad debts from 2016 to 2018, all of which are owned and internally managed by KR&C. The PSM method is used to reduce selection bias owing to confounding variable by making the treatment and non-treatment groups comparable based on a predictive probability of group membership.

We classify debtors into beneficiaries and non-beneficiaries of the debt adjustment program and compare their repayment amounts. Average repayment amount paid by beneficiaries is KRW 2.931 million, which is higher than the KRW 0.761 million by non-beneficiaries. In addition, we divide debtors with similar characteristics into the following three groups and investigate their repayment

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[3] A thorough property investigation is also conducted to curb the moral hazard of the debt adjustment system.

[4] This study uses most of the information on debtors held by KR&C. Most of KR&C's insolvent assets were held by savings banks, and they were bad debts transferred to KR&C during the 2011–2012 savings bank insolvency. Therefore, debtors used in this study are expected to be households with relatively low credit ratings and low income. Evidently, there is a limit to the study, given that the sample used in the analysis does not represent the entire Korean debtor because the debt period is long and debtors' ability to repay is remarkably low. We focus on households with incomes below KRW 1.5 million. These households are not seized. The results from KR&C's debt adjustment program cannot be generalized for debtors benefiting from other debt adjustment programs. However, they provide empirical evidence of the efficacy of the debt rescheduling program for low-income debtors in situations, in which repayment is nearly impossible.

[5] For example, the age of household heads, marital status, and family size are potentially correlated with debtors' repayment abilities (Canner and Luckett, 1990). Such a correlation would affect who will be selected as beneficiaries.

effects: (1) individuals whose repayments have ended, (2) individuals whose repayment performance is similar to beneficiaries' repayment performance prior to the application for debt adjustments, and (3) individuals subject to public debt adjustments. We find that repayment effect for beneficiaries of debt adjustment remains large.

Lastly, we derive an appropriate principal reduction rate based on a quadratic function consisting of the expected repayment and reduction rates, and examine possible moral hazards if the principal reduction rate of debt adjustment is increased. Analysis shows that when reduction rate is increased from 60% to 70%, the maximum repayment rate is not reached, but the effect of the debt adjustment program and stability of the fund are maintained. Accordingly, the reduction rate expansion of the debt adjustment program is effective in helping debtors' self-sufficiency, instead of maximizing the repayment effect.

Our study is related to Dobbie and Song (2015), Dobbie et al. (2017), Dobbie and Song (2020), Ganong and Noel (2020), and Cespedes et al. (2021), who have investigated the benefits of (un)secured debt relief. We contribute to the literature by investigating the (1) effect of a debt adjustment program for bad debts and (2) benefits of an expansion of the principal reduction rate. This study is based on the unique South Korean data set of the debt ledger, debt adjustment information, and debtors' characteristics from KR&C. In particular, we focus on debt repayment rate and amounts for troubled debtors, whose repayment capacity is close to zero after collateral liquidation. Lastly, we discuss the appropriate reduction rates and moral hazard issues. Nam et al. (2014) calculate an appropriate reduction rate that secures the fund's stability, focusing on the National Happiness Fund in South Korea. They claimed that institutional aspects, such as the review process and follow-up management, should be considered in addition to debtors' self-activity in the debt adjustment program. Indarte (2020) shows that debt forgiveness has a positive but small effect on moral hazard, implying that the social cost of generous bankruptcy is minimal.

The remainder of this paper is organized as follows. Section II develops the hypotheses with a literature review. Section III examines the characteristics and basic statistics of the KR&C debt-related data. Section IV discusses the analysis method. Section V analyzes the repayment effect of the debt adjustment program. Section VI derives an appropriate reduction rate and discusses moral hazard issues. Lastly, Section VII summarizes the main results and concludes the paper.

II. Literature Review and Hypothesis Development

An increasing number of studies have investigated the determinants of mortgage default and effects of debt-relief intervention (Bhutta et al., 2017; Gerardi et al.,

2018; Gupta and Hansman, 2020; Ganong and Noel, 2020; Dobbie and Song, 2020). Ganong and Noel (2020) emphasize the benefits of maturity extensions but show no significant effects of principal reductions on default and consumption. Dobbie and Song (2020) show the positive benefits of debt write-downs but find that immediate payment reductions have minimal impact on the repayment rates of debtors. Effects of debt write-downs are driven by borrowers with above-median debt-to-income ratios. Kim (2019) finds that a cut in overdue interest rate increases repayment. When overdue interest rate is lowered further, the repayment amount increases by 16.7%–41.7% over the next year. Given that the empirical results of debt-relief interventions vary depending on the data set, we cannot generalize these results to our case.[6] The results of Ganong and Noel (2020) are based on underwater borrowers in the mortgage market, where liquidity constraints are essential. By contrast, the results of Dobbie and Song (2020) are obtained from financially distressed credit card borrowers. The KR&C data set is closely related to that of Dobbie and Song (2020). That is, debtors are included in a low-income group and are extremely financially constrained with small loans from savings banks. Thus, we propose the first hypothesis:

H1. An increase in the principal reduction rate of KR&C's debt adjustment program is effective in increasing debtors' repayment amounts. Repayment amounts of beneficiaries of the debt adjustment program are higher than those of non-beneficiaries.[7]

The theoretical basis for households' balance sheet dates to Thurow (1969). He emphasizes that households can defer current consumption for future consumption by saving but cannot easily borrow from their future income to finance current consumption. These households may have better incentives to go bankrupt or postpone payments than to repay overdue loans. However, increasing the principal

[6] The policy of lowering overdue interest rate is applied to all debtors and not those subject to debt adjustment. Considering that the debt adjustment program is for debtors who have difficulty repaying (i.e., not for all debtors), the effect of the debt adjustment program on repayment is unlikely obscured or amplified by reduced overdue interest rate.

[7] This study uses cumulative repayment amount, not repayment ratio, as primary variable. In the case of benefiting from debt adjustment, a certain percentage of debt is reduced. In general, bullet repayment is the principle, so the remaining debt is repaid at once. That is, repayment ratio consequently has the same meaning as (1-reduction rate). In addition, inducing debtors to repay as much as possible is one of the purposes of debt adjustment. Hence, the amount is a more direct measure in explaining the effect of an increase in principal reduction rate rather than the ratio. Other factors may influence households' decision-making in forming disparate debt portfolios. For example, age of household heads has a negative relationship with debt repayment hardships (e.g., Canner & Luckett, 1990). Canner and Luckett (1990) show that marital status and family size are correlated with debtors' repayment capabilities. We thank the referees for mentioning these facts. We control for these factors by employing PSM, thereby enabling us to find a suitable control group for the treatment group.

reduction and exemption rate can help insolvent individuals resolve their debt-ridden balance sheets and rebuild their credit at the expense of losses of associated institutions. Indarte (2020) conducts theoretical and empirical analyses on the roles of moral hazard and liquidity by estimating the causal effect of debt relief available in bankruptcy on filing and mortgage payment reductions on filing. She shows that the social costs of considerably generous debt relief are negligible, implying that the moral hazard effect is small. Therefore, we propose our second hypothesis:

H2. When principal reduction rate is increased from 60% to 70%, maximum repayment rate is not reached, but the effect of the debt adjustment program and stability of the fund are maintained. An increase in the principal reduction rate (60% to 70%) would not generate serious moral hazard issues.

Alternatively, Kanz (2016) shows that debtors who receive generous debt adjustment (i.e., full and unconditional debt relief) are likely to be minimally concerned with their reputational consequences of default, causing a moral hazard. Kanz (2016) also shows that beneficiaries of debt adjustment consider debt relief as a temporary benefit, not a permanent one, and are concerned with credit constraints, causing difficulty for them to access credit in the future. The expected fall in access to credit may lead to decreased investments and productivity. This result implies that one-time settlements, such as KR&C's debt forgiveness program, may be ineffective in incentivizing indebted households to rebuild financially sound and sustainable balance sheets unless it also recovers their liquidity constraints and accessibility to the credit market.

III. Data and Basic Statistics

1. Data

Data used in this study are taken from KR&C, which acquires the sales or contracts of insolvent financial companies and manages insolvency obligations. KR&C supports debt adjustment for debtors who are deemed unable to repay their debts considering their property or income level. Most debtors in the data set were transferred from failed mutual savings banks. Although the debtors' individual debt is not huge, they have long-term overdue debts. Given that debtors have a high average age, low income, and insufficient solvency, they are relatively far from the issue of moral hazards caused by debt adjustment (refer to Kim (2019) for additional information on KR&C).

We analyze the effects of the debt adjustment program by using the debt ledger, debt adjustment-related information, and debtor-specific characteristics provided by

KR&C for the period 2015–2018. Table 1 lists the key variables in the data set. Debt ledger contains such information as personal identification number, debt number, public debt adjustment, takeover date, collection category, debt amount, and takeover price. Debt adjustment-related variables contain information on debtors who have applied for debt adjustment. This study only analyzed debtors who appear in the debt ledger. Furthermore, we include individual non-corporate debtors, main debtors who are not guarantors, and debtors against whom collection can be made. The socially marginalized class is excluded from the analysis because its members' reduction rate is different from that of ordinary debtors. Repayment completion date for debtors who have completed their repayments is set based on the completion date in the debt ledger, expected end date for the repayment of debt adjustment, and completed reduced debts in debt adjustment information. Completion date in the debt ledger includes absolved debt because the actual profit of collection is judged to be zero. These debts are excluded from the analysis because they can distort the effects of the debt adjustment program.[8]

Debtors' property-related information can be an important variable because the interest and principal reduction rates are determined based on the property and income levels when applying for the debt adjustment program. Three types of property information, namely, real estate, financial assets, and monthly income, are available. However, the property information in the debt adjustment data set is not useful. Real estate and financial assets are seized immediately upon discovery during property investigation, and debt is repaid through their forcible auction or sale. Accordingly, these assets cannot be considered as currently held properties. In the case of monthly income, only income exceeding KRW 1.5 million is to be seized; incomes below this amount are determined to be non-repayable incomes and assumed to be zero.[9]

Debtors whose liabilities are higher than their income and property levels can apply to the KR&C debt adjustment program. Among them, debtors are selected as eligible for debt restructuring in consideration of their repayment ability, such as financial conditions, occupation, and age. Depending on their financial conditions, debtors subject to debt adjustment will either have their interest partially or fully

[8] In accordance with the Financial Services Commission's "Improvement plan of the bad debt management system for public financial institutions" in March 2017 and "Measures to support long-term small delinquent persons" in November 2017, parts of individual bad debts and long-term minor delinquents are sold to South Korea on the premise of incineration within three years. Furthermore, if repayment performance is KRW 0 among applicants for debt adjustments, then it is excluded from analysis because it is a case of abnormal debt completion (e.g., sale or death of the main debtor). If there is a repayment performance after the expected repayment end date, then it is considered that debt adjustment has not been faithfully implemented and is set as a non-beneficiary of the debt adjustment system.

[9] From the end of 2018, income level for seizure has been increased to KRW 1.8 million. Thus, monthly income available for seizure is calculated to reflect this fact.

[Table 1] Layout of key variables

	Variable name	Variable contents
Debt ledger	Classification	Individual, company
	Personal information	Gender, age
	Customer number	Matching criteria
	Public debt adjustment	Individual rehabilitation debt, credit recovery debt, general debt
	Date of takeover	Date of overdue occurrence
	Classification of collection	Normal, unable to collect[1)]
	Current balance/Interest balance	Debt balance
Repayment details	Customer number	Matching criteria
	Amount of repayment	Total amount of repayment, principal, interest
Debt-related personal info.	Customer number	Matching criteria
	Relationship	Whether the individual is a guarantor or not
	Completion date	Whether repayment is complete or not
Property information	Debtor's name, date of birth	Matching criteria
	Property	Real estate, finance, income etc.
Debt adjustment info.	Approval completion date	Debt adjustment approval date
	Personal information	Age, gender (matching criteria)
	Loan balance at the time of application	Principal applied with reduction rate
	Interest amount at the time of application	Most interest is canceled when debt is adjusted
	Balance of provisional payment upon application	Amount of obligation of repayment at the time of debt adjustment
	Total amount of debt	(Loan balance at the time of application) + (Interest amount at the time of application) + (Balance of provisional payment upon application)
	Amount of collection	Total expected repayment
	Amount of reduction	Total debt amount - Recovered amount
	Repayment method	Lumpsum payment, equal installment payments of principal, lumpsum + equal installment payments
	Expected end date of repayment	Expected end date of repayment in case of debt adjustment contract
	Account completion status	When the reduction is completed (Data for 2017 and 2018) 1) Final payment date if data on the final payment date are available at the time of completion of the account 2) Expected end date of repayment if there are no data on the final payment date at the time of account completion
	Socially marginalized class[2)]	Data for 2017, 2018

Note: 1) Reasons for collection failure: fled, decision of indemnification, death, abandonment of inheritance, end of lawsuit loss, absence of cause documents, lapse of prescription before takeover, completion of settlement procedure, confirmation of the absence of debt, completion of settlement and bankruptcy, completion of judgment, completion of settlement procedure, and completion of rehabilitation (Kim, 2019).

2) Socially marginalized class: beneficiaries of national basic livelihood, severely handicapped persons, those aged 70 years or older.

exempted or have their principal reduced. Among the beneficiaries of the debt adjustment program, debtors who belong to the case of equal installment payments of principal or lump-sum and equal installment of the principal other than lump-sum payments are excluded from the analysis because repayment end date is not clear.[10] In this manner, 61,497 debtors are constituted out of a total of 307,153. Furthermore, 50,898 out of 290,979 debtors are non-beneficiaries of the debt adjustment program, and 11,049 out of 16,174 debtors are beneficiaries. Beneficiaries and non-beneficiaries of debt adjustment, who have similar characteristics, are matched thereafter for the analysis. Reduction rate is based on debt principal because interest is completely canceled. In addition, most of the beneficiaries of debt adjustment are subject to lump-sum repayment. Thus, the comparison is made using the accumulated repayment amount because fluctuation in debtors' repayment amount may be large at a given period.

2. Basic Statistics

Table 2 illustrates the number of applicants for debt adjustment by year. During the analysis period, the overdue interest of all debtors is cut from 18% to 12% in September 2015, and the principal reduction rate for debt-adjusted debtors is increased from 50% to 60% in July 2016. The number of applicants for debt adjustment from 2015 to 2018 is 11,049. Among them, 7,277 have completed their repayment, amounting to KRW 31.58 billion. When 2016 is divided into the first and second halves to compare the amount of repayment before and after the expansion of the principal reduction rate for debt adjustment, the number of applicants for debt adjustment after the expansion increases by 276 and the number of debtors who have completed repayment increases by 133. Furthermore, additional repayment amount is approximately KRW 320 million.

Calculating the net effect of the debt adjustment program for 2015 is difficult because of the overdue interest rate cut. Therefore, the analysis period is limited from 2016 to 2018 in the subsequent analysis.[11] Amounts of debt and repayment, overdue periods, and reduction rates are compared by period by dividing debtors into applicants (post-beneficiaries) and non-applicants (post-non-beneficiaries) of the debt adjustment program.

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[10] Lump-sum repayment is the principal, but equal installment payment of principal or lump-sum and equal installment payment are allowed considering debtors' repayment abilities.

[11] In July 2016, principal reduction rate increased. This study includes reduction rate as a major explanatory variable. Thus, the first half of 2016 is also included in the analysis period.

[Table 2] Number of applicants for debt adjustment (unit: persons, KRW 100 million)

Period	Debt adjustment program (Persons, KRW 100 million)				Note
	Number of applicants	Number of debt completion	Number of remaining applicants	Repayment Amount	
Total	11,049	7,277	-	315.8	
2015	3,286	1,869	1,417	82.4	Reduction in the overdue interest rate in September 2015 (18% → 12%)
2016	3,730	1,943	3,204	95.0	
First-half	1,727	905	2,239	45.9	
Second-half	2,003 (+276)	1,038 (+133)	3,204	49.1 (+3.2)	Expansion of principal reduction and exemption rate in July 2016 (50% → 60%)
2017	2,559	1,934	3,829	76.7	
2018	1,474	1,531	3,772	61.7	

Note: Number of remaining applicants = Cumulative number of applicants – Number of debts completed until the current quarter.

Table 3 shows the basic statistics based on the status of benefits from the debt adjustment program. By examining the basic statistics of beneficiaries and non-beneficiaries of debt adjustment as of 2018, the total debt amount of beneficiaries (i.e., KRW 170.8 billion) is only 9.8% of that of non-beneficiaries (i.e., KRW 1.7387 trillion). However, the share of the total repayment of beneficiaries (i.e., KRW 6.17 billion) is 32% of the non-beneficiaries' total repayment (i.e., KRW 19.14 billion), which is higher than the proportion of the total debt amount. Moreover, average repayment amount (i.e., KRW 1.16 million) is higher for beneficiaries than that (i.e., KRW 0.47 million) for non-beneficiaries. Average delinquency period is 15.07 years for non-beneficiaries, which is less than (i.e., 17.63 years) that for beneficiaries. In terms of a guarantor, 67% of non-beneficiaries have guarantors, whereas only 33% of beneficiaries are debtors with guarantors. In the case of the reduction rate applied only to beneficiaries of debt adjustment, the average reduction rate for all beneficiaries is 23.59%, and average reduction rate for beneficiaries who have received principal reduction is 34.80%.[12] In addition, reduction amount is KRW 150.4 billion. Average monthly income of beneficiaries of debt adjustment is KRW 983,620, which is higher than the KRW 780,545 of non-beneficiaries. In terms of gender and age, there are more women than men, with an average age of

[12] Among the beneficiaries of debt adjustment, debtors who can repay the principal will receive a partial reduction of the accrued interest, and the principal reduction rate is 0%. By contrast, debtors who cannot repay the principal are subject to a principal reduction rate of up to 60% (after July 2016).

[Table 3] Basic statistics by status of benefits from the debt adjustment program

Period		First-half of 2016		② Second-half of 2016		③ 2017		④ 2018	
		A	B	A	B	A	B	A	B
Debt amount (KRW 100 million)		19,504 (40.37)	656 (20.86)	18,860 (41.08)	1,085 (25.59)	18,185 (42.39)	1,555 (26.98)	17,387 (42.74)	1,708 (32.22)
	Principal	4,176 (8.64)	128 (4.07)	3,927 (8.56)	219 (5.17)	3,599 (8.39)	315 (5.47)	3,291 (8.09)	330 (6.23)
	Interest	15,328 (31.73)	518 (16.49)	14,933 (32.53)	852 (20.09)	14,586 (34.00)	1,219 (21.16)	14,096 (34.65)	1,358 (25.60)
	Provisional payment		10 (0.31)		14 (0.32)		20 (0.35)		21 (0.39)
Repayment (KRW 100 million)		139.8 (0.29)	45.9 (1.46)	182.5 (0.40)	49.1 (1.16)	259.8 (0.61)	76.7 (1.33)	191.4 (0.47)	61.7 (1.16)
	Principal	97.3 (0.20)	37.3 (1.19)	124.5 (0.27)	40.3 (0.95)	169.6 (0.40)	61.4 (1.07)	138.2 (0.34)	48.3 (0.91)
	Interest	42.5 (0.09)	8.6 (0.27)	58.0 (0.13)	8.8 (0.21)	90.2 (0.21)	15.3 (0.27)	53.2 (0.13)	13.4 (0.25)
Average overdue period (years)		15.49	17.90	15.36	18.03	15.20	17.78	15.07	17.63
Status of a guarantor		0.63	0.25	0.65	0.26	0.67	0.27	0.67	0.33
Average reduction rate (%) (Debtor with reduction)			21.05 (31.73)		22.84 (36.60)		22.32 (34.21)		23.59 (34.80)
Status of male on average		0.41	0.42	0.41	0.42	0.41	0.40	0.41	0.40
Average age		53.25	52.93	53.17	53.57	53.17	53.01	53.13	53.05
Reduction amount (KRW 100 million)			553 (17.63)		947 (22.39)		1,362 (23.66)		1,504 (28.42)
Average monthly income (KRW) (Debtor with income)								3,933.7 (780,545)	7,048.4 (983,620)
	Repayment								
	(Lumpsum payment)		2,129		2,880		3,994		3,757
	(Equal installment payment of principal)		744		985		1,259		1,067
	(Lumpsum + Equal installment)		271		377		510		479
Number of samples		48,314	3,144	45,905	4,242	42,905	5,763	40,677	5,303

Note: 1) A debtor with a reduction refers to a debtor for whom all accrued interest has been cancelled and the principal reduction rate has been applied.
2) The number of debtors with regular monthly income is 243 (205 non-applicants and 38 applicants for debt adjustment).
3) Provisional payment refers to an amount that must be repaid without being reduced for expenses, such as a lawsuit for extension of prescription.
4) A: Non-beneficiary of debt adjustment, B: Beneficiary of debt adjustment
5) Values in the parenthesis indicates average KRW100 million.

approximately 53 years for beneficiaries and non-beneficiaries. For repayment method, lump-sum payment is used by the largest number, with a total of 3,757 people; equal installment payment of principal is used by 1,067 people; and lump-sum and equal installment payments are used by the least number of people, totaling 479.

As shown in Table 3, there are differences in the characteristics of debtors, such as overdue repayment period, guarantor status, gender, and age, between beneficiaries and non-beneficiaries of debt adjustment. For the main analysis, repayment performance is compared using debtors with similar characteristics selected through PSM. However, future income and willingness to repay, which are essential factors in determining who are subject to debt adjustment, are not known in the data set.[13] Effects of both factors could be reflected in the principal reduction rate. Given that debtors of KR&C used in this study are expected to be households with relatively low credit ratings and low future income, their willingness to repay could be considered the most important determinant of debt adjustment beneficiaries.

IV. Empirical Specification

To analyze the effects of the debt adjustment program for troubled debtors held by KR&C from 2016 to 2018, beneficiaries and non-beneficiaries of debt adjustment are matched by their characteristics and compared thereafter in terms of their repayment performance. Accordingly, PSM and average treatment effect on the treated (ATT) are used. Propensity score can be obtained by estimating the logit model of the group dummy for the debt adjustment beneficiary group ($T_i = 1$) and debt adjustment non-beneficiary group ($T_i = 0$), in which the common characteristics X of debt adjustment beneficiaries are given as follows:

$$PS = P(X) = Pr[T_i = 1 \mid X], \tag{1}$$

where the assumptions of conditional independence, strong irrelevance, and common areas are satisfied.

ATT is used to investigate the average difference in repayment performance between groups classified through PSM. If j is 1 for the variable to be compared (repayment amount) $H_{j,i}$, then it indicates the debt adjustment beneficiary group; if it is 0, then it refers to the debt adjustment non-beneficiary group. ATT is expressed as follows:

$$ATT = E[H_{1,i} - H_{0,i} \mid T_i = 1] = E[H_{1,i} \mid T_i = 1] - E[H_{0,i} \mid T_i = 1]. \tag{2}$$

[13] Given that KR&C conducts property investigations only for applicants for debt adjustment, there is no income information for non-applicants. However, their income level can be inferred to be not high because they do not have a high repayment rate. This assumption is considered reasonable because the overdue repayment period is long and the age is high even though the principal is small.

For the estimation, Equation (2) can be transformed as follows:

$$\begin{aligned} ATT = & [E[H_{1,i} \mid T_i = 1, X] - E[H_{0,i} \mid T_i = 0, X]] \\ & [E[H_{0,i} \mid T_i = 0, X] - E[H_{0,i} \mid T_i = 1, X]]. \end{aligned} \tag{3}$$

All terms in Equation (3) are identifiable, and there is a selection bias in the second term. However, if the conditional independence assumption is satisfied, then it can be expressed as follows:

$$\begin{aligned} ATT &= E_X[E[H_{1,i} \mid T_i = 1, X] - E[H_{0,i} \mid T_i = 1, X] \mid T_i = 1] \\ &= E_X[E[H_{1,i} \mid T_i = 1, X] - E[H_{0,i} \mid T_i = 0, X] \mid T_i = 1] \\ &= E[H_{1,i} \mid T_i = 1] - E_{X|T_i=1}[H_{0,i} \mid T_i = 0]. \end{aligned} \tag{4}$$

To deal with selection bias, average treatment effect (ATE) can be used, which is a weighted average of applying ATT of non-beneficiaries of debt adjustment. However, this study employs ATT because non-beneficiaries of debt adjustment are less likely to receive benefits in policy analysis.

V. Debt Adjustment Program and Repayment

1. Completion of Repayment with Debt Adjustment and Reduction Rate

Prior to the main analysis, we estimate a logit model for the probability of all debtors and beneficiaries of debt adjustment completing the repayment. We likewise investigate the effects of debt adjustment and reduction rate. Effects of debtor-specific characteristic variables on the probability of debt completion are compared by estimating the logit model, which considers a dummy variable as a dependent variable, indicating whether or not the debt is eliminated. The logit model used in this study is shown as follows:

$$\begin{aligned} & \log\left(\frac{p[Y=1 \mid X_i]}{p[Y=0 \mid X_i]}\right) = \alpha + \varphi_1 X_{i,1} + \varphi_2 X_{i,2} + \ldots + \varphi_n X_{i,n} = X_i'\Phi, \\ & p[Y=1 \mid X_i] = \frac{\exp(X_i'\Phi)}{1+\exp(X_i'\Phi)}, \end{aligned} \tag{5}$$

where Y represents the status of debt completion and $X_{i,j}$ denotes explanatory variables.

Table 4 shows the estimation results of the logit model on whether or not debt is eliminated. Debtors' characteristic variables include gender, age, overdue period, guarantor status, cumulative repayment, debt balance (principal), current balance (principal + interest), debt adjustment dummy, and reduction rate.[14] Key variables are debt adjustment dummy and principal reduction rate. Models (1) and (2) show that the results of all debtors, older debtors, shorter overdue periods, higher number of guarantors, and smaller amounts of debt are associated with a higher probability of completing repayment. In particular, beneficiaries of debt adjustment are more likely to complete repayment than non-beneficiaries, indicating the program's efficacy.

Existing studies have shown a negative relationship between age and debt adjustment (Canner and Luckett, 1990; Canner, 1988; Duca and Rosenthal, 1990; Lindley et al., 1989). For example, young debtors are likely to repay debts for economic–financial revitalization and rehabilitation. However, depending on debtors' characteristics, such as inheritance, guarantor, and willingness to engage in economic activities, there may be cases in which the incentive to repay debts is relatively higher among the elderly.[15]

According to the results of Models (3) and (4) for beneficiaries of debt adjustment, fewer guarantors, smaller debt amounts, and higher reduction rates are associated with higher probability of completing repayment. Higher reduction rate is associated with higher probability of repayment completion for beneficiaries of debt adjustment. However, repayment amount may not be high even if repayment is completed because the interest or principal is partially cancelled when individuals benefit from the debt adjustment program. In the next section, program beneficiaries and non-beneficiaries with similar characteristics are matched. Thereafter, their cumulative repayment amounts are compared to verify the probability of completing repayment and also the repayment amount.[16]

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[14] No information on family members is available in the KR&C data. Instead, we investigate the role of guarantors for debtors' repayment capabilities. Considering the case of giving up inheritance, guarantors are a crucial variable for debt repayment completion. According to the results of debt adjustment beneficiaries (see Tables 4 and 10), debt completion is weakened for debtors with guarantors.

[15] Debtors of KR&C have long periods of overdue payments exceeding 15 years, with higher interest accumulated than the principal, and the average age of debtors is at least 50 years. Moreover, problems related to inheritance may arise if there are no guarantors, in which repayment is more likely to occur for older debtors. There may be other cases, such as installment repayment or discovery of hidden property. Given that these cases are not significant, we delete or disregard them from the sample.

[16] Beneficiaries of debt adjustment are determined by a thorough review procedure. In verifying the ability of debtors to repay their debt, if they can repay all debts, then they cannot benefit from the debt adjustment system. Therefore, selection bias may arise in reviewing and selecting debtors who would receive debt restructuring benefits. However, debtors benefiting from debt adjustment does not necessarily mean that repayment will be eventually completed. In the case of debtors who requested for lump sum repayment, debt adjustment may be canceled owing to the inability to repay. In the case of

[Table 4] Results of estimation for debt completion status (logit model)[17]

	Total debtors		Beneficiaries of debt adjustment	
	Model (1)	Model (2)	Model (3)	Model (4)
Debt adjustment dummy	5.972 (0.106)***	6.052 (0.107)***		
Reduction rate			1.242 (0.441)***	1.059 (0.448)**
Gender (Male=0, Female=1)	-0.045 (0.040)	-0.029 (0.040)	0.306 (0.193)	0.340 (0.192)*
Age	0.005 (0.002)**	0.004 (0.002)*	-0.003 (0.010)	-0.013 (0.010)
Overdue period	-0.010 (0.005)*	-0.015 (0.005)***	0.011 (0.022)	0.003 (0.023)
Guarantor status (Guarantor=1)	0.731 (0.074)***	0.737 (0.075)***	-0.593 (0.214)***	-0.947 (0.199)***
ln(Cumulative repayment)	0.459 (0.011)***	0.449 (0.011)***	0.646 (0.062)***	0.585 (0.050)***
ln(Debt balance)	-0.089 (0.007)***		-0.520 (0.110)***	
ln(Current balance)		-0.021 (0.003)***		-0.080 (0.029)***
Constant term	-7.394 (0.232)***	-8.325 (0.214)***	2.850 (1.517)*	-2.833 (0.915)***
$\bar{R}^2$	0.695	0.691	0.363	0.354
Number of observed value	74,466	74,357	6,551	6,442

Note: *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

2. Comparison between Beneficiaries and Non-beneficiaries of Debt Adjustment

Table 5 presents ATT of the cumulative repayment amount between non-

debtors who requested to repay in installments, debt adjustment may be canceled owing to overdue repayment. That is, selection bias would not be significant because the debt adjustment process evaluates the ability to repay and does not necessarily select debtors who can repay.

[17] Given the insufficient number of covariates used in this study, other hidden biases may exist. However, considering all relevant information is impossible because it exceeds the scope of the KR&C data set used in this study. Income is an essential factor for the successful completion of repayment. However, the KR&C data set has income information only for applicants of the debt adjustment program and not for the entire debtor. Furthermore, there is a limit to analyzing using income data in this study because whether or not income is stable and regular is uncertain. Considering that principal reduction rate is set lower as income increases, we can infer that information on income is partially reflected in the reduction rate. Thus, we use principal reduction rate to analyze debt adjustment beneficiaries in Table 4.

beneficiaries and beneficiaries of debt adjustment. The two groups are selected based on gender, age, overdue period, guarantor status, and debt balance through PSM.[18] The results show that cumulative repayment by beneficiaries is higher than that by non-beneficiaries for the first half of 2016 and second half of 2016, 2017, and 2018. In the results for the entire period, average cumulative repayment amount of beneficiaries is KRW 2.931 million, which is KRW 2.169 million more than the KRW 0.761 million of non-beneficiaries. One explanation for this finding is that an increase in the principal reduction rate alleviates the liquidity constraints of troubled debtors. However, an accurate comparison may be difficult because in most cases, non-beneficiaries do not pay off all their debts. Given that most of the interest amount is canceled and the principal is reduced for the beneficiaries of debt adjustment, the amount of repayment made by beneficiaries is significantly reduced relative to the original debt level. That is, a simple comparison of averages is difficult, even when using cumulative payments. After subdividing these debtors, the differences in repayment amounts are compared in the following subsection.

[Table 5] Average treatment effect of repayment amounts (unit: KRW 1 million)

Period	Group	Beneficiaries	Non-beneficiaries	Difference	Sample number of beneficiaries	Sample number of non-beneficiaries
Entire period	Unmatched	2.931	1.180	1.750***	34,255	712,428
	Matched	2.931	0.761	2.169***	34,255	34,255
First-half of 2016	Unmatched	2.774	0.753	2.021***	3,213	93,708
	Matched	2.774	0.610	2.164***	3,213	3,213
Second-half of 2016	Unmatched	2.776	1.094	1.681***	4,547	89,981
	Matched	2.776	0.758	2.018***	4,547	4,547
2017	Unmatched	2.898	1.570	1.328***	11,000	171,030
	Matched	2.898	1.050	1.848***	11,000	11,000
2018	Unmatched	3.117	2.064	1.053***	11,695	163,399
	Matched	3.117	2.546	0.571***	11,695	11,695

Note: 1) When the debt balance is used for matching, the result is similar, and when comparing quarterly, the beneficiaries' repayment amount is larger and more significant.
2) *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

3. Comparison by Groups of Similar Personalities

To further investigate the effect of debt adjustment on debt repayment performance, debtors are divided into three groups: (1) debtors whose repayment has ended, (2) non-beneficiaries who have repayment performance similar to the

[18] Whether or not PSM works well is discussed in Section V.4.

repayment performance of debt adjustment beneficiaries before debt adjustment, and (3) debtors subject to credit recovery and individual rehabilitation.

Table 6 shows the statistics comparing the total repayment amount of debtors whose repayment has ended. In this case, there are only a few debt-adjustment beneficiaries and non-beneficiaries with similar characteristics. Thus, the total repayment amount is compared using the simple sum and mean of the repayment amount. First, looking at the repayment amount among the debtors whose repayment has ended, non-beneficiaries of debt adjustment must repay the principal and accrued interest. Thus, non-beneficiaries can be expected to have a high average repayment amount. However, the total repayment of debt-adjustment beneficiaries who have completed repayment for three years is KRW 13.13 billion, which is more than twice the amount of KRW 6.044 billion for non-beneficiaries. As of 2018, the average repayment amount made by beneficiaries of debt adjustment is KRW 2.91 million, which is more than the KRW 1.75 million made by non-beneficiaries. This result implies that the repayment effect of the debt adjustment program still exists in this case. For the number of debtors, the number of beneficiaries of debt adjustment who have completed repayment for three years is 5,408, which is about 2.46 times the 2,200 non-beneficiaries.

Second, past repayments are divided into three distinct types to examine non-beneficiaries who had a repayment performance similar to that of the beneficiaries of debt adjustment before the application of debt adjustment. Most beneficiaries are

[Table 6] Repayment amounts between beneficiaries and non-beneficiaries of debt adjustment (debtors whose repayment has ended, KRW 100 million)

	Period	Beneficiaries of debt adjustment		Non-beneficiaries of debt adjustment	
		Repayment completion X	Repayment completion O	Repayment completion X	Repayment completion O
Total repayment amount (KRW 100 million)	2016–2018	101.95	131.3	713.05	60.44
	2016				
	First-half	23.76	22.09	125.04	14.72
	Second-half	27.74	21.32	171.12	11.42
	2017	33.33	43.34	236.16	23.65
	2018 (Average)	17.12	44.55 (KRW 2.91 million)	180.73	10.65 (KRW 1.75 million)
Number of debtors (Number of persons)	2016–2018	13,044	5,408	175,601	2,200
	2016				
	First-half	2,239	905	47,908	406
	Second-half	3,204	1,038	45,466	439
	2017	3,829	1,934	42,158	747
	2018 (Average)	3,772	1,531	40,069	608

[Table 7] Average treatment effect of repayment based on past payments (Total debtors, KRW 1 million)

Repayment amount before debt adjustment	Beneficiary/ non-beneficiaries	ATT		Number of matched debtors
		Before benefit	After benefit	
Past repayment amount is KRW 0	Beneficiaries	0	2.626	4,572
	Non-beneficiaries	0	0.251	4,572
	Difference	0	2.376***	-
Past payment is less than 1% of debt	Beneficiaries	0.012	2.799	4,757
	Non-beneficiaries	0.029	0.162	4,757
	Difference	-0.017***	2.637***	-
Past repayment amount is less than 1% of principal	Beneficiaries	0.00059	2.655	4,462
	Non-beneficiaries	0.0065	0.172	4,462
	Difference	-0.006***	2.483***	-

(Repayment completion, Individual debtor's final point, such as 4Q of 2018, KRW 1 million)

Repayment amount before debt adjustment	Beneficiary/ non-beneficiaries	ATT		Number of matched debtors
		Before benefit	After benefit	
Past repayment amount is KRW 0	Beneficiaries	0	3.925	1,451
	Non-beneficiaries	0	4.341	1,451
	Difference	0	-0.416***	-
Past payment is less than 1% of debt	Beneficiaries	0.017	2.800	4,780
	Non-beneficiaries	0.165	1.440	4,780
	Difference	-0.148***	1.361***	-
Past repayment amount is less than 1% of principal	Beneficiaries	0.001	2.768	3,962
	Non-beneficiaries	0.050	1.322	3,962
	Difference	-0.049***	1.436***	-

Note: 1) In the case of repayment before being a beneficiary, the average may differ because a debtor with a similar past repayment rate is selected.
2) *, **, and ***represent statistical significance at the 10%, 5%, and 1% levels, respectively.

at a level where the repayment amount before the application is nearly zero. Accordingly, to group debtors who have similar characteristics, we divide them into (1) debtors whose past repayment amount is zero, (2) debtors whose past repayment amount is below 1% of the total debt, and (3) debtors whose past repayment amount is under 1% of the principal. Thereafter, we implement matching. Table 9 shows that for debtors whose past payment is zero and for those whose total debt or repayment rate to the principal is below 1%, cumulative repayment amount by beneficiaries after debt adjustment is larger and statistically significant compared with that before debt adjustment. Repayment amounts of beneficiaries are also high when comparing only debtors whose cumulative repayment is most likely to be completed or as of the fourth quarter of 2018. Although the assumption that the

past repayment of KRW 0 can be strong, this result is also robust for debtors whose total debt or rate of repayment to the principal is below 1%.

Lastly, we compare debtors under public debt adjustment, such as credit recovery and individual rehabilitation, among non-beneficiaries of KR&C's debt adjustment with those who do not receive public debt adjustment among the beneficiaries of KR&C's debt adjustment. As shown in Table 8, regardless of whether or not debtors undergo public debt adjustment, beneficiaries of debt adjustment outperform non-beneficiaries in terms of repayment amount. Moreover, repayment performance of beneficiaries of KR&C's debt adjustment is better than that of non-beneficiaries who have undergone public debt adjustment.[19]

[Table 8] Average treatment effects based on public debt adjustment

Repayment amount before debt adjustment	Beneficiary/ non-beneficiaries	ATT	Number of matched debtors
General debtor	Beneficiaries	2.921	33,993
	Non-beneficiaries	2.516	33,993
	Difference	0.405***	-
Credit recovery or individual rehabilitation debtor	Beneficiaries	4.128	260
	Non-beneficiaries	0.883	260
	Difference	3.245	-
Beneficiaries of debt adjustment: General debtor Non-beneficiaries of debt adjustment: Credit recovery, individual rehabilitation	Beneficiaries	2.931	34,253
	Non-beneficiaries	0.752	34,253
	Difference	2.179***	-

Note: *, **, and ***represent statistical significance at the 10%, 5%, and 1% levels, respectively.

4. Quality Assessment of PSM

This study employs PSM to match beneficiaries and non-beneficiaries of the debt adjustment program based on their similar characteristics. Accordingly, this section verifies whether or not a correct matching has been made for PSM used in Table 5. Table 9 shows the T-test statistics of the characteristic variables before and after matching between beneficiaries and non-beneficiaries. Overall, T-test statistics and significance level decreased after matching, even though the statistical significance level of all variables did not disappear. These results can also be confirmed in Figure 1, which shows the probability density of propensity scores for the treated and control groups before and after matching. Figure 1 also shows that the

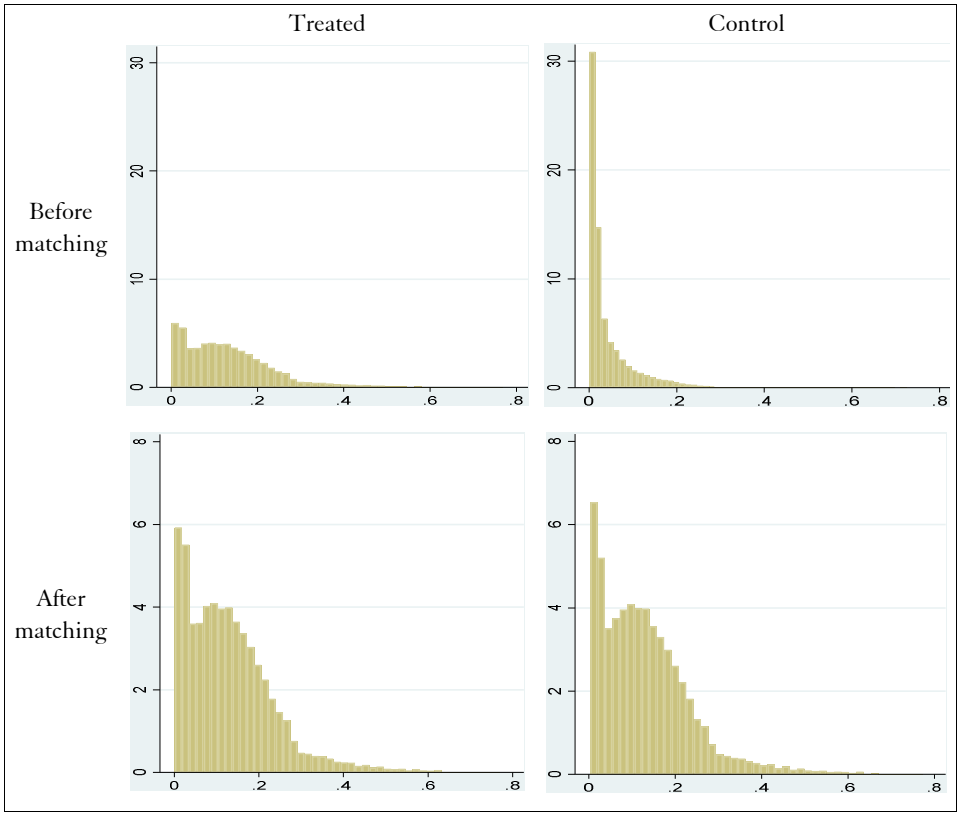
[19] Given that individuals can hold multiple debts, even if some of the debts are under public debt adjustment, the remaining debts can benefit from KR&C's debt adjustment system. As shown in the analysis results, repayment effect of debt adjustment beneficiaries is greater than that of debtors who receive public debt adjustment. However, this situation is related to individual choices, is not an accurate result, and is discussed at a level that complements the conclusion.

distributions of propensity scores in the treatment and control groups are different before matching but similar after matching.

[Table 9] Comparison of T-test statistics before and after PSM

Variables	Matching	Mean		T-test
		Treated	Control	
Gender (Male=0, Female=1)	Unmatched	0.399	0.408	-3.30
	Matched	0.399	0.548	-1.97
Age	Unmatched	53.134	53.180	-0.87
	Matched	53.134	51.262	1.27
Overdue period	Unmatched	17.944	15.322	95.20
	Matched	17.944	8.143	15.25
Guarantor status (Guarantor=1)	Unmatched	0.200	0.643	-168.32
	Matched	0.200	1.000	-12.96
ln(Debt balance)	Unmatched	21.994	40.510	-5.99
	Matched	21.994	27.292	-0.35
Point of time	Unmatched	10.179	8.185	78.63
	Matched	10.179	3.976	9.91

[Figure 1] Comparison of distribution before and after PSM



VI. Discussion on Moral Hazards and Appropriate Reduction Rate

KR&C cut the overdue interest rate in September 2015 (18% → 12%) and increased the principal reduction rate in July 2016 (50% → 60%). In June 2019, it increased the debt-adjustment principal reduction rate from 60% to a maximum of 70% in accordance with the Financial Services Commission's "Improvement plan of credit recovery support system for individual debtors" in February 2019. From the standpoint of managing bad debts for the vulnerable, a debt adjustment system that enables debtors to repay the maximum amount that they can and write off the rest would be desirable in terms of creating social value and supporting the vulnerable. However, a problem with this approach is that excessive reduction can cause a moral hazard. This section discusses the repayment effect from an increase in the principal reduction rate and also the moral hazards that may arise from debt adjustment.

The debt adjustment program and moral hazards are typically discussed together because they are closely related. However, in the case of the KR&C data set used in this study, the situation is different from that of general debt adjustment. First, most of KR&C's insolvent debtors are overdue with an average delinquency period of over 15 years. The natural assumption is that a moral hazard problem exists before debt adjustment. However, when applying for debt adjustment, principal reduction rate is determined based on the amount expected to be repayable through property investigation. Given that most of the debts are repaid after the interest and principal are reduced, the problem of moral hazards is not severe.

Judgment of whether or not a debt adjustment scheme is morally hazardous may differ depending on whether it is placed in the recovery performance or in support of vulnerable groups, such as the self-support of debtors. In this regard, debtors will possibly reduce their effort to repay faithfully or increase their risk-taking tendency if they receive a principal reduction through the debt adjustment program. However, there is no considerable room for raising the issue of moral hazards, considering that most of KR&C's insolvent debtors have long-term overdue debts and belong to low-income and vulnerable groups.[20]

Two situations are examined to consider the moral hazard problem in this study. First, the amount repaid by beneficiaries of the debt adjustment program is possibly less than that of non-beneficiaries because of excessive principal reduction. Given this situation, the maximum reduction rate can be considered the rate at which the

[20] After completing repayment through debt adjustment, the moral hazards problem may arise based on the experience of debt adjustment. However, the Korea Deposit Insurance Corporation has been exerting effort to reduce moral hazards issues, such as implementing an economic resurgence support program since October 2018.

repayment amount of beneficiaries is higher than that of non-beneficiaries, whose characteristics are similar to those of debt adjustment. The second possibility is related to fund stability. Given that KR&C borrows funds from the Korea Deposit Insurance Corporation and purchases insolvent debts, an excessive reduction is likely to lead to loss of funds. Accordingly, repayment amount should be more than the amount purchased for the first bad debt. Reduction rate applied to debt adjustment that satisfies this situation can also be considered the maximum reduction rate. This study discusses an appropriate reduction rate by assuming that the lower one of the two is the maximum reduction rate.

1. Calculation of an Appropriate Reduction Rate

A higher principal reduction rate of the debt adjustment program is associated with financial support for the vulnerable and would lead to a higher probability of repayment. However, the problem of moral hazards simultaneously increases. This section examines this relationship by analyzing, after deriving the relationship between the reduction rate and expected reduction rate (or expected repayment amount), whether or not the stability of the fund and effects of the debt adjustment program are maintained if the principal reduction rate is further expanded. Hence, a quadratic function is used between the expected reduction rate and reduction rate, which is introduced by Nam et al. (2014). This relationship is illustrated as follows:

$$\text{Expected reduction rate} = (1 - \text{Reduction rate}) \times (\hat{\beta}_1 \overline{X} + \hat{\beta}_2 \quad \text{Reduction rate}), \quad (6)$$

where $\overline{X}$ is the average of the debtor's characteristic variable related to debt completion status and $\hat{\beta}_1$ and $\hat{\beta}_2$ denote the estimation coefficients of $\overline{X}$ and principal reduction rate, respectively. That is, expected reduction rate is the expected value for which the probability of the beneficiaries of debt adjustment completing repayment is multiplied by the ratio of the amount of debt, excluding deductions to the total debt amount. This relationship is summarized as follows:

$$\begin{aligned} \text{Expected reduction rate} &= \{(\text{Total debt amount} - \text{Reduction amount}) / \\ &\quad \text{Total debt amount}\} \times \text{Probability of repayment completion} \\ &= (1 - \text{Reduction rate}) \times \text{Probability of repayment completion} \\ &\quad (= (\hat{\beta}_1 \overline{X} + \hat{\beta}_2 \quad \text{Reduction rate})). \end{aligned} \quad (7)$$

If the expected repayment amount is calculated using the expected reduction rate, then it can also be expressed in the form of a quadratic function of the reduction rate. Expected repayment amount refers to repayment when reduction rate is applied. Interest is assumed to be zero because accrued interest is completely

canceled when reduction rate is applied to the principal. However, the balance of provisional payments that includes lawsuit cost is not canceled. Thus, the product of expected repayment rate and principal plus the balance of provisional payments for the probability of completing repayment is assumed as the expected repayment amount. In summary, expected repayment amount can also be expressed in the form of a quadratic function of the reduction rate, similar to the expected reduction rate. This relationship between the expected repayment amount and reduction rate is shown as follows:

$$\begin{aligned}\text{Expected repayment amount} &= (\text{Provisional payment balance} \times \text{Probability of repayment completion}) + (\text{Principal} \times \text{Expected reduction rate}) \\ &= \{\text{Provisional payment balance} + \text{Principal} \times (1 - \text{Reduction rate})\} \\ &\times \text{Probability of repayment completion} \\ &(= (\hat{\beta}_1 \overline{X} + \hat{\beta}_2 \quad \text{Reduction rate})).\end{aligned} \tag{8}$$

Estimated coefficients in Equations (6) to (8) are extracted using Equation (9). Moreover, Equation (9) represents a logit model in which cross-sectional data are constructed on debtors among beneficiaries of the debt adjustment program who received principal reduction, and the status of debt completion is established as a dependent variable. In particular, Y_i refers to the status of debt completion; X_i represents control variables, such as gender, age, overdue period, guarantor status, and debt principal; and Z_i represents reduction rate.

$$Y_i = \alpha + \beta_1 X_i + \beta_2 Z_i + \nu_i . \tag{9}$$

Table 10 presents the estimation results of Equation (9). $\overline{X}$ denotes the average value of an explanatory variable. Estimation is performed by classifying debtors into beneficiaries of debt adjustment for whom the total principal is reduced and those with monthly income of under KRW 1.5 million. In both cases, estimation results are similar.

To examine the appropriate reduction rate, the current study explores ATT of non-beneficiaries with characteristics similar to those of beneficiaries of debt adjustment. We use information on debtors who have completed repayment or use information in the last period (fourth quarter of 2018) to compare non-beneficiaries of debt adjustment with debtors who received a reduction on the principal and completed their repayment. Table 11 shows ATT of repayment amounts of beneficiaries and non-beneficiaries of the debt adjustment program. Among all debtors, beneficiaries' average repayment amount is KRW 2.686 million and that of non-beneficiaries is KRW 2.101 million. In the latter, when repayment amount is multiplied with the number of debtors, total repayment amount becomes

approximately KRW 11.635 billion.

[Table 10] Logit model estimation results for debt elimination (beneficiaries of debt adjustment)

	Model (1), total		Model (2), monthly income=0	
	Estimated result	Mean ($\bar{X}$)	Estimated result	Mean ($\bar{X}$)
Gender (Male=0, Female=1)	-0.028 (0.063)	0.378	-0.029 (0.063)	0.378
Age	-0.012 (0.003)***	52.905	-0.012 (0.003)***	52.887
Overdue period	-0.008 (0.008)	18.026	-0.008 (0.008)	18.025
Guarantor status (Guarantor=1)	-0.435 (0.079)***	0.195	-0.435 (0.079)***	0.193
ln(Current balance)	0.112 (0.007)***	13.402	0.112 (0.007)***	13.391
Reduction rate	1.171 (0.195)***	0.343	1.176 (0.195)***	0.342
ln(Monthly income)	0.121 (0.070)*	0.049	-	-
Constant term	-0.223 (0.215)	-	-0.213 (0.215)	-
$\bar{R}^2$	0.058	-	0.057	-
Number of observed values	5,536	-	5,517	-

Note: *, **, and ***represent statistical significance at the 10%, 5%, and 1% levels, respectively.

[Table 11] Average treatment effect of repayment amounts

Repayment amount before debt adjustment	Model	Beneficiaries	Non-beneficiaries	Difference	Number of debtors
Total debtors	Average treatment effect	2.686	2.101	0.585***	5,536
Past payment is less than 1% of debt		2.762	1.405	1.356***	5,300

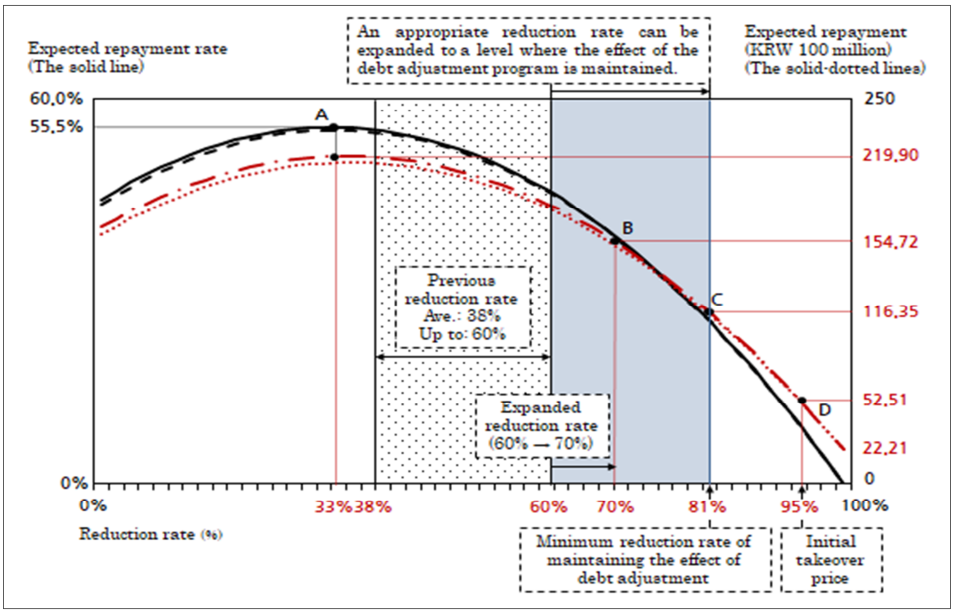
Note: *, **, and ***represent statistical significance at the 10%, 5%, and 1% levels, respectively.

2. Adequate Reduction Rate and Moral Hazards

Figure 2 shows a graph in which the reduction rate is the X-axis, and expected repayment rate (left axis) and expected repayment amount (right axis) are the Y-axis, based on the results estimated in the previous section. As shown by the four main points in Figure 2, a 33% reduction rate achieves maximum repayment rate. Expected repayment rate is 55.5% and expected repayment amount is KRW 21.28 billion (A). Moreover, when the maximum reduction rate is increased from 60% to 70%, in accordance with the Financial Services Commission's system improvement

plan, expected repayment rate is 38% and expected repayment amount is KRW 15.472 billion (*B*). To discuss whether or not this situation may constitute a moral hazard, we investigate the debt adjustment system's effectiveness and the fund's stability when the principal reduction rate is increased.

[Figure 2] Reduction rate and expected repayment rate (Repayment amount)



Note: The solid and dotted lines represent the cases of total debtors and debtors without regular monthly income, respectively.

The aspect of maintaining the debt adjustment system's effectiveness can be confirmed by comparing the repayment amounts of beneficiaries who receive principal reduction with non-beneficiaries having similar characteristics. Assuming that the reduction rate maintaining the efficacy of debt adjustment is the minimum reduction rate, referring to the previously estimated Table 11, minimum reduction rate is 81% and repayment amount is up to KRW 11.635 billion (*C*). In addition, minimum repayment amount to maintain the stability of the fund can be defined as the sum of the initial debt takeover price at which KR&C takes over debts from savings banks and bankruptcy foundations and the balance of provisional payment, which is an expense incurred on a lawsuit to extend the statute of limitations. Considering that the initial takeover price is KRW 3.03 billion and provisional payment balance is KRW 2.221 billion, the minimum repayment amount is KRW 5.251 billion and the corresponding reduction rate reaches 95% (*D*). The results are shown in Table 12.

[Table 12] Comparison of reduction rates

Category	Reduction rate	Expected repayment rate	Expected repayment amount (KRW 100 million)	Note
(A) Maximum reduction rate	33%	55.5%	212.8	-
Current reduction rate	38–60%	46–55%	181.9–211.8	Average: 38%, Maximum: 60%
(B) Financial Services Commission's system improvement	70%	38%	154.72	60%→ 70%
(C) Non-beneficiaries' repayment amount	81% (81–93%)	26% (10–26%)	116.35 (61.98–116.35)	Minimum reduction rate that can maintain the effect of the debt adjustment program
(D) Minimum repayment amount	95%	8%	52.51 (Initial takeover price: 30.30)	Stability of the fund (Initial takeover price + provisional payment balance)
Provisional payment balance	100%	0%	22.21	Provisional payment balance repaid upon reduction
Appropriate expandable reduction rate	60% → 81%			Maximum reduction rate that can maintain the effect of debt adjustment

Note: Non-beneficiaries' repayment amounts refer to non-beneficiaries' repayment amounts matched with beneficiaries of debt adjustment.

When situations $(A) \sim (D)$ are combined, an appropriate reduction rate can be observed from 60% to a maximum of 81%, in which the effects of the debt adjustment program and stability of the fund are maintained. If the most important goal is to increase repayment rate, then increasing the reduction rate that may decrease the expected repayment amount would not be desirable. However, if self-sufficiency of the vulnerable, who are willing to repay but are incapable, is set as a goal, then from a social standpoint, a desirable action is to increase the reduction rate within the range where there are no problems, such as moral hazards or fund instability.

VII. Conclusion

This study analyzes the effect of debt adjustment on repayment amounts between beneficiaries and non-beneficiaries of the debt adjustment program. We employ the PSM and logit models based on the unique data set of debt ledger, debt adjustment information, and debtor-specific characteristics provided by KR&C for the period 2016–2018. In addition, we discuss the possibility of moral hazard. We particularly consider the current situation, in which the debt adjustment program's principal reduction rate has been increased from 60% to 70% according to the "Improvement plan of credit recovery support system for individual debtors" published by the Financial Services Commission in February 2019. We examine if there is a moral hazard problem and identify an appropriate reduction rate within the range where the problem of moral hazards does not occur when principal reduction rate is further expanded.

The debt adjustment program's achievements from 2016 to 2018 are noted as a result of examining the repayment effect by classifying debtors into beneficiaries and non-beneficiaries of the program. Average repayment effect of beneficiaries is KRW 2.931 million, which is higher than the KRW 0.761 million of non-beneficiaries. Moreover, the analysis reveals that the repayment effect of the debt adjustment beneficiaries is significant, in which debtors are classified as follows: (1) those who completed repayment, (2) non-beneficiaries who have repayment performance similar to that of debt adjustment beneficiaries before debt adjustment, and (3) those subject to public debt adjustment. To examine the possible moral hazards when debt adjustment reduction rate is increased, a quadratic function consisting of expected reduction rate and reduction rate is estimated, and an appropriate reduction rate is derived.

According to the analysis, the optimal reduction rate to achieve maximum repayment rate is 33%. In such a scenario, expected repayment rate is 55.5% and expected repayment amount is KRW 21.28 billion. If maximum reduction rate is increased from 60% to 70%, then expected repayment rate is 38% and expected repayment amount is KRW 15.472 billion. Repayment amount for minimum reduction rate that maintains the effect of the debt adjustment program is KRW 11.635 billion, and reduction rate reaches 81%. Lastly, the minimum repayment amount, which equals the sum of the initial takeover price for maintaining fund stability and the balance of provisional payment, is KRW 5.251 billion, and reduction rate is 95%. Therefore, when reduction rate is increased by 10 percentage point, as implemented by the Financial Services Commission, the debt adjustment system's effectiveness and fund stability are maintained, although maximum reduction rate is not reached. Thus, increasing the reduction rate of the debt adjustment program appears to be effective in enhancing debtors' self-sufficiency,

instead of maximizing the repayment effect.

Debt settlement through debt adjustment programs may cause moral hazard, creating repeated insolvency of debtors in the future. Kanz (2016) mentions that the long-term effect of the debt adjustment system may be limited. Considering that most debtors in this study are elderly and could not repay their debts for a long period, solving the limitations of the debt adjustment system is impossible by simply improving the system. Instead, additional policies are required to enable debtors who have completed repayment through debt adjustment to rebuild financially sound and sustainable balance sheets through financial and vocational education.

To minimize the moral hazard of the debt adjustment system, we do not pursue maximizing reduction rate but seek to find an appropriate reduction rate, which may overcome some limitations of the debt adjustment system. The debt adjustment program is essential for the vulnerable classes, who are burdened with low incomes and difficulty in repaying. This study uses debt ledger, debt adjustment information, and debtor-specific characteristics held by KR&C to investigate the effects of debt adjustment on the repayment rate and amount. Although the availability of related data is limited, further studies on this topic should be conducted to support the rehabilitation of the financially underprivileged.

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부실 채권에 대한 채무조정과 상환효과: KR&C 자료를 중심으로*

김 남 현** · 노 산 하***

초 록 본 연구에서는 KR&C가 보유한 부실채권에 대한 채권원장, 채무조정통계, 채무자 특성변수 등을 이용하여 성향점수매칭, 로짓모형을 통해 감면율에 따른 채무조정제도의 상환효과에 대해 분석하고 적정 감면율과 도덕적 해이에 대해 논의한다. 채무조정제도의 효과를 비교하기 위해 채무자를 수혜자와 비수혜자로 구분한 결과, 수혜자는 비수혜자에 비해 상환효과가 더 큰 것으로 나타났다. 또한, 채무조정 감면율이 확대되는 경우 발생할 수 있는 도덕적 해이에 대해 살펴보기 위해 기대상환율과 감면율로 구성된 2차 함수를 상정하고, 적정 감면율을 도출하였다. 적정 감면율을 고려할 때, 감면율이 60%에서 70%로 확대되는 경우 최대 상환율을 달성하지는 못하지만, 채무조정제도의 효과와 기금의 안정성은 유지되는 것으로 나타났다.

핵심 주제어: KR&C, 성향점수매칭, 부실채무조정, 원금 감면율, 도덕적 해이
경제학문헌목록 주제분류: D1, G2, G5, H0

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