

Kim, Dongwoo

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Banks' Portfolio Similarity During the COVID-19 Pandemic

Dongwoo Kim[†]

Baekseok University, Cheonan, Korea

ABSTRACT

Purpose: This study tries to identify the impact of the COVID-19 pandemic on the similarity of banks' loan portfolios. **Design/methodology/approach:** Using the entire firm-level bank loan data from 2009 to 2020 in the Korean market, this study analyzes the cosine similarity in terms of credit rating, industry, and region between banks. **Findings:** The study discovered that interbank portfolio similarity has escalated over time, with the similarity notably intensifying during the COVID-19 pandemic. Additionally, it was found that larger banks exhibit greater similarities, a trend that has become increasingly pronounced during the pandemic period. **Research limitations/implications:** This study provides empirical evidence of the synchronization in lending behaviors among major South Korean banks during the COVID-19 pandemic. It posits that while the synchronicity of banks' lending patterns during typical financial crises is generally accepted, further research in financial markets of other countries is necessary to substantiate this claim universally. **Originality/value:** Therefore, the role of financial authorities to alleviate deepening interbank portfolio synchronization triggered by the COVID-19 pandemic and the resulting escalation of financial market instability is emphasized.

Keywords: Portfolio similarity, COVID-19, Corporate loan, Credit rating, industry, Region

I. Introduction

Unexpected crises such as the COVID-19 pandemic shock financial markets, heightening system instability. Under these circumstances, the homogeneity of banks' portfolio is likely to further deepen the market instability (Wagner, 2010). Especially, larger banks tend to have more similar portfolios over time (Fricke, 2016). With several larger banks dominating the market in most countries, this deepening interbank portfolio synchronization is likely to serve as a

potential source of instability in the banking market. In addition, in case that crises such as the COVID-19 incident are further added to this trend, it could be a double risk factor for the market. The degree of interbank portfolio homogeneity can be analyzed as portfolio similarity, which means how similar the asset configurations that banks allocate by type are (Fricke, 2016). As portfolio homogeneity can occur in various forms, including credit rating, industry, and geographical region, portfolio similarity needs to be analyzed considering such criteria.

This study aims to identify how the COVID-19 pandemic has affected banks' portfolio similarities in terms of credit rating, industry, and region. Furthermore, we try to clarify the relationship between

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[†] Corresponding author: Dongwoo Kim
E-mail: dongwoo.kim@gmail.com

the banks' portfolio similarity and their asset size and find out how the COVID-19 pandemic is interacting with the relationship. The results of this study have confirmed that the interbank portfolio similarity has increased over time and that the similarity has been particularly intensified during the COVID-19 pandemic. It is also found that the larger banks tend to have higher similarities and such trend is getting stronger during the pandemic.

This study has a theoretical contribution in that, to the best of our knowledge, it is the first to analyze the impact of the COVID-19 pandemic on the similarity of the banks' portfolios. Practically, the results of this study emphasize the importance of the role of coordinator of financial authorities to provide loans to companies which belong to marginalized industries and provincial regions and have inferior credit ratings, and thus to alleviate the imbalance and discrimination in the loan market.

II. Data and Methodology

The data used in this study is corporate loan information provided by Korea Credit Information Services (www.kcredit.or.kr), which periodically accumulates loan outstanding data from all companies using bank loans in Korea. Using this loan data, we created annual loan portfolios of each individual bank by asset type from 2009 to 2020. As banks are most likely to manage their loan portfolios based on the credit rating, industry and geographical region, in this study, the types of assets were also analyzed by such criteria.

For the credit rating, 22-level rating system was applied, ranging from the lowest, D, to the highest, AAA and NR as not rated and being additional classes with positive and negative signs from AA to CCC grades (e.g., AA+, AA, AA-). For the industry, using KSIC (Korea Standard Industrial Classification) division-level codes which denoted by a single alphabetic letter and two digits, we ended up with

78 different assets including NA as not available. The geographical regions were divided into five classes such as capital area, metropolitan city, provincial area, overseas, and NA as not available. Information on each company's credit rating, industry and geographical region was provided by NICE Information Service (www.niceinfo.co.kr), the credit rating agency.

In this study, a cosine similarity is applied to measure how similar the portfolio compositions of two banks are (Salton & McGill, 1987), which is defined as

$$\text{Similarity}(i,j) = \frac{\sum_{k=1}^K w_{t(i,k)} w_{t(j,k)}}{\sqrt{\sum_{k=1}^K w_{t(i,k)}^2} \sqrt{\sum_{k=1}^K w_{t(j,k)}^2}} \quad (1)$$

where $w_{t(i,k)}$ and $w_{t(j,k)}$ are bank i's and j's vectors of loan portfolio weights in asset type k at year-end t, respectively. While the resulting similarity conceptually ranges from -1 meaning exactly opposite, to 1 meaning exactly the same, in this study, it ranges from 0 to 1 due to the non-negative values of $w_{t(i,k)}$ and $w_{t(j,k)}$. Representing the number of levels of portfolio for each type of assets, K is 22, 78, and 5 for credit rating, industry, and region, respectively. The cosine similarities in these asset types are used as the dependent variables SIMILARITY. The independent variable BANK SIZE, representing the combined asset size of a pair of banks of which similarity is compared, is calculated by the natural logarithm of the product of each bank's total corporate loan asset at the end of each year (Girardi, Hanley, Nikolova, Pelizzon, & Sherman, 2018, Wang, W., & Park, H. (2021)). We then set the moderating variable COVID-19, a dummy variable of 1 for 2020 and 0 for the rest of the year. Control variables include annual unemployment rate, end-of-year KRW/USD exchange rates, and average interest rate on corporate loans. A hierarchical regression analysis (Baron & Kenny, 1986) with the above variables was conducted to determine the effect of COVID-19 pandemic on the similarity of banks' portfolio compositions,

followed by ANNOVA in order to determine whether the differences in explanatory power between each hierarchical model are statistically significant.

III. Results

Table 1 shows the results of hierarchical regression analyses. The dependent variables in models I, II and III are portfolio similarities on credit rating, industry and region, respectively. First, for all three asset types, the BANK SIZE variable shows a positive relationship with the dependent variable SIMILARITY, meaning that the larger the size of a pair of banks, the higher the portfolio similarity between them. In other words, larger banks tend to have more similar corporate loan portfolios by credit rating, industry, and region. Next, the COVID-19 variable is also found to have a positive relationship with the SIMILARITY variable in all the three models, meaning that the portfolios of a pair of banks have become more similar since the COVID-19 pandemic occurred than before. Finally, for each model, the three-stage submodels (i.e., I-3, II-3, and III-3)

demonstrate the interaction effects of the BANK SIZE and COVID-19 variables on the dependent variable SIMILARITY, all of which are positive. This means that the impact of banks' size on portfolio similarity is further strengthened during the COVID-19 pandemic in all three asset types. In other words, the larger the size of banks, the greater the similarity of portfolios by credit rating, is becoming stronger during the pandemic and this is the same for similarities by industry or region.

To compare year-to-year similarity trends in more detail, smooth density distributions are drawn using the Kernel density estimation technique. Figure 1 shows

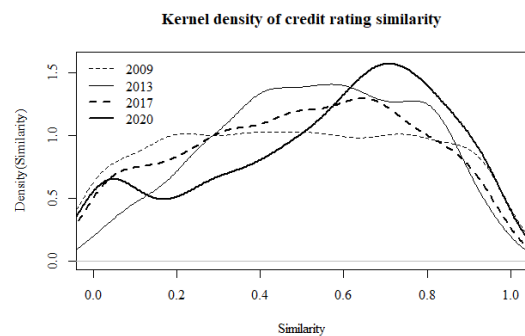


Figure 1. Kernel density distribution of credit rating similarity

Table 1. β coefficients for the hierarchical linear regression models

Independent/ Control variables	Dependent variable: SIMILARITY in ...								
	Credit rating			Sector			Region		
	I-1	I-2	I-3	II-1	II-2	II-3	III-1	III-2	III-3
(Intercept)	-1.04e ⁻¹⁵	-2.82e ⁻¹⁵	-0.001	-1.53e ⁻¹⁵	-4.75e ⁻¹⁵	-0.001	1.82e ⁻¹⁵	3.79e ⁻¹⁵	0.002
UNEMPLOYMENT	-0.004*	-0.027*	-0.027*	-0.041***	-0.083***	-0.083***	0.047***	0.073***	0.073***
KRW/USD	-0.026***	-0.018*	-0.018*	-0.007	0.008	0.008	-0.008	-0.017	-0.017
LENDING RATE	-0.074***	-0.070**	-0.070***	-0.024**	0.032***	0.032***	-0.023*	-0.027**	-0.027**
BANK SIZE	0.513***	0.513***	0.513***	0.501***	0.500***	0.500***	0.070***	0.071***	0.070***
COVID-19		0.032*	0.028*		0.058***	0.055***		0.035*	-0.029
COVID 19*BANK SIZE			0.031***			0.017*			0.046***
df	12285	12284	12283	12285	12284	12283	12285	12284	12283
R ²	0.2701	0.2705	0.2714	0.2531	0.2542	0.2544	0.0090	0.0094	0.0113
F-statistics	1137***	910.8***	762.5***		837.2***	698.5***	27.78***	23.2***	23.48***
ΔF -statistics		3.887*	15.37***		12.75***	4.263*		4.775*	24.65***

Note: ***, ** and * indicate statistical significance at the 0.1%, 1% and 5% levels, respectively.

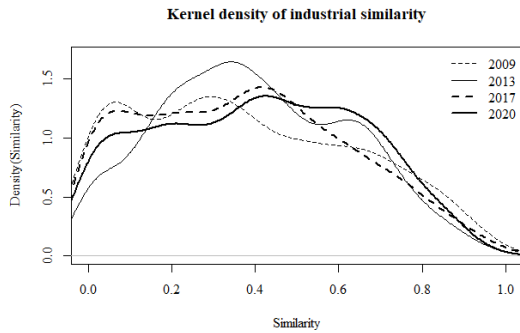


Figure 2. Kernel density distribution of industrial similarity

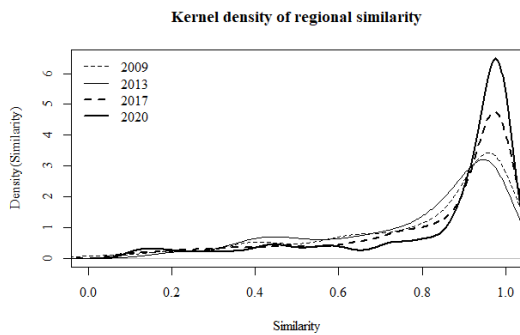


Figure 3. Kernel density distribution of regional similarity

the cosine similarity distributions for the portfolio by credit rating as the selected years (i.e., 2009, 2013, 2017, and 2020). It can be seen that 2020 during the COVID-19 pandemic period shows a skewed distribution further to the left than other years. This means that there are more cases in which the portfolio similarity between banks in credit rating has increased during the pandemic period. This trend is also observed in Figures 2 and 3, showing similarities by industry and region, respectively. In Figure 2, 2020 shows a lower density in around 0.5 or lower of cosine similarity, while a higher density in the above than other years, representing banks' portfolio similarity by industry has increased during the pandemic period. Figure 3 also shows that 2020 is particularly dense with similarity near to 1 compared to other years.

Figure 4 shows the average portfolio similarity trend for all banks of each asset type, representing

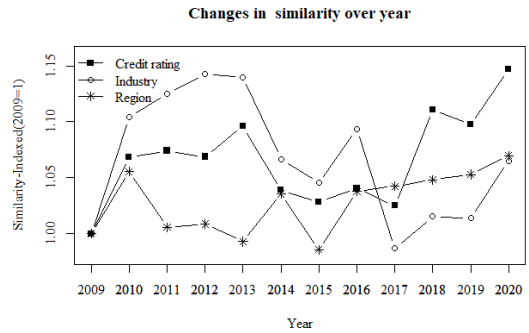


Figure 4. Changes in similarity over year

that the average similarity has increased especially in 2020 compared to the previous years. While Fricke (2016), which analyzed data from Japanese banks from 1996 to 2013, showed that the portfolio similarity between banks has decreased over time, on the other hand, the results of this study indicate that the similarity has been increasing in Korean banks from 2009 to 2020.

IV. Conclusion

This study investigates how the COVID-19 pandemic affects the similarity of banks' portfolios, revealing an increasing trend towards homogeneity, especially among larger banks, which the pandemic has further intensified. This convergence in portfolio management strategies—not only in credit rating but also across industries and regions—exacerbates financial market instability and narrows funding opportunities for companies with poorer credit ratings or in less preferred sectors. Incorporating the perspective that portfolio investment serves as a tool for company risk management, it becomes crucial for banks to diversify their portfolio strategies to distinguish themselves from competitors. This differentiation strategy is essential to mitigate the risks associated with interbank portfolio synchronization and to support a more stable financial market environment. The role of financial authorities in

alleviating the compounded effects of COVID-19 on interbank portfolio similarity and financial market instability cannot be overstated. Empirical evidence from major South Korean banks during the pandemic underscores the need for further research in other countries' financial markets to generalize these findings. Additionally, While this study did not analyze the difference in synchronization phenomena according to bank size, it is expected that there would be variations in the synchronization effects due to differences in customer groups and loan products between large and small banks. This topic is deemed worthy of further research and should be considered a valuable future research agenda.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Author Contributions

This paper was solely authored by Dongwoo Kim

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