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Research paper

Analysis the risk contagion from financial sector to other economic sectors

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Abstract:
This research has three main goals. The first goal is to investigate the contagion of the tail risk from the financial sector to other industries. The second objective is to examine the impact of the competitiveness of industries on the risk contagion from the financial sector to the industries, and the third objective is to examine the effect of three main industrial indicators, namely, net debt, value spread and investment spread, on the risk contagion from the financial sector to other industries. In this research, a new method to measure the spillover of the risk sequence from the financial sector to other industries has been introduced as the occurrence of similar conditions, which for each industry in each period is equal to the number of simultaneous occurrences of severe negative returns in that industry and the financial sector. Empirical findings show that the contagion of the risk from the financial sector to other industries was significant and this contagion was greater for competitive industries due to the greater need for external financing. The occurrence of similar conditions in each sector has a positive relationship with the net debt of that industry. Also, there is no relationship between the value spread and the investment spread with the occurrence of similar conditions.

Keywords: Risk Contagion, Risk Spillover, Value Spread, Investment Spread.
Classification: G32

1 Introduction

In most countries, the financial sector is the key investment source for industrial and service companies (real economy) with limited domestic capital. The profit, loss, and risk of real economy companies are strongly influenced by the drivers of the

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financial sector. The financial crisis in 2007 and 2008 represents a situation where a strong strain in the financial sector causes severe credit failure with damaging effects on the real economy [17]. It is therefore not surprising that linkages between the financial sector and sectors of the real economy have been widely explored [17]. Although the link between risk in the financial sector and the real economy sector has so far attracted little attention, this research is trying to cover the spreads of past research with two innovations of risk scope overflow criteria and empirical evidence in the Iranian market. The main topic in this research is financial risk contagion.

One of the factors that portfolio managers should consider is portfolio risk. One of the factors that can be effective in risk management is the contagion of risk from the financial sector to other economic sectors. This research is an attempt to pay attention to the transfer of risk from the financial sector to other economic sectors. The problem that can be solved in line with this research is that the portfolio managers, to manage the risk of their stock portfolio, predict the spread of risk to the desired industries by observing the fluctuations of the financial sector. To evaluate the spread of risk from one sector to another sector, it is necessary to have a measure of this contagion. In this research, the effect of industry indicators on the spread of risk from the financial sector to other industries is measured. The results of the present research are partially related to the study of Diebold and Yilmaz [21] and Chiu et al. [17] concerning the fact that the volatility of the financial sector increases rapidly and spills over to other sectors. Also, this research is related to the study of Kroszner et al. [32] according to which the increase in risk in the real economy is rooted in the increase in risk in the financial sector. Also, according to the study of Hoberg and Phillips [27] and Hou and Robinson [29], the competitiveness in an industry has an effect on the cash flow and return on shares of companies, and following the study of Valta [41], the more competitiveness in the industry, the higher the risk of that industry due to the need for more development plans and gaining more market share and the need for more financing. In this research, firstly, the validity of the taik risk contagion from the financial sector to other sectors is investigated, then the impact of the market structure (level of competitiveness) of industrial products is investigated and finally, the impact of economic indicators such as Net debt financing, value spread, and investment spread is examined on the expansion of the risk sequence.

(i) Is there a contagion of the risk from the financial sector to other industries?

(ii) Will the contagion of the risk sequence from the financial sector to competitive industries be greater than to concentrated industries?

(iii) Is there a relationship between net debt spread and risk contagion?

(iv) Is there a relationship between the value of the industry and the risk contagion?

(v) Is there a relationship between the level of investment and the risk contagion?

This research consists of five parts. The second part is the theoretical background that provides the basic definitions and insights of the research along with its research background. The third part is related to hypothesis, The fourth part is dedicated to the research method, which describes the method of conducting the study. The fifth section is the findings section, which reflects the results obtained from the research. Finally, the sixth part belongs to the results and suggestions, which is considered the final part of this research.

The evidence of the increase of risk in the financial sector and its spillover to other industries is relatively low. Huston and Stiroh [30] found in the American economy that the volatility of the financial sector had a significant and negative effect on economic growth from 1985 to 1994. At the time of lack of volatility, Wang [44] showed that the volatility of the financial sector led to the creation of volatility in non-financial sectors in the US market from the years 1963 to 2008, and the results of Cheong et al. [15] from these findings in the UK supported in the period 1990 to 2010. Although, as far as is we know, there is no evidence from other economic domains or periods, the relevant question is whether the financial crisis affects the risk spillover mechanism from the financial sector to the real economy. If a sudden loss occurs in the financial system, the corresponding effect on the real economy sectors is quite strong [32]. The financial crisis will lead to an increase in the simultaneous movements between the returns of financial companies and shares of other industries [3]. (Recent evidence indicates that the financial crisis has had a negative effect on the investment activities of industrial sectors [11]. Bae et al. [2] investigated the high co-movements between the stock returns of the financial industry and other industries. using co-occurrence correlations. Hartman et al. [26] use a non-parametric measure using the infinite value theory to measure the spread effects of the risk sequence between the bond and stock sectors. According to the risk spillover between financial and industrial sectors, Christiansen and Ranaldo [16] and Bau [2] provided a method to compare the financial integrity of the old and current stock markets of EU countries and found that the strong persistence of the simultaneous occurrence of fluctuations of both regions, especially in the expansion of the sequence the risk is evident. Many studies have been done in relation to the risk contagion. Bau et al. [2] study the common movements between dividends by examining similar occurrences. Also, Hartman et al. [26] used a non-parametric measurement of the degree of impact of risk spillover from the side of the stock market to the debt market. By linking the risk sequence of the financial industry and other economic sectors, Christian and Ranaldo [16] applied the method of Bau et al. [2] to investigate the financial integration between the old and new EU countries. Bain et al. [9] using a regression showed that financial liberalization will increase the left tail of risk. Focusing on the skewness of market returns, Frey et al. [24] showed the spillover effects between the real estate industry and the stock market in the 1997 Hong Kong crisis and the 2007 financial crisis.

Therefore, this hypothesis is proposed, that there is an expansion of the sequence of risk from the financial sector to other economic sectors. The most recent research is related to Jing et al. [17], which investigates the spillover effects of banking sector risk on companies in China and examines risk transfer channels from the perspective of the financial cycle. In Jing et al. [17], bank risk-taking and systemic risk are used as signs of financial prosperity and recession. Jing et al.'s study yield four main findings [17]. First, bank risk-taking reduces the company's risk in a financial boom. Higher financing costs and constraints, larger firm size and financing scale, and government ownership moderate spillover effects. Second, systematic banking risk increases firm risk during financial downturns. Higher financing costs and constraints, larger firm size and financing scale, and government ownership facilitate spillover effects. Third, the magnitude of banking risk spillovers varies across industries, and this effect is more pronounced in the manufacturing industry. Fourth, bank risk-taking affects firm risk through different channels in different leading periods [17].

Ortiz Molina and Phillips [37] emphasize that the problems caused by the low liquidity of assets are significant for companies with low value (low ratio of market value to book value). Industrial sectors with a higher value can earn higher returns over time because they sell their assets and hence reduce their dependence on the financial sector. In addition, Fama and French [23] and Chen and Zhang [14] showed that companies with a low ratio of market value to book value have lower profits and financial adjustments are more in them and have high-income uncertainty. That is, companies with a low market value to book value ratio (low value) have a higher risk tail and hence a higher risk tail associated with the financial sector during times of weak economy [17].

In the study of Chiu et al. [17], it has been shown that the low level of investment in industrial sectors can lead to the expansion of the financial risk sequence. If the companies are not able to fully exploit their investment opportunities, they accept the risk of losing these opportunities, hence the market share is also at risk against the competitors. In other words, high investment in advance means that companies have made the most of their investment opportunities and therefore have a lot of internal financing sources, thus reducing their dependence on the financial industry and thus the scope reduce risk [17].

Fallah Shams and Banisharif [22] purpose of research is considering the remarkable role of the banking industry in the economies, determining the financial risks and the spillover mechanism between banks is of particular importance. The goal of this research is to study the spillover of financial risks such as credit, liquidity, and market risks in the banks accepted in the Tehran Stock Exchange (TSE) and the Over-The-Counter stock market of Iran using GARCH-DCC model. The results show that there are market, liquidity, and credit risks spillover among banks, and the banks with low liquidity are more likely to be at the risk of liquidity spillover. Besides, banks with overdue debts play a more prominent role in the credit risk

spillover. Bank with a positive open foreign exchange position (banks with more foreign exchange assets than foreign currency debit) have to lower market risk than banks with a negative foreign exchange position

Keshavarz and Noftakhar Daryaee [31] analyzes spillover effects of financial volatility among three international markets: Gold, Stocks and Foreign Exchange. They use the logarithmic returns of the assets - ounces of gold, the euro-dollar exchange rate and America stock index S&P500- from 2000-2014 to identify the relationship between these three international markets. Identification returns transmission between markets is provided by using Vector Auto Regressive (VAR) model. Volatility spillover effects could be measured by the Multivariate Generalized Auto Regressive Conditional Heteroscedasticity (MGARCH) models. They use VAR-MGARCH model to identify information spillovers between three markets and introduce value at risk to measure portfolio risk. The empirical results suggest that spillover effects are statistically significant and the VaR forecasts are generally found to be sensitive to the inclusion of spillover effects in any of the multivariate models considered. Ignoring this sensitivity is resulted in overestimation of the portfolio's value at risk and, therefore, lead to inefficient allocation of resources to cover the risk of the asset portfolio

Seraj et al. [42] evaluates the risk of contagion by using Dynamic causality statistics (DCI), and has identified the banks that have a systemic importance in terms of contagion or so-called too-connected-to-fail (TCTF). The relationship between GDP changes and the value added of the financial sector with changes in the DCI index of Iran's banking sector has been evaluated using Granger causality, which indicates a negative relationship up to 12-month time horizon. To take a timely measure for decreasing the adverse effects of systemic risks, Policymakers should monitor DCI index continuously.

Ansari Samani and Heydarpoor [1] purpose of study is to study the financial interactions between financial markets of selected financial partner of Iran, including China, France, Germany, Italy and the UAE. For this purpose, the VAR model has been used. Financial risk data is collected annually (from 1984 to 2017). The results indicated that there was a positive and two-side relationship between the financial risk fluctuations between Iran and China, the UAE and Italy, the United Arab Emirates and China during the period under review. In addition, financial risk aversion was observed one- side from Iran to Italy and the UAE to France and China to the UAE. Also, financial risk aversion from Germany to China, Iran, Italy, and the United Arab Emirates was seen one-side, in other cases, there was not Fluctuation overflow. Ultimately, it could be said that Germany was only country affected by risk of the other countries

Bazrayi et al. [4] aims to detect path of currency crisis in different listed industries, to manage risk of shareholders in stock market. For this purpose, joint Contagion Test, Joint Coskewness Contagion Test and the Ornstein – Uhlenbeck Process are used. The data used in this study include stock return of the listed

industries and daily exchange rate during 2008 to 2020. The results suggest that currency crises of 2011 and 2018 have transmitted to all export- oriented import-oriented and neutral industries (except mass construction). Moreover, the findings support the fact that starting point of crisis contagion in both currency crises is pharmaceutical industry that attracted currency crises due to its strong correlation with exchange market. The next point of contagion in the first currency crisis is investment industry, and in the second currency crisis, basic metals and oil products. It is suggested that when currency crisis occurred, investors increase weight of basic metals stocks and decrease share of pharmaceutical and computers in their portfolio.

2 Hypotheses

Hypothesis 1 the expansion of the risk sequence from the financial sector to the real sector of the economy emerges.

Hypothesis 2 the expansion of the risk sequence from the financial sector to industries that have more competitiveness will be greater.

Hypothesis 3 more debt financing increases the risk of contagion from the financial sector.

Hypothesis 4 the higher the value of the industry, the lower the risk contagion from the financial sector.

Hypothesis 5 the higher the investment of industrial companies, the lower the risk contagion from the financial sector.

3 Methodology

In this section, the method of measuring the variables will be discussed first. The dependent variable of this research, on which all the hypothesis tests are performed, is the occurrence of similar conditions, which is equal to the number of simultaneous occurrences of extreme negative returns in a specific industry and the financial industry in one season, which is calculated in the form of equation (1) and (2). It can be According to the study of Bao et al. [2] focusing on the simultaneous occurrence of negative returns in the financial sector and other economic sectors, and following the study of Chiu et al. [17] to calculate the occurrence of similar conditions, first the daily returns in a period of three month will be calculated. If the lowest 10th percentile of returns in that period for the industry and the financial industry are the same, the variable of the occurrence of similar conditions will take the value of one, and otherwise, its value will be equal to zero, and the amount of occurrence of similar conditions in an industry in period A of three months is equal

to the sum of the number of days in which the same event occurred.

$$I_t{}^i\,(c=10\%)=1 \quad \text{if} \quad r_t{}^i \in c \;\; t=1\ldots T$$
$$I_t{}^i\,(c=10\%)=0 \qquad\qquad \text{otherwise} \tag{1}$$
$$CCX_t{}^i = I_t{}^i\,(c=10\%) \times I_t{}^{FIN}\,(c=10\%) \tag{2}$$

The independent variables that are used in testing the third to fifth hypothesis include the net debt issued and equal to the net loan received to the total assets, which are the value spread and the investment spread. According to the study of Hoberg and Phillips [27] and the study of Chiu et al. [17], net debt financing is calculated as equation 4.3.

$$\text{Net Debt Financing} = \frac{\text{Net Debt Issuance}}{\text{Total Asset}} \tag{3}$$

To calculate the value spread, following the study of Hoberg and Phillips [27] and the study model of Pastor and Veronesi [38] as well as the study of Chiu et al. [17], the value spread is calculated from relation (4) to(5). The value spread determines how much the company's intrinsic value is based on estimated future cash flows. To calculate the investment spread, according to the study of Hoberg and Phillips [27] and the study of Chiu et al. [17], is calculated through relations(6) to(7), where investment represents an investment, and PPE represents the property. constant, M market value, B book value of equity, LEV represents financial leverage and is equal to the ratio of long-term debt to assets, ROE represents the return on equity and is equal to the ratio of net profit to equity and SIZE represents the logarithm The book value of the assets.

$$\log\left(\frac{M}{B}\right) = a + bLEV_{i.\tau} + c\log\left(SIZE_{i.\tau}\right) + dROE_{i.\tau} \tag{4}$$
$$SPREADVALUE_{i.t} = \log\left(\frac{M}{B}\right)_{i,t} - Predicted\left(\log\left(\frac{M}{B}\right)_{i,t}\right) \tag{5}$$
$$\log\left(\frac{Invest_{i,\tau}}{PPE_{i,\tau}}\right) = a + bLEV_{i,\tau} + c\log\left(SIZE_{i,\tau}\right) + eROE_{i,\tau} \tag{6}$$
$$SPREADINV_{i.t} = \log\left(\frac{Invest_{i.t}}{PPE_{i,t-1}}\right) - Predicted(\log\left(\frac{Inve\tau st_{i.t}}{PPE_{i.t-1}}\right) \tag{7}$$

The statistical population of this research is all the industries accepted in the Tehran Stock Exchange and the Iran Farabourse that have more than 5 companies and were accepted in the Tehran Stock Exchange from the beginning of 2012 and were active in the stock exchange until the end of 2021 and are from the list of companies accepted in the stock exchange that have not been deleted and includes the information of their financial statements and price information available during this period.

To test the first hypothesis, the purpose of which is risk contagion from the financial sector to other economic sectors, first, the variable of the occurrence of similar conditions for each of the industries in different years is calculated, then using the student's t-test, the equality of the average of this variable is tested with zero. In the test of the second hypothesis, the purpose of which is to measure the competitiveness of each industry in risk transmission from the financial sector to that industry, first by using the Herfindahl Hirschman competitiveness index, the industries are divided into two categories, competitive and concentrated. Then, firstly, in each year, the average difference in the occurrence of similar conditions for competitive and concentrated industries has been tested using the student's t-test, and the effect of competitiveness characteristics has been measured in each year. Then, in the whole period, this test has been tested for competitive and concentrated industries. To test the third, fourth, and fifth hypotheses, following Chiu et al. [17], in this research, in accordance with relation 8, using panel regression, the relationship between industry characteristics and risk sequence contagion has been investigated.

$$\begin{aligned} \mathrm{CCX_{i.t}} =& \alpha + \beta_1 NET\ DEBT_{i,t} + \beta_2 SPREADVALUE_{i,t} \\ &+ \beta_3 SPREADINV_{i,t} + \gamma_1 SIZE_{i,t} + \gamma_2 DEBT\ COST_{i,t} \\ &+ \gamma_3 DELTAROE_{i,t} + \varepsilon_{\mathrm{it}} \end{aligned} \tag{8}$$

Table 1 shows the descriptive statistics of the dependent, independent, and control variables of the research. In this table, it is shown that the average occurrence of similar conditions is equal to 1.68 units in each season. From a descriptive point of view, it is concluded that the simultaneous occurrence of extreme negative returns in the financial industry and other industries is greater than zero and there is risk contagion from the financial sector to other industries. Also, in the variable of occurrence of similar conditions, the net spread debt and the investment spread have a left skew because the median is higher than the average, and the value spread variable has a right skew because the median is higher than the average. Other statistical parameters are also fully shown in the table.

Table 1: Statistics Descriptive

Variable	Mean	Median	Standard Deviation	Min	Max
CCX	1.68	2.00	1.28	0.00	6.00
NETDEBT	-0.08	-0.02	0.31	-2.56	0.76
SPREADVALUE	0.00	-1.10	3.79	-6.05	24.06
SPREADINV	0.00	0.06	1.03	-3.98	3.30
SIZE	17.51	17.43	1.61	13.97	21.54
DEBT COST	0.05	0.04	0.02	-0.15	0.16
DELTA ROE	0.00	0.00	0.19	-2.38	3.95

Table 2: The results of the student's t-test for hypothesis 1 for the industries under study

Industry Name	**Mean**	**Variance**	**t-Value**	**P-Value**
Iron and Steel	2.38	3.11	8.51	0.00***
Auto	2.03	1.36	10.99	0.00***
Oil Products	1.98	2.59	7.76	0.00***
Aggregation, real estate	1.95	1.43	10.30	0.00***
Production of non-ferrous precious metals	1.93	2.12	8.36	0.00***
Other non-metallic mineral products	1.93	1.20	11.12	0.00***
Miscellaneous chemicals	1.88	2.32	7.79	0.00***
Cement, lime, and plaster	1.75	1.47	9.12	0.00***
Metal minerals	1.73	2.15	7.43	0.00***
Pharmaceutical	1.65	1.36	8.94	0.00***
Auto Parts	1.65	1.62	8.20	0.00***
Rubber and plastic	1.65	1.41	8.78	0.00***
Fertilizers	1.58	1.64	7.79	0.00***
Electric machines	1.55	1.59	7.78	0.00***
Cleaning products	1.53	1.08	9.30	0.00***
Machinery	1.50	1.33	8.22	0.00***
Ceramic Tile	1.38	0.75	10.02	0.00***
Dairy products	1.30	1.19	7.54	0.00***
Other food products	1.25	0.96	8.06	0.00***
Sweets	1.13	1.09	6.83	0.00***

*, ** and *** indicate the significance level of 90%, 95% and 99%, respectively.

Table 3: CCX mean equivalation test results for comparative and concentrated industries

Year	Total CCX	Comparative -CCX	Concentrated -CCX	Comparative and Concentrated CCX diff	P-Value
2012	1.45	1.33	1.03	0.30	0.10*
2013	0.98	0.87	0.90	-0.03	0.31
2014	1.15	1.10	1.00	0.10	0.29
2015	2.29	2.37	1.73	0.64	0.00***
2016	1.61	1.46	1.40	0.06	0.35
2017	1.23	1.19	1.10	0.09	0.29
2018	1.17	1.04	1.08	-0.04	0.41
2019	1.33	1.33	1.15	0.18	0.24
2020	3.16	3.21	2.88	0.34	0.04**
2021	2.21	2.44	1.68	0.77	0.01***
Total Period	1.66	1.63	1.39	0.24	0.00***

*, ** and *** indicate the significance level of 90%, 95% and 99%, respectively.

To test the third, fourth, and fifth hypothesis, which examines the effect of industrial indicators on the variable of the occurrence of similar conditions and, in fact, the factors affecting the spread of risk from the financial sector to other financial sectors, the three variables of net outstanding debt, The value spread, and the investment spread have been investigated. The control variables of this model are size, cost of debt, and changes in return on equity. In this regression, panel regression with fixed effects is used in accordance with Limer's F-test and Hausman's test. In this hypothesis, 4 models have been tested, and in the first to third models, the order of net spread debt, value spread, and investment spread alone were independent variables. In the fourth model, all three indicators are simultaneously entered into the model as independent variables. The findings show that the variable of net outstanding debt in the state that entered the model alone appeared with a coefficient of 0.245 and it is significant at the confidence level of 90%. Also, when all three industry indicators are present in the model, the variable of net outstanding debt will appear with a coefficient of 0.242 and it is significant at the 90% confidence level, which indicates that the higher the net outstanding debt, due to the dependence of the industry to the financial sector, the higher risk contagion from the financial sector to that industry. But in relation to the value spread and the investment spread, no significant relationship is observed either alone or together with other variables. Tables 4 to 7 show the results of these tests.

Table 4: Model (1)- Estimation of the relationship between CCX and net debt, value spread, and investment spread

Variable Type	Variable name	Coefficient	P-Value
Control Variable	**SIZE (γ_1)**	0.500	0.000^{***}
	DEBT COST (γ_2)	3.708	0.104
	DELTAROE (γ_3)	0.346	0.127
Independent Variable	**NetDebt ((β_1)**	0.245	0.094^{*}
	SPREAD VALUE (β_2)	-	-
	SPREAD INV (β_3)	-	-
	R^2		0.090

Table 5: Model (2)- Estimation of the relationship between CCX and net debt, value spread, and investment spread

Variable Type	Variable name	Coefficient	P-Value
Control Variable	**SIZE (γ_1)**	0.444	0.000^{***}
	DEBT COST (γ_2)	2.878	0.194
	DELTAROE (γ_3)	0.354	0.118
Independent Variable	**NetDebt ((β_1)**		
	SPREAD VALUE (β_2)	0.015	0.273
	SPREAD INV (β_3)		
	R^2		0.089

Table 6: Model (3)- Estimation of the relationship between CCX and net debt, value spread, and investment spread

Variable Type	Variable name	Coefficient	P-Value
Control Variable	**SIZE (γ_1)**	0.458	0.000^{***}
	DEBT COST (γ_2)	3.857	0.092^{*}
	DELTAROE (γ_3)	0.342	0.133
Independent Variable	**NetDebt ((β_1)**	0.242	0.099^{*}
	SPREAD VALUE (β_2)	0.014	0.297
	SPREAD INV (β_3)	-0.017	0.723
	R^2		0.092

Table 7: Model (4)- Estimation of the relationship between CCX and net debt, value spread, and investment spread

Variable Type	Variable name	Coefficient	P-Value
Control Variable	**SIZE (γ_1)**	0.488	0.000^{***}
	DEBT COST (γ_2)	2.767	0.211
	DELTAROE (γ_3)	0.345	0.130
Independent Variable	**NetDebt ((β_1)**		
	SPREAD VALUE (β_2)		
	SPREAD INV (β_3)	-0.017	0.735
	R^2		0.092

4 Conclusion

In this article, a new approach has been adopted to measure risk contagion from the financial sector to other economic sectors where the occurrence of similar conditions has been named in the Iranian market for the years 1390 to 1399. This method measures the number of occurrences of simultaneous extreme negative returns in each industry and financial sector and in a way indicates the occurrence of a simultaneous crisis in each industry and financial sector. The difference between this method and other methods that have been used in some studies such as Diebold and Yilmaz [21], Chiu et al. [17], and Kroszner et al. [32] and have used variance as a proxy for risk is that it measures the spread of the risk sequence. and measures risk contagion in extreme cases. The findings of this research indicate that the expansion of the sequence of risk from the financial sector to other industries accepted in the stock exchange has been observed, in addition, it has been observed that the degree of this contagion for competitive industries is due to greater dependence on the banking network and foreign financing will be more than concentrated industries. An industry index that can help explain the intensity of risk contagion from the financial sector to other industries is net debt, which has a positive relationship with the size of risk contagion, and the more debt financing for an industry, the dependency of that industry on the financial sector will increase and the occurrence of risks and problems in the financial sector will spread to that industry more intensely. In the relationship between the investment spread and the value spread with risk contagion, it has been discussed in the study of Chiu et al. [17], no significant relationship has been observed in the Iranian market during the study period. Also, the results of this research add to the body of literature on the topic that the role of the financial sector as an indicator of the risk leader and especially the sequence of risk is very important. Also, the results of this research will help financial legislators to better evaluate the economic costs caused by financial crises.

In line with the topic of this research, as other studies such as Bradley et al. [10] and Mackay and Phillips [35] have shown that the capital structure depends on the industry structure, the question will remain that what product structure can affect the sequence of risk? Another thing that can be considered as future research is choosing the results of this research to choose a portfolio based on risk aversion.

In terms of time, the research is limited to the period 2012 to 2021, and one should be careful in generalizing the results to other time periods, and in terms of the subject, it is only limited to the contagion of the risk sequence and be careful in generalizing it to other historical subjects, and in terms of location, it is limited to non-financial companies of the Tehran Stock Exchange and Iran Farabourse, and it is necessary to be cautious in generalizing the results to other companies.

Bibliography

[1] Chiu, W. C., Peña, J. I., & Wang, C. W. *Industry characteristics and financial risk contagion.* Journal of Banking & Finance,50(2015), 411-427.

[2] Diebold, F. X., & Yilmaz, K. *Better to give than to receive: Predictive directional measurement of volatility spillovers.* International Journal of forecasting,28(1)(2012), 57-66.

[3] Kroszner, R. S., Laeven, L., & Klingebiel, D. *Banking crises, financial dependence, and growth.* Journal of financial Economics,84(1)(2007), 187-228.

[4] Hoberg, G., & Phillips, G. *Real and financial industry booms and busts.* The Journal of Finance,65(1)(2010), 45-86.

[5] Hou, K., & Robinson, D. T. *Industry concentration and average stock returns.*The Journal of Finance,61(4) (2006), 1927-1956.

[6] Valta, P. *Competition and the cost of debt.* Journal of Financial Economics,105(3)(2012), 661-682.

[7] Houston, J. F., & Stiroh, K. J. *Three decades of financial sector risk.* FRB of New York Staff Report(2006), (248).

[8] Wang, Z. *Dynamics and causality in industry-specific volatility.* Journal of Banking & Finance34(7) (2010), 1688-1699.

[9] Cheong, C. S., Olshansky, A., & Zurbruegg, R. *The influence of real estate risk on market volatility.* Journal of Property Investment & Finance(2011).

[10] Baur, D. G. *Financial contagion and the real economy.* Journal of banking & finance,36(10)(2012), 2680-2692.

[11] Campello, M., Graham, J. R., & Harvey, C. R. *The real effects of financial constraints: Evidence from a financial crisis.* Journal of financial Economics,97(3)(2010), 470-487.

[12] Bae, K. H., Karolyi, G. A., & Stulz, R. M. *A new approach to measuring financial contagion.* The Review of Financial Studies,16(3)(2003), 717-763.

[13] Hartman, P., Straetmans, S., & Vries, C. D. *Asset market linkages in crisis periods.* Review of Economics and Statistics,86(1)(2004), 313-326.

[14] Christiansen, C., & Ranaldo, A. *Extreme coexceedances in new EU member states' stock markets.* Journal of banking & finance,33(6)(2009), 1048-1057.

[15] Beine, M., Cosma, A., & Vermeulen, R. *The dark side of global integration: Increasing tail dependence.* Journal of Banking & Finance,34(1)(2010), 184-192.

[16] Fry, R., Martin, V. L., & Tang, C. *A new class of tests of contagion with applications.* Journal of Business & Economic Statistics,28(3)(2010), 423-437.

[17] Jing, Z., Liu, Z., Qi, L., & Zhang, X. *Spillover effects of banking systemic risk on firms in China: A financial cycle analysis.* International Review of Financial Analysis,82(2022), 102171.

[18] Rajan, R., & Zingales, L. *Financial development and growth.* American Economic Review,88(3)(1998), 559-586.

[19] Ortiz-Molina, H., & Phillips, G. M. *Real asset illiquidity and the cost of capital.* Journal of Financial and Quantitative Analysis,49(1)(2014), 1-32.

[20] Fama, E. F., & French, K. R. *Size and booktomarket factors in earnings and returns.* The journal of finance,50(1)(1995), 131-155.

[21] Chen, N. F., & Zhang, F. *Risk and return of value stocks.* The Journal of Business,71(4) (1998), 501-535.

[22] Fallah Shams, M., & Banisharif, A. *Investigating the Financial Risk Spillover in Banks Accepted in Tehran Stock Exchange Market through MGARCH Approach.* Financial Research Journal,23(1)(2021), 87-107.

[23] Keshavarz, G., & Noftakhar Daryaee, K. *Returns and Volatility Spillover Effects on the Estimated VaR of Gold and Exchange Rate Portfolio.* Journal of Economic Research (Tahghighat- E- Eghtesadi),53(1)(2018), 117-152.

[24] Seraj, M., Tehrani, R., & Fallahpour, S. *Evaluation of the Effect of Contagion Risk on the Macroeconomic Performance of Iran and Identifying Too-Connected-To-Fail (TCTF) Banks.* The Journal of Economic Studies and Policies,7(1)(2020), 153-175.

[25] ANSARI SAMANI, H., AND HEYDARPOOR, H. *Investigation the financial risk contagion between Iran and selected financial partners.* Journal of Econometric Modelling,4 (1)(2019), 93-119.

[26] BAZRAYI, M., GHAVIDEL, S., & EMAMVERDI, G. *Identification of Contagion Path of currency Crises in Industries of Tehran Stock Exchange.* Economical Modeling,15(53)(2021), 73-96.

[27] PÁSTOR, L'., & PIETRO, V. *Stock valuation and learning about profitability.* The Journal of Finance,58(5)(2003), 1749-1789.

[28] BRADLEY, M., JARRELL, G. A., & KIM, E. H. *On the existence of an optimal capital structure: Theory and evidence.* The journal of Finance,39(3) (1984), 857-878.

[29] MACKAY, P., & PHILLIPS, G. M. *How does industry affect firm financial structure?.* The review of financial studies,18(4) (2005), 1433-1466.

[30] BECK, T., & LEVINE, R. *Industry growth and capital allocation: does having a market-or bank-based system matter?.* Journal of financial economics,64(2)(2002), 147-180.

[31] BECK, T., & LEVINE, R. (2004). *Stock markets, banks, and growth: Panel evidence.* Journal of Banking & Finance,28(3), 423-442.

[32] BECK, T., LEVINE, R., & LOAYZA, N. *Finance and the Sources of Growth.* Journal of financial economics,58(1-2)(2000), 261-300.

[33] CETORELLI, N., & GAMBERA, M. *Banking market structure, financial dependence and growth: International evidence from industry data.* The Journal of Finance,56(2) (2001), 617-648.

[34] CHAVA, S., & PURNANANDAM, A. *The effect of banking crisis on bank-dependent borrowers.* Journal of financial economics,99(1) (2011), 116-135.

[35] CLAESSENS, S., & LAEVEN, L. . *Financial dependence, banking sector competition, and economic growth.* Journal of the European Economic Association,3(1) (2005), 179-207.

[36] COLE, R. A., MOSHIRIAN, F., & WU, Q. *Bank stock returns and economic growth.* Journal of Banking & Finance,32(6) (2008), 995-1007.

[37] DELL'ARICCIA, G., DETRAGIACHE, E., & RAJAN, R. *The real effect of banking crises.* Journal of Financial Intermediation,17(1) (2008), 89-112.

[38] GHOSAL, V., & LOUNGANI, P. . *Product market competition and the impact of price uncertainty on investment: Some evidence from US manufacturing industries.* The Journal of industrial economics (1996), 217-228.

[39] HOGGARTH, G., REIS, R., & SAPORTA, V. *Costs of banking system instability: some empirical evidence.* Journal of Banking & Finance,26(5) (2002), 825-855.

[40] LEVINE, R. *Finance and growth: theory and evidence.* Handbook of economic growth,1 (2005), 865-934.

[41] LIU, Y. A., & PAN, M. S. *Mean and volatility spillover effects in the US and Pacific-Basin stock markets.* Multinational Finance Journal,1(1) (1997), 47-62.

[42] MERTON, R. C. *On the pricing of corporate debt: The risk structure of interest rates.* The Journal of finance,29(2) (1974), 449-470.

[43] SANTOS, S. J., & TENREYRO, S. (2006). *The log of gravity.*

[44] VIVES, X. *Competition in the changing world of banking.* Oxford review of economic policy,17(4)(2001), 535-547.

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