Leverage and size growth

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Abstract

During the recent crisis periods, credit and asset prices increased and deviated significantly from the fundamental trends. Furthermore, during such a period of exuberance, financial intermediaries' lending activity and their stock of debts are high due to an expansion in the aggregate demand. However, when the process is reversed due to exogenous shock, asset prices decrease, collateral value diminishes and borrowers' profitability deteriorates. Consequently, the credit supply in the economy is reduced marking a procyclical nature of the financial system. Our analysis helped us to identify valuable insights into the intricate dynamics of financial systems, emphasizing the role of external factors, regulatory environment, business strategies, and market conditions in shaping leverage decisions.

1 Introduction

It is important to note that the recent COVID-19 and the global financial crises of 2007-2008 have made financial systems undergo remarkable changes. According to the Bank of International Settlements (2008), pro-cyclicality refers to the dynamic interactions between the financial system and the real sectors of the economy. In contrast, with traditional models of the financial accelerator, the pro-cyclicality of asset prices explains business cycle boom and recession (Bernanke & Gertler, 1989; Kiyotaki & Moore, 1997)

Our study aimed to analyze how financial institutions manage their balance sheets by understanding the intricate balance between leverage growth and various economic variables like size growth, and market value growth for three different financial entities (commercial banks, finance services, and Real Estate finance services). In proceeding with the present work, our goal was to investigate the US financial system in three distinct parts. The initial step involves data extraction, with a specific focus on obtaining relevant data related to various components of the financial system. We proceed with the creation of a suitable panel data set merging and structuring the different data sets to ensure consistency and coherence. Then, we performed logarithmic transformations, followed by a thorough inspection of the variables and the computation of summary statistics. The second part of our study focuses on the sensitivity of leverage ratio to size growth. The coefficients derived from these regressions serve as indicators of their impact and are interpreted accordingly. Additionally, the goodness of fit indicators of each regression are also examined. The final segment of our analysis explores leverage procyclicality across sub periods and financial entities. This involves conducting panel regressions for each entity and sub period. By examining the variations, trends, and implications observed within these regressions we gained valuable insights into the dynamics within the US financial system.

2 Data cleaning and descriptive statistics

The study considered the period from the fourth quarter of 2005 to the second quarter of 2023, using quarterly data from the United States financial systems. The data set used had financial metrics for each reporting period and entity that included total assets, equity market value, price, leverage ratio, and market-to-book value ratio. In our data set, there were missing values which became necessary to address for our analysis.

We employed the some interpolation techniques: by leveraging values preceding and succeeding the missing one as the averages which became substitutes for the absent values. Then we added the necessary variables like the natural logarithm of the leverage and the total assets growth.

Figure 1: Distribution by entity

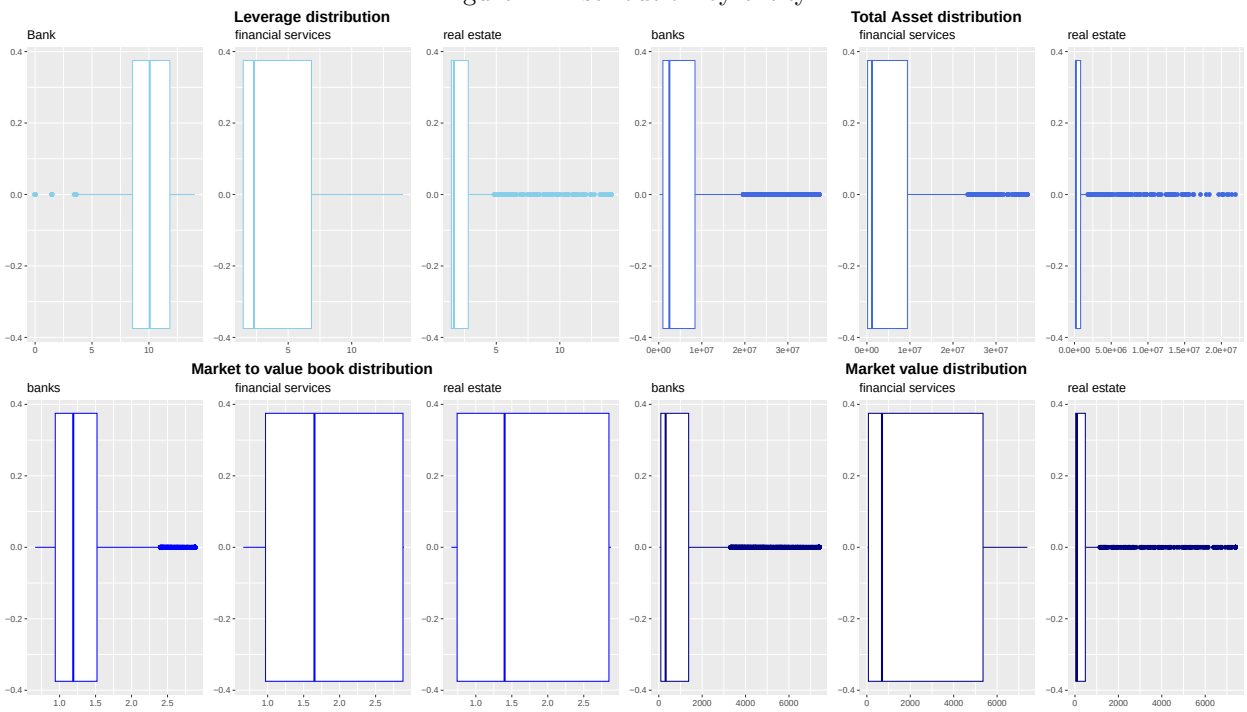

Table 1: Summary statistcs of the complete dataset

XS	Minimum	Mean	Median	Maximum	Standard_Deviation	Skewness	Kurtosis
PRICE_OR_TRADE	5.61754000	25.54	20.10	63.05	18.00	0.91	-0.32
TOTAL_ASSETS	163975.80000000	7683195.54	1919705.00	37274551.00	11721949.26	1.75	1.60
TOT_NATLOG	0.00000000	14.63	14.47	17.43	1.67	0.07	-0.22
TOT_GRWTRATE	-0.03511370	0.01	0.01	0.07	0.03	0.38	-0.65
MRKT_VALUE_TO_BOOK	0.66000000	1.43	1.24	2.88	0.67	0.97	-0.10
MARKET_VALUE	33.60800000	1533.98	331.14	7393.31	2354.17	1.69	1.41
MRKT_VALUE_NATLOG	0.00000000	5.99	5.80	8.91	1.76	0.22	-1.18
MKT_VALUE_GRWTRATE	-0.18566125	0.02	0.01	0.25	0.13	0.19	-0.78
TOT_ASSETS_CMN_EQUITY_RATIO	0.00000000	8.47	9.25	14.04	4.04	-0.50	-0.88
LEVERAGE_NATLOG	0.00000000	1.94	2.22	2.64	0.74	-1.20	-0.01
LEVERAGE_GRWTRATE	-0.05638301	0.00	0.00	0.07	0.04	0.28	-0.67

Focusing on a comparative analysis amongst banks, financial services, and real estate financial services, we observed that financial services in the US showed a higher mean across several variables. Indeed, this implies that financial services might generally be bigger in terms of assets and market capitalization compared to banks and real estate financial services. Moreover, these higher values might imply that financial services are not only perceived as more valuable or actively traded, but also as a better investment opportunity due to higher business expansion. However, it's crucial to keep in mind that financial services also bear higher variability, potentially indicating higher risk compared to banks and real estate services.

Table 2: Summary statistics for banks

XS	Minimum	Mean	Median	Maximum	Standard_Deviation	Skewness	Kurtosis	
1	PRICE_OR_TRADE	5.61754000	24.52	20.05	63.05	16.03	1.05	0.25
2	TOTAL_ASSETS	163975.80000000	7895079.54	2460636.50	37274551.00	11298125.99	1.76	1.75
3	TOT_NATLOG	12.01746277	14.92	14.72	17.43	1.41	0.31	-0.94
4	TOT_GRWTRATE	-0.03511370	0.01	0.01	0.07	0.03	0.46	-0.27
5	MRKT_VALUE_TO_BOOK	0.66000000	1.29	1.19	2.88	0.49	1.14	1.23
6	MARKET_VALUE	33.60800000	1275.58	317.60	7393.31	2043.16	2.08	3.21
7	MRKT_VALUE_NATLOG	3.51547795	5.95	5.76	8.91	1.61	0.29	-1.02
8	MKT_VALUE_GRWTRATE	-0.18566125	0.02	0.01	0.25	0.12	0.22	-0.59
9	TOT_ASSETS_CMN_EQUITY_RATIO	0.00000000	10.21	10.07	14.04	2.31	-0.11	-0.14
10	LEVERAGE_NATLOG	0.00000000	2.29	2.31	2.64	0.26	-1.82	11.72
11	LEVERAGE_GRWTRATE	-0.05638301	0.00	0.00	0.07	0.03	0.32	-0.47

Despite financial services having higher means in other variables, banks show the highest mean for the leverage ratio. This result could reflect the unique nature of banking operations, as banks might use leverage as a deliberate strategy to amplify returns. In fact, it's important to remember that banks often operate with different capital structures compared to other financial entities. They might rely more on debt financing or have specific regulatory reasons for maintaining higher leverage, due to the nature of their operations, where leverage is a crucial part of their lending and investment activities.

Table 3: Summary statistics for Finance Services

XS	Minimum	Mean	Median	Maximum	Standard_Deviation	Skewness	Kurtosis
PRICE_OR_TRADE	5.61754000	29.63	22.56	63.05	22.58	0.43	-1.43
TOTAL_ASSETS	163975.80000000	8909625.89	1187667.50	37274551.00	13805867.05	1.38	0.14
TOT_NATLOG	0.00000000	14.27	13.99	17.43	2.08	0.15	-0.15
TOT_GRWTRATE	-0.03511370	0.01	0.01	0.07	0.04	0.23	-1.38
MRKT_VALUE_TO_BOOK	0.66000000	1.81	1.65	2.88	0.88	0.09	-1.62
MARKET_VALUE	33.60800000	2478.72	697.35	7393.31	2983.88	0.82	-1.08
MRKT_VALUE_NATLOG	3.51547795	6.38	6.55	8.91	2.07	-0.13	-1.51
MKT_VALUE_GRWTRATE	-0.18566125	0.02	0.01	0.25	0.15	0.12	-1.16
TOT_ASSETS_CMN_EQUITY_RATIO	1.46230000	4.76	2.31	14.04	4.47	1.18	-0.18
LEVERAGE_NATLOG	0.38321950	1.18	0.84	2.64	0.84	0.65	-1.13
LEVERAGE_GRWTRATE	-0.05638301	0.00	0.00	0.07	0.04	0.16	-1.17

Studying standard deviation from a financial point of view, we observed that financial services had higher standard deviations in most variables, suggesting greater variability and volatility within this sector, as they might experience more significant fluctuations in pricing, market values and growth rates compared to banks and real estate services. Furthermore, the highest standard deviation in total assets for financial services might signify a mix of financial institutions within the sector, including both larger corporations and smaller entities with distinct business models, investment focuses, or asset compositions.

Finally, we noted that Real Estate services showed the highest skewness and kurtosis values in almost all variables. This result might imply a higher concentration of extreme values in various financial metrics within this sector, which means that a few entities with exceptional performance or size might be dominating the sector. However, this might also indicate higher volatility, significant variability, and potentially more diverse and influential entities within the real estate sector compared to banks and financial services. Investors should consider these factors when making investment decisions and be mindful of the specific characteristics and risks associated with each sector under analysis.

Table 4: Summary statistcs for Real Estate Industries

XS	Minimum	Mean	Median	Maximum	Standard_Deviation	Skewness	Kurtosis
PRICE_OR_TRADE	5.61754000	22.08	16.40	63.05	17.38	1.19	0.36
TOTAL_ASSETS	163975.80000000	1247806.59	185142.00	21916459.00	2938485.01	4.09	18.25
TOT_NATLOG	12.01746277	12.91	12.13	16.90	1.24	1.38	1.00
TOT_GRWTRATE	-0.03511370	0.01	0.00	0.07	0.03	0.68	-0.38
MRKT_VALUE_TO_BOOK	0.66000000	1.65	1.40	2.88	0.89	0.30	-1.54
MARKET_VALUE	33.60800000	967.40	91.74	7393.31	2026.79	2.41	4.39
MRKT_VALUE_NATLOG	0.00000000	5.14	4.52	8.91	1.75	0.86	-0.36
MKT_VALUE_GRWTRATE	-0.18566125	0.02	0.00	0.25	0.14	0.20	-1.05
TOT_ASSETS_CMN_EQUITY_RATIO	1.46230000	3.18	1.66	14.04	3.32	2.36	4.45
LEVERAGE_NATLOG	0.38321950	0.85	0.51	2.64	0.67	1.52	1.15
LEVERAGE_GRWTRATE	-0.05638301	0.00	0.00	0.07	0.04	0.28	-0.59

3 Panel analysis on the long time period

In the second part, we focused on analyzing how sensitive the leverage ratio is to the size growth. For this section, we utilized the entire panel data, containing all three entities: commercial banks, Real Estate Finance Services, and Finance services.

3.1 Model description

(1)$\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1 \Delta\text{TotalAssets}_{i,t} + \beta_2(\ln)\text{Leverage}_{i,t-1} + \sum_{2005}^{2023} \text{year}.$

(2)$\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1 \Delta\text{TotalAssets}_{i,t} + \beta_2 \text{MarketToBook}_{i,t-1} + \beta_2(\ln)\text{Leverage}_{i,t-1} + \sum_{2005}^{2023} \text{year}.$

(3)$\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1 \Delta\text{MarketValue}_{i,t} + \beta_2(\ln)\text{Leverage}_{i,t-1} + \sum_{2005}^{2023} \text{year}.$

(4)$\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1 \Delta\text{MarketValue}_{i,t} + \beta_2 \text{MarketToBook}_{i,t-1} + \beta_2(\ln)\text{Leverage}_{i,t-1} + \sum_{2005}^{2023} \text{year}.$

We implemented four regressions. All of them have as the dependent variable the leverage growth at t. In all four regressions, we have added dummy variables for each year. In the first regression(1), the independent variables are the size growth at t and the natural logarithm leverage at time t-1. In the second regression(2), the independent variables are the size growth at t, the market-to-book ratio value at t-1, and the natural logarithm of leverage at t-1. In the third regression(3), the independent variables are the market value growth rate at t and the natural logarithm of leverage at t-1. In the last regression(4): the market value growth rate at t, the market to book value ratio at t-1, and the natural logarithm of leverage at time t-1.

The first time we ran these regressions we obtained very poor-quality estimates. Moreover, the key statistical indicators, such as r-squared, and adjusted r-squared, were very low, if not negative. This was because of numerous outliers in the dataset. So, we proceed by applying some winsorization. We set a lower threshold of 0.1 and an upper threshold of 0.90. The results remarkably improved, and even the statistical indicatorsincreased.

3.2 Analysis of the results

Table 5: Panel analysis of the long time period

	Dependent variable:			
	ΔLeverage$_{i,t}$			
	(1)	(2)	(3)	(4)
ΔTotalAssets$_{i,t}$	0.547***	0.546***		
	(0.007)	(0.007)		
MarketToBook$_{i,t-1}$		0.001***		0.002***
		(0.0005)		(0.001)
ΔMarketValue$_{i,t}$			−0.022***	−0.021***
			(0.002)	(0.002)
(ln)Leverage$_{i,t-1}$	−0.011***	−0.011***	−0.016***	−0.016***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	21,823	21,823	21,823	21,823
R^2	0.223	0.224	0.017	0.018
Adjusted R^2	0.211	0.211	0.002	0.002
F Statistic	3,086.556*** (df = 2; 21487)	2,061.458*** (df = 3; 21486)	190.964*** (df = 2; 21487)	130.128*** (df = 3; 21486)
Note:				*p<0.1; **p<0.05; ***p<0.01

As shown in Table 5, in the first two regressions - (1) and (2) - all the regressors are statistically significant, with large t-values and very small p-values. In both cases, we can observe a strong, positive relationship between the dependent variables and the independent one. This constitutes strong statistical evidence of their impact on the leverage growth rate. Speaking about the indicators of goodness of fit, in both cases the R^2 is above 0.22, and the Adjusted R^2 is above 0.21. Also, the very low p-value ($<$ 2.22e-16). associated with the F-statistic of both models, indicates that the models are statistically significant.

In the last two regressions - (3) and (4) - we substituted the growth rate with the market value growth rate. The relationship between the leverage growth rate and all the regressors - market value growth rate, lagged market-to-book value ratio, lagged natural logarithm of leverage - are highly statistically significant. Regarding the model fit: the R^2 is above 0.017 and the Adjusted R^2 is 0.002, so the model explains very little of the variance in the dependent variable. However, the F-statistic is highly significant, suggesting that the models are statistically significant.

In summary, the regression results indicate that the independent variables, including market value growth rate, lagged logarithm of leverage, and time dummies, are statistically significant in explaining variations of the leverage growth rate. The fact that the growth rate presents a high, statistically significant coefficient led to the conclusion that the growth is accompanied by increased revenue and earnings, so the leverage ratio may improve because the equity base is expanding.

From a financial point of view, a positive relationship between leverage growth and size growth may indicate that larger financial institutions may find it advantageous to use leverage to finance their operations and expansion. As a bank grows, for example, it may take on more debt to fund additional investments, extend more loans, or engage in other financial activities. However, the relationship between leverage growth and size growth in commercial banks and financial service industries can vary based on various factors. For example:

- **Capital Structure**: The relationship between size growth and leverage growth may be influenced by the concept of optimal capital structure. Financial institutions often aim to strike a balance between debt and equity to optimize their cost of capital and minimize financial risk. The optimal capital structure may change as the institution grows, and external factors, such as interest rates and economic conditions, evolve.

- **Regulatory Environment**: The regulatory environment plays a significant role in shaping the capital structure of banks and financial institutions. Regulatory requirements may influence the

amount of capital that banks are required to hold, affecting their decisions regarding leverage. Regulatory changes can impact the observed relationship between size growth and leverage growth.

- **Business Strategies**: Different banks may pursue different business strategies, which can impact their capital structure decisions. Some banks may actively use leverage to magnify returns and pursue growth opportunities, while others may prioritize a more conservative approach, focusing on stability and risk management.

- **Market Conditions**: Market conditions, including interest rates, economic stability, and the availability of credit, can influence a bank's decision on leverage. During periods of economic expansion and favorable market conditions, banks may be more inclined to leverage for growth.

4 Panel analysis by entity and distress periods

For the final part of our research the leverage procyclicality is tested for each financial entity and if its present on financial distress periods within the financial market.

4.1 Model description

First, a model with a type of financial entity as a dummy variable is defined for the analysis of the possible effect that could have different finance entity business model on the leverage growth:

$$(5)\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1\Delta\text{TotalAssets}_{i,t} + \beta_2(ln)\text{leverage}_{i,t-1} + \beta_3\text{MarketToBook}_{i,t-1} + \beta_4\text{Finance Service}_{i,t} + \beta_5\text{Real Estate FS}_{i,t} + \sum_{2005}^{2023}\text{year}.$$

Where Finance Services i,t takes value 1 at quarter t when the financial entity i is a finance service entity and 0 otherwise and Real Estate FS i,t when the financial entity i is a real estate finance entity and 0 otherwise. As well this model control for time dummy.

Second, to capture the different behavior on proclycality by each kind of financial entity marginals effects are created:

$$(6)\Delta\text{Leverage}_{i,t} = \beta_0+\beta_1\Delta\text{TotalAssets}_{i,t}+\beta_2(ln)\text{leverage}_{i,t-1}+\beta_3\text{MarketToBook}_{i,t-1}+\beta_4\text{SizeGrowthxNoBanks}_{i,t}$$

Where SizeGrowthxNoBanks i,t represents a marginal effect in which NoBanks takes value 1 when the finance entity is a finance service entity or a real estate finance entity. Its coefficient suggests if the pro-cyclicality in leverage is more present on banks than in financial institutions that are related to other type of finance activity. To confirm the results the following marginal effects are considered:

$$(7)\Delta\text{Leverage}_{i,t} = \beta_0+\beta_1\Delta\text{TotalAssets}_{i,t}+\beta_2(ln)\text{leverage}_{i,t-1}+\beta_3\text{MarketToBook}_{i,t-1}+\beta_4\text{SizeGrowthxFinance Services}_{i,t}+\beta_5\text{SizeGrowthxRealEstate}_{i,t}$$

Where SizeGrowthxFinance Services and SizeGrowthxFinance Services represent marginals effect for which variable Finance Services takes value 1 when the I entity is a finance service entity, 0 otherwise and Real Estate takes value 1 when the I entity is a real estate finance entity, 0 otherwise.

For the study, if the leverage procyclicality is present in financial distress periods, the 2008 financial crisis and the Covid-19 crisis were chosen to estimate the following model for each crisis period:

$$(8)\Delta\text{Leverage}_{i,t} = \beta_0 + \beta_1\Delta\text{Size}_{i,t} + \beta_2(ln)\text{leverage}_{i,t-1} + \beta_3\text{MarketToBook}_{i,t-1}$$

The distress period for the 2008 financial crisis analysis is from 2007 to 2009 and for the Covid-19 crisis analysis from 2020 to 2022.

4.2 Results

The results for the equation (5) are presented in the column 1 from the Table 6. The coefficient estimated for the size growth is positive and highly significant which suggests the leverage procyclicality. The coefficient for the Market to Book Value Ratio is an expected value in which it's common to have an increase in the leverage growth if there is an increase in the market value respect to the book value, in this case in a small amount. As the previous variable,

the natural logarithm of the leverage from the previous quarter is highly significant and presents a small value but this time with a negative relationship with the leverage growth. However, the value for the Real Estate FS is not as significant as the Finance Service coefficient.

Regarding the analysis related to the effect on each type of entity, the negative coefficient for Finance Service and Real Estate FS suggests that the banks are characterized more by the leverage growth than the finance service entities and the real estate entities.

Table 6: Results panel data analysis for leverage procyclicality by type of entity

	Dependent variable:		
	$\Delta\text{Leverage}_{i,t}$		
	(1)	(2)	(3)
$\Delta\text{TotalAssets}_{i,t}$	0.537^{***}	0.625^{***}	0.625^{***}
	(0.007)	(0.009)	(0.009)
$\text{MarketToBook}_{i,t-1}$	0.002^{***}	0.001^{**}	0.001^{**}
	(0.0004)	(0.0004)	(0.0004)
$(\ln)\text{Leverage}_{i,t-1}$	-0.006^{***}	-0.005^{***}	-0.005^{***}
	(0.001)	(0.0004)	(0.0004)
FinanceServices	-0.004^{***}		
	(0.001)		
RealEstateFS	-0.003^{**}		
	(0.001)		
SizexNoBanks		-0.211^{***}	
		(0.014)	
SizeGrowthxFinanceServices			-0.200^{***}
			(0.014)
SizeGrowthxRealEstate			-0.276^{***}
			(0.028)
Observations	21,823	21,823	21,823
R^2	0.238	0.219	0.219
Adjusted R^2	0.229	0.211	0.211
F Statistic	292.631^{***} (df = 23; 21581)	$1{,}512.091^{***}$ (df = 4; 21600)	$1{,}211.521^{***}$ (df = 5; 21599)
Note:			*p<0.1; **p<0.05; ***p<0.01

As for the marginal effects in order to capture different behavior on proclycality by each kind of financial entity, the results for the equation (6) and (7) are presented in columns 2 and 3 from the table 6, respectively. The size growth and natural logarithm of the previous quarter maintain the significance and the positive relationship with the leverage growth hence the evidence of the leverage procyclicality. Market to book value ratio keeps the positive relationship but reduce its significance at 90

The results of the measure of the leverage procyclicality on no banks entities that its finance services and reals estate finance service entities, confirm and complement the result with the negative value which says that the banks characterize the leverage growth, but this time also suggest that banks characterize the leverage procyclicality, more than finance services and reals estate finance service entities.

The table 7 report the results for the equation (8) that its the analysis if in distress periods the leverage procyclicality is maintained for all type of financial entities. The leverage procyclicality is presented in distress periods as well suggesting that in financial crisis periods the financial entities maintain its leverage behavior as could be in normal periods illustrated by a size growth coefficient that its similar to the table 1.

Table 7: Results panel data analysis for leverage procyclicality by financial distress periods

	Dependent variable:	
	ΔLeverage$_{i,t}$	
	(1)	(2)
ΔTotalAssets$_{i,t}$	0.483***	0.604***
	(0.033)	(0.033)
MarketToBook$_{i,t-1}$	0.0002	0.009***
	(0.002)	(0.002)
(ln)Leverage$_{i,t-1}$	0.0003	0.005**
	(0.002)	(0.002)
Observations	1,281	1,233
R^2	0.173	0.251
Adjusted R^2	0.0001	0.087
F Statistic	73.730*** (df = 3; 1059)	112.650*** (df = 3; 1011)
Note:		*p<0.1; **p<0.05; ***p<0.01

Given the expectation of having a negative relationship in which, due to a reduction in growth related to the financial crises, financial entities would reduce the growth in leverage, is possible that they decided to increase the change in leverage because of the loan facilities that government implemented during the crisis that could be more affordable than in normal periods. However, these suggestions should be tested and require deeper research for a following investigation.

5 Conclusion

Our analysis reveals that financial systems are procyclical, exhibiting remarkable changes during crises. We notice that financial intermediaries lend more and increase credit during exuberant periods, but the exogenous shocks reverse this process, leading to decreased credit supply, highlighting the procyclical nature of the financial system. The analysis categorized by financial entity types (commercial banks, finance services, and real estate finance services) and distress periods (2008 financial crisis and COVID-19 crisis) revealed nuanced dynamics. Despite variations, the evidence suggests a positive relationship between size growth and leverage growth, underscoring the financial entities' propensity to leverage for expansion during growth periods. The regression results indicated that during financial distress, the relationship between size growth and leverage growth remained present. Notably, financial entities, particularly banks, exhibited procyclical behavior during distress periods.

6 Refrences

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