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The contagion of the subprime crisis to the U.S. Treasury bond Markets

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Abstract

The American Treasury bond markets have suffered catastrophic losses due to the subprime crisis, which erupted in 2007. We study in this paper the contagion of this crisis by examining the increase links between these markets and the U.S. subprime loan market. We use a VAR model considered most suitable for this purpose. Our study is based on the prices of subprime Asset-backed collateralized debt obligations (CDOs) and changes in U.S. Treasury bond yields. Our results support the hypothesis of contagion from the subprime crisis between the U.S. financial markets.

Key words: contagion, subprime CDOs, Treasury bond Markets, VAR model.

Biographical notes: Meriam CHIHI is now a researcher at both the Applied Economics Laboratory in the Faculty of Economics and Management of Sfax in Tunisia and the Group on Law Economics and Management, (GREDEG), UMR CNRS 6227, University of Nice Sophia Antipolis (UNS), Higher Institute of Economics and Management (ISEM), Department of Human Science (MSH). This article is a part of her PhD entitled "The international transmission of the subprime crisis between developed countries".

Introduction

The subprime crisis, born in the United States in 2007, paralyzed the structured credit market and resulted in catastrophic losses in the financial markets. Individuals and financial institutions in this country have been facing a severe credit crisis. This situation has resulted in a significant decrease in the liquidity of debt in almost all markets. In 2008, the subprime crisis has deepened and become the catalyst for a broader global financial crisis.

Federal Reserve has intervened repeatedly providing liquidity and financial guarantees for the markets. The massive intervention of the Treasury and the Federal Reserve in the financial markets had a goal to prevent a wider contagion of the crisis and the impact on other markets and sectors of the economy. Therefore, it was very important to understand the contagion phenomenon between financial markets. Extensive literature addressing the causes and effects of contagion has emerged since the 90s. We can cite as examples the work of Allen and Gale (2000), Kyle and Xiong (2001), and Kodres Pritsker (2002), Kiyotaki and Moore (2002), Kaminsky, Reinhart and Vegh (2003), Allen and Gale (2004), Brunnermeier and Pedersen (2005, 2009), Longstaff (2008-2010).

We discuss in this paper the financial contagion effects from the subprime crisis on the U.S. Treasury bond markets. We adopt an approach of testing whether an increase in inter-market links from one period to another between the subprime Asset-backed collateralized debt obligations (CDOs) market and Treasury bond markets during the subprime crisis. The choice of this approach is motivated by the standard definition in the literature on contagion as "a change in market linkages after a stressful period" (Forbes and Rigobon (2002)). We use a VAR model for three sub-periods: a pre-crisis period (2006), a period representing the subprime crisis (2007) and a period representing the global crisis (2008)). This model allows us to directly examine whether cross-market linkages during the subprime crisis of 2007 differ from those in the other two sub-periods.

The remainder of this paper is organized as follows: the second section describes our econometric methodology. The third section summarizes our empirical results, and the fourth section is our conclusion.

II- Econometric Methodology

The VAR model is presented as follows:

$$Y_t = \alpha + \sum_{k=1}^p \beta_k Y_{t-k} + \gamma_k ABXHE_{t-k} + \varepsilon_t \quad (1.1)$$

where $ABXHE_t$ is the exogenous variable representing one of five sub-indices, ε_t is the vector of canonical residues, β_k is the matrix of coefficients, k is the lags number chosen based on the information criteria AIC and the Schwartz and Y_t is the dependent variable.

1. 1-year Treasury bond market

$$1 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 1 - yaerTY_{t-k} + \delta_k ABXHAA_{t-k} + \varepsilon_t \quad (1.2)$$

$$1 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 1 - yaerTY_{t-k} + \delta_k ABXHAAA_{t-k} + \varepsilon_t \quad (1.3)$$

$$1 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 1 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.4)$$

$$1 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 1 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.5)$$

$$1 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 1 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.6)$$

2. 10-year Treasury bond market

$$10 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 10 - yaerTY_{t-k} + \delta_k ABXHAA_{t-k} + \varepsilon_t \quad (1.7)$$

$$10 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 10 - yaerTY_{t-k} + \delta_k ABXHAAA_{t-k} + \varepsilon_t \quad (1.8)$$

$$10 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 10 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.9)$$

$$10 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 10 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.10)$$

$$10 - yaerTY_t = \alpha + \sum_{i=1}^k \beta_k 10 - yaerTY_{t-k} + \delta_k ABXHBBB_{t-k} + \varepsilon_t \quad (1.11)$$

III. Empirical results

1. Data and descriptive statistics

As return measures in the market for subprime Asset-backed security CDOs in trouble, we use the weekly variations of the ABX-HE. In total, we have five of the series, each representing a different credit rating, which is designated by: ABX-HE-AAA, ABX-HE-AA, ABX-HE-A, ABX-HE-BBB, and ABX-HE-BBB_. These are the closing prices of the ABX-HE index, obtained from the Markit Group Ltd, for the three years since the inception of the ABX-HE (the January 19, 2006 until December 31, 2008).

To detect the changes in U.S. Treasury bond markets, we use the weekly variations (over the same period for returns of ABX-HE) to a constant maturity of the one- and ten- year Treasury yields (obtained from the website of the Federal Reserve Board).

Figure.1. Evolution of ABX-HE index

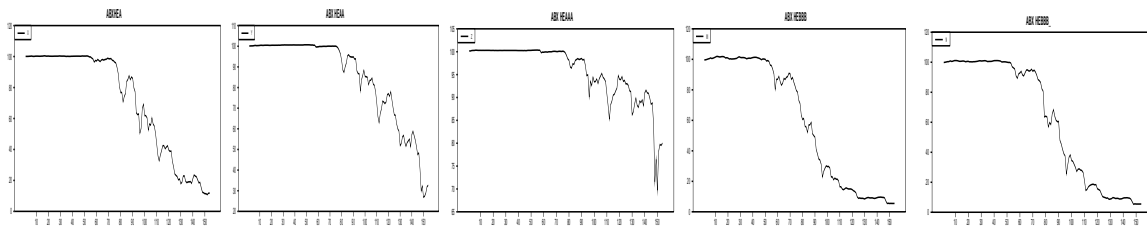


Figure.1. represents the time series of five sub-indices ABX-HE for the entire period. This figure shows that ABX-HE indices were generally almost constant over a large period of 2006, although the sub-indices ABXHE

BBB-and ABX-HE-BBB_ have begun to decline in late 2006. During the first part of 2007, the ABXHE BBB_ index continued to fall. By mid 2007, however, other indices ABX-HE rated started to decline. In late 2007, the ABX-HE-AAA was less than 80 and the other indices were all below 50. In 2008, all ABX-HE indexes continued their declines steadily and ended the year below 10, with the exception of the ABX-HEAAA which has dipped below 30, but it recorded some recovery at 40 in late 2008.

Figure. 2. The weekly ABXHE returns

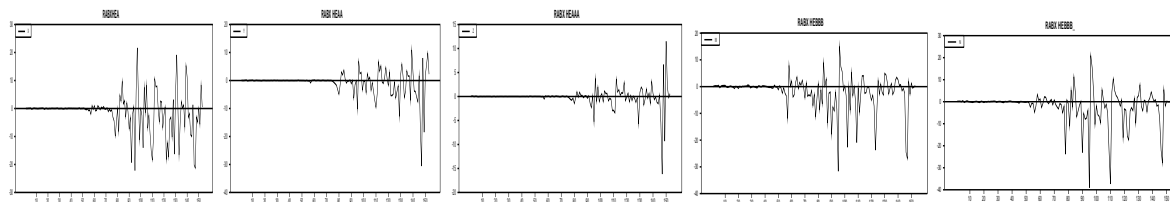


Figure. 2. represents the evolution of weekly changes in the levels of ABX-HE index between 2006 and 2008. We find that the volatility of the ABX-HE was significantly higher in 2007 than in 2006 and 2008. This figure shows that the indices ABX-HE-BBB_ and ABX-HE BBB were most volatile during 2007 while the indices ABX-HEAAA, ABX-HEAA, ABX-HEA were the most volatile during 2008.

Tableau.1. Descriptive statistics

Variables	2006					
	Mean	Std. dev.	Skewness	Kurtosis	JB	ADF
ABXHEA	0.004	0.072	-0.946 (0.00)	2.40 (0.00)	18.69 (0.00)	-6.93 (S)
ABXHEAA	0.011	0.042	0.272 (0.45)	1.706 (0.02)	6.416 (0.04)	-6.67 (S)
ABXHEAAA	0.002	0.020	1.935 (0.00)	6.610 (0.00)	117.3 (0.00)	-6.30 (S)
ABXHEBBB	0.008	0.204	-0.661 (0.07)	0.794 (0.29)	4.76 (0.09)	-4.98 (S)
ABXHEBBB_	0.011	0.309	-0.394 (0.27)	-0.339 (0.45)	1.479 (0.47)	-4.59 (S)
One-Year Treasury yields	0.010	0.056	0.039 (0.91)	0.221(0.77)	0.110 (0.94)	-4.238 (S)
10- Year Treasury yields	0.003	0.081	-0.001 (0.99)	0.322 (0.671)	0.208 (0.90)	-4.446 (S)
Variables	2007					
	Mean	Std. dev.	Skewness	Kurtosis	JB	ADF
ABXHEA	-0.931	6.139	-0.428 (0.22)	6.469 (0.00)	92.28 (0.00)	-5.762 (S)
ABXHEAA	-0.320	2.383	-1.218 (0.00)	7.014 (0.00)	119.46 (0.00)	-4.625 (S)
ABXHEAAA	-0.135	1.090	-1.253 (0.00)	12.18 (0.00)	335.18 (0.00)	-4.184 (S)
ABXHEBBB	-2.083	8.715	-1.560 (0.00)	7.263 (0.00)	135.40 (0.00)	-5.507 (S)
ABXHEBBB_	-2.333	7.038	-1.342 (0.00)	5.544 (0.00)	82.227 (0.00)	-4.869 (S)
One-Year Treasury yields	-0.028	0.136	-1.554 (0.00)	3.416 (S)	46.219 (S)	-4.137 (S)
10- Year Treasury yields	-0.006	0.103	0.019 (0.95)	0.368 (0.61)	0.297 (0.86)	-3.33 (S)
Variables	2008					
	Mean	Std. dev.	Skewness	Kurtosis	JB	ADF
ABXHEA	-3.122	9.251	0.019 (0.95)	-0.264 (0.72)	0.158 (0.91)	-4.541 (S)
ABXHEAA	-1.809	7.186	-1.482 (0.00)	4.305 (0.00)	60.361 (0.00)	-4.182 (S)
ABXHEAAA	-0.294	3.623	-1.230 (0.00)	8.637 (0.00)	178.12 (0.00)	-4.442 (S)
ABXHEBBB	-3.429	8.934	-1.819 (0.00)	3.947 (0.00)	63.66 (0.00)	-4.909 (S)
ABXHEBBB_	-3.182	7.535	-1.941 (0.00)	3.361 (0.00)	58.23 (0.00)	-4.495 (S)
One-Year Treasury yields	-0.058	0.211	-0.081(0.81)	1.435 (0.04)	4.606 (0.09)	-5.337 (S)
10- Year Treasury yields	-0.038	0.192	-0.099 (0.77)	-0.042 (0.95)	0.091 (0.95)	-4.763 (S)

According to table .1. our study shows that during the pre-crisis period, the average yield is generally low and positive for different sub-indexes. We note that all return series have negative average returns in 2007-2008 when they were positive in 2006. These series have a low yield and very high risk between 2007 and 2008. We conclude, therefore, that these markets are characterized by high volatility.

The results of normality test allow us to reject the normality assumption regarding the Kurtosis and Skewness, which raises a problem with the asymmetric preferences of financial actors; the latter are naturally more concerned about their risk of loss as their chances of gain.

2. Results of the VAR models

Table .2. presents the results of the estimation of VAR models, where each VAR is estimated separately for the year indicated. We also report the P value for Fisher's test of the hypothesis that the coefficients are jointly equal to zero ($\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$). In this specification, Y_t refers to the variable representing the Treasury bond markets, which appear as dependent variables. The ABX-HE refers to variations in the ABX-HE indices; including its own lagged values appear as explanatory variables.

Table 2. Estimation results of the VAR models

Y	ABX-HE	2006				2007				2008			
		γ_k	Sign	DW	P	γ_k	Sign	DW	P	γ_k	Sign	DW	P
One-Year Treasury yields	AAA	-0.124	0.76	2.03	0.22	0.013	0.54	2.07	0.00	0.0005	0.94	2.02	0.48
	AA	0.100	0.60	2.05	0.67	-0.003	0.72	1.93	0.05	-0.001	0.74	2.01	0.12
	A	-0.089	0.44	2.01	0.22	0.012	0.00	2.04	0.87	-0.002	0.44	2.00	0.41
	BBB	-0.034	0.40	2.04	0.37	0.008	0.00	2.03	0.00	0.0025	0.45	2.03	0.64
	BBB_	-0.007	0.79	2.03	0.55	0.01	0.00	2.03	0.00	-0.001	0.79	2.01	0.32
10- Year Treasury Yields	AAA	0.433	0.46	1.99	0.55	0.034	0.01	1.98	0.00	-0.006	0.42	2.18	0.15
	AA	0.328	0.24	2.07	0.86	0.0098	0.02	1.95	0.17	-0.0009	0.81	2.47	0.14
	A	-0.037	0.81	1.97	0.50	0.007	0.00	2.03	0.70	0.003	0.26	2.06	0.64
	BBB	-0.036	0.53	1.98	0.90	0.002	0.10	1.93	0.03	0.006	0.02	2.09	0.52
	BBB_	0.010	0.78	1.99	0.74	0.0043	0.05	1.96	0.00	0.004	0.18	2.08	0.13

Our results reported in table 2. show that all of the coefficients γ_k , reflecting the predictive ability of the changes in the five sub-indices ABX-HE for the treasury bond yields markets, are not significant in 2006. This is expected since the CDOs market is much less liquid than the Treasury bond market. Thus, in ordinary circumstances, it is anticipated that there will be very little information useful in predicting changes in Treasury rates by ABX-HE indices returns. This factor becomes significant with a positive signs in 2007 for the sub-indices ABX-HE A, BBB and BBB_. This result indicates that changes in ABX HE indices have predictive power and guarantee a Granger causality in regard to changes in Treasury rates. In addition, all the five sub-index of ABXHE have a significant predictive power in forecasting 10 years Treasury yields for about four weeks. The significant and positive signs of the coefficients γ_k in 2007 indicate that a negative shock to the ABX-HE returns translates a decline in Treasury yields, which in turn implies an increase in the value of Treasury bonds. These results are consistent with a *flight to quality* in the market for Treasury bond in response to subprime market shocks. Finally, the predictive ability of the ABX-HE returns for the Treasury bond yields largely disappears in 2008. The exception is that the Fisher statistic for the ABX-HE-BBB is significant at the 5% level for the 10- year Treasury bond market.

In summary, the beginning of the subprime crisis has led to a significant change in the relationship between ABX-HE returns and Treasury bond yields changes. During the crisis, the explanatory power of the Treasury yield becomes significant. Such a relationship was absent in pre-crisis period, when the Treasury bond markets was very liquid. Once the subprime crisis has evolved into another form, the CDOs represented by the ABX-HE index are no longer a vector of contagion and the relationship between the ABX-HE returns and the Treasury bond yields returned to its pre-crisis nature. Our results strongly support the idea that the subprime crisis of 2007 has been accompanied by financial contagion and that shocks in the market for CDOs were transmitted to the Treasury bond markets.

IV. Conclusion

The subprime crisis of 2007 provides an ideal opportunity to study the effects of contagion in financial markets. Motivated by the definition of contagion proposed by Forbes and Rigobon (2002) we estimated five VAR models for each of treasury-bond markets. We tested the changes in the relationship between the CDO market represented by the five sub-indices ABX-HE and the Treasury bond markets represented by the changes in the treasury bonds yields. To do this, we divided the full period into three sub-periods: a pre-crisis period (2006), a period representing the subprime crisis (2007) and a period representing the global crisis (2008).

Our results show a significant causal relationship between the ABX-HE returns and changes in the Treasury yields. This relationship is due to the subprime crisis of 2007. Indeed, Treasury bond prices rose in response to negative shocks to the subprime market, which supports the model of flight to quality. This effect is much stronger for long-term Treasury bonds than for those of short-term.

Our study resulted in strong evidence of contagion in financial markets during the subprime crisis in 2007. These links disappear in 2008 once this crisis is a global financial one. The perturbations appear to spread from the subprime market to the Treasury bond ones at the beginning of the crisis when losses of subprime loans were the main concern. However, after the collapse of major financial institutions and once the potential of a global depression has become widespread in 2008, the subprime market did not work as a vector of contagion of the other markets. This finding is consistent with the usual vision of contagion that is identified when there is a significant but temporary connection between the various financial markets after a negative shock is realized.

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