

RISK AND CONTAGION ON FINANCIAL MARKETS AFTER THE 2007 SUB-PRIME MORTGAGE CRISIS

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Abstract:

The sub-prime mortgage crisis of 2007 that affected the US economy is considered the most severe financial catastrophe that affected the United States since the Great Depression. The main purpose of this study is to examine whether any contagion effect occurred across international financial markets after the sub-prime financial crisis. We investigate the co-movements in the US market index and sixteen European indices for the period between April 2007 and February 2012 using daily observations of prices and returns. We calculate the unconditional correlation coefficients for a stable period and a turmoil period and observe significant increases in their values, which indicate that contagion has occurred in the sub-prime financial crisis from the US market to almost all European markets under scrutiny – except for Greece.

Keywords: risk, contagion, crisis, sub-prime mortgages

JEL Classification: G01, G15

1. Introduction

Before 1997 the term “contagion” was primarily in reference to the transmission of a medical disease, but this changed in July 1997, when a currency crisis that started in Thailand spread rapidly throughout East Asia. As Dornbusch et al. (2000) noted, “This turmoil roiled capital markets in industrial countries, altering dramatically the (relative) pricing of many financial instruments, and spilled over into speculative hedge-fund bets, leaving Long-Term Capital Management, a large U.S. hedge fund, facing near bankruptcy. The crisis subsequently hit Brazil, creating uncertainty about the country’s ability to roll over its public sector debt, and spread to other emerging markets in Latin America and elsewhere”. The global repercussions of the Thailand’s crisis have transformed the use of the term “contagion”: if before 1997 Internet searches found almost no article that used this term in relation to financial markets, after mid-1997 such search discovered that almost all articles that used the term contagion referred to the propagation of financial market shocks among countries.

Nowadays there is an extensive literature on the international transmission of shocks and the World Bank taxonomy uses three definitions of contagion: (1) a broad definition: “Contagion is the cross-country transmission of shocks or the general cross-country spillover”; (2) a restrictive definition: “Contagion is the transmission of shocks to other countries or the cross-country correlation, beyond any fundamental link among the countries and beyond common shocks” - this definition is usually referred to as “excess co-movement” and is commonly explained by herding behavior; (3) a very restrictive definition: “Contagion occurs when cross-country correlations increase during “crisis times” relative to correlations during “tranquil times.”

Forbes and Rigobon (2001) divide the theories on international propagation of shocks into two groups: crisis-contingent and non-crisis-contingent theories. According to them, crisis-contingent theories are those that explain why transmission mechanisms change during a crisis, while non-crisis-contingent theories claim that transmission mechanisms remain the same during a crisis as in stable periods; thus cross-market linkages do not increase after a shock occurs in one country or more countries. “Crisis-contingent theories that explain how shocks are spread internationally can be divided into three broad mechanisms: multiple equilibrium, endogenous liquidity, and political economy” (Forbes and Rigobon, 2001). The multiple equilibrium mechanism operates when a shock in a particular country is being used as a sunspot for the other countries. A second category of crisis-contingent mechanisms is represented by the endogenous liquidity shocks. Valdés (2000) has developed a model in which a shock in one country can cause reduction of the liquidity of the market participants. Further, this could cause investors to evaluate the structure of their portfolios and sell assets in other countries in order to continue to operate in the market. When the liquidity shock is large, a shock in one market can force investors to sell assets in countries which are not affected by the initial shock. Similarly, Calvo (1998) has developed a model of endogenous liquidity based on asymmetric information among investors. The third category of crisis-contingent transmission mechanisms is the political contagion. By using the European devaluations from the 1992-1993period, Drazen (2000) has developed a model which is based on the assumption that the governors of central banks are under pressure to maintain their countries’ fixed exchange rates. This particular category of crisis-contingent theories suggests a wide range of channels through which shocks could be propagated internationally, namely “multiple equilibrium based on investor psychology; endogenous-

liquidity shocks that cause a portfolio re-composition; and political economy affecting exchange rate regimes”(Forbes and Rigobon, 2001). These theories have the same critical implication: the mechanism of transmission during the turmoil period is significantly different from any that existed before the crisis. A structural shift is caused by the crisis and shocks are transmitted through a channel that does not operate during stable periods. All of these theories can be used to explain the occurrence of shift-contagion.

The non-crisis-contingent theories that explain the manner in which shocks can be transmitted internationally do not imply shift-contagion. According to these theories, the transmission mechanisms after an initial shock has occurred do not differ significantly from those that operate before the shock. Instead, any large cross-market correlations after an initial shock represent a continuation of linkages that were present before the shock. These channels are referred to as “real linkages”, since many of them are based on macroeconomic fundamentals. These can be divided into four broad channels: “trade, policy coordination, country reevaluation, and random aggregate shocks” (Forbes and Rigobon, 2001). Borrowing from and Haile and Pozo (2008), there are three main channels for the transmission of international shocks that can be found in the literature: (1) real economic links, often associated with trade links; (2) financial links (see Asongu, 2011), and (3) the effect of herding behavior or panics resulting from asymmetric information (see Khan and Park, 2009).

We opt in this paper for contagion defined as “a significant increase in cross-market linkages after a shock to one country or group of countries” (Forbes and Rigobon, 2002). According to this definition, the fundamental condition for contagion is a significant growth in markets’ co-movements as a result of a shock that occurs in one market. Furthermore, this implies that “if two markets display a high degree of co-movements during the stable period, even if they are highly correlated during the turmoil period, if the crisis-correlation is insignificant then contagion has not taken place.” (Asongu, 2011). If there is not a significant increase in correlation during the turmoil period compared with the stable period, the relation between two markets can be qualified using the term “interdependence”.

2. The sub-prime crisis: a brief overview

Before addressing the problem of contagion during the sub-prime financial crisis, we briefly consider some relevant aspects of the developments that shaped the sub-prime financial crisis. The crisis that emerged in 2007 was triggered by the deteriorating quality of the U.S. subprime mortgages and has spread rapidly throughout Europe. Whalen (2008) claims that three issues are at the root of this crisis “... the first of which is an odious public policy partnership, spawned in Washington and comprising hundreds of companies, associations and government agencies, to enhance the availability of affordable housing via the use of creative financing techniques. Second, federal regulators have actively encouraged the rapid growth of over-the-counter (OTC) derivatives and securities by all types of financial institutions. And third, also bearing blame for the subprime crisis is the related embrace by the Securities and Exchange Commission (SEC) and the Financial Accounting Standards Board of fair value accounting”.

The subprime crisis spread quite fast across different classes of assets and financial markets. The adjustable-rate mortgage (ARM) loan has also played a significant role in the sub-prime mortgage crisis. According to the official statistics, in 2006, more than 90% of the sub-prime mortgages were adjustable-rate mortgages. In February 2007, the crisis started to affect the financial sector when the world’s largest bank (in 2008), HSBC, wrote down its holdings of sub-prime related MBS by \$10.5 billion. During 2007, almost 100 mortgage companies were forced either to suspend their operations, to shut down or were sold. In late 2007 changes intervened in the top management, as the CEOs of Citigroup and Merrill Lynch resigned. As the impact of the crisis became more visible, many financial firms either announced that they were seeking merger partners or merged. The crisis spread panic in the financial institutions and encouraged investors to redraw their money out of risky mortgage bonds and shaky equities and to invest them into commodities.

After the collapse of the derivative markets, financial speculation in commodity futures has caused the world food price crisis and an increase in the price of oil as a result of “commodities super-cycle”. Trillions of dollars from mortgage bonds and equities have been redrawn by financial speculators looking for quick returns in order to be invested into food and raw materials. Provisions for future defaults and mortgage defaults caused profits at the 8,533 USA depository institutions to decrease from \$35.2 billion in the last quarter of 2006 to \$646 million in the same quarter of 2007, a significant decline of 98%. In the last quarter of 2007 were registered the worst bank and thrift quarterly performances since 1990. In 2007, insured depository institutions earned more than \$100 billion, a decrease with 31% from the 2006 record profit of \$145 billion. Profits dropped from \$35.6 billion in the first quarter of 2007 to \$19.3 billion in the first quarter of 2008 Q1, a decline of 46%.

As of August 2008, financial firms around the globe began to write down their holdings of subprime related securities by US\$501 billion. The IMF mentioned that financial institutions around the globe were forced to write off \$1.5 trillion of their holdings of subprime MBSs. In November 2008, there have been recognized US\$750 billion in such losses. The world banking system was eventually wiped out by such losses. The crisis reached a peak in September 2008, when Lehman Brothers and other important institutions have failed. In the same month, during a two-day period approximately \$150 billion were retired from the USA money funds. Effectively, the money market that has been a primary source of credit for non-financial firms and banks was subject to a bank run. Furthermore, this credit freeze contributed to the collapse of the financial system. The actions taken by the European Central Bank, US Federal Reserve and other central banks were prompt and dramatic. Their response consisted in the purchase of US\$2.5 trillion of government debt as well as troubled private assets from banks. This constituted the largest injection of liquidity into

the credit market in world history. The US and European governments have purchased newly issued proffered stock with the purpose of raising the capital of their national banking systems by \$1.5 trillion. The International Monetary Fund announced that major US and European banks suffered losses of more than US\$1 trillion on toxic assets and from bad loans in the period from January 2007 to September 2009. These huge losses were forecasted to hit US\$ 2.8 trillion in the period 2007-2010, whereas the losses of US and European banks were expected to top US\$1 trillion, respectively US\$1.6 trillion. The IMF announced that US banks were 60% through their losses, while Euro zone and British banks only 40%.

3. Contagion effects of the sub-prime crisis

We observe contagion effects from the United States to a number of sixteen European countries during the volatile period directly after August 2007 and we define the “turmoil” period as the month starting on August 2007 and the stable period as April 2, 2007 to the start of the turmoil period. We examine increases in cross-market linkages after the shock from August 2007 in US to the 16 countries from Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, and United Kingdom. Data on stock market indices was collected on a daily basis from Bloomberg.

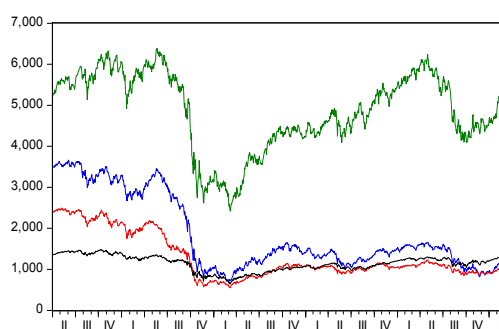
Figure 1 below shows the stock market indexes for the seventeen analyzed countries in the period subject to analysis April 2, 2007 - February 29, 2012. As presented in these figures, stock markets that have different structure, geographic location and size exhibited a high degree of co-movements with the United States, which might indicate the existence of mechanisms through which the shocks in the US economy have been propagated internationally.

Although the evolution of stock market indices offers an indication of possible contagion effects from the US market to the European markets, such graphical perspective on the crisis is not sufficient to conclude that contagion has occurred. Therefore, we have calculated the correlation coefficient between the sixteen European markets and the US market for the entire period, for the “turmoil” period and for the “stable” period, presented in Table 1. When analyzing the results, there are several patterns that can be easily identified. First, the correlations between the United States and the other 16 countries during the stable period are not at all surprising, revealing that USA is highly correlated with the economies from Europe. Second, the cross-market correlations between USA and the other countries have increased during the crisis period versus the stable period. This is a fundamental condition for contagion to occur. The increase is particularly noticeable in Austria (where the correlation coefficient has increased from 0.169 to 0.486 in the turmoil period compared with the stable period), Netherlands and Switzerland. In one particular example, the conditional correlation coefficient between USA and Greece decreased from 0.331 to 0.32 in the turmoil period compared with the stable period. Third, the t-tests indicate a significant increase in the conditional correlation coefficient in the turmoil period for 14 countries. On the basis of standard interpretation in the literature on contagion, this clearly implies that contagion has occurred from the USA market to Austria, Belgium, Denmark, Finland, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

4. Conclusions

The 2007 sub-prime mortgage crisis that emerged in the US economy is nowadays considered the most severe financial upheaval that affected the United States since the Great Depression. At the same time, the literature in the field has fiercely debated the issue of whether the crisis was transmitted to the European markets through contagion effects. The main objective of our research was to examine whether such contagion effects occurred across international financial markets after the crisis. We observed stock market co-movements between the United States and Europe for the period between April 2007 and February 2012 and identified the presence of contagion with the aid of unconditional correlation coefficients. Our results indicate that there were significant increases in the values of these coefficients from a stable period to a turbulent period, which may be interpreted as contagion occurrence in the sub-prime financial crisis from the US market to almost all European markets under scrutiny, except for Greece – this is a matter that needs to be further investigated.

Figure no. 1: European stock market indices versus USA stock index, 2007-2012



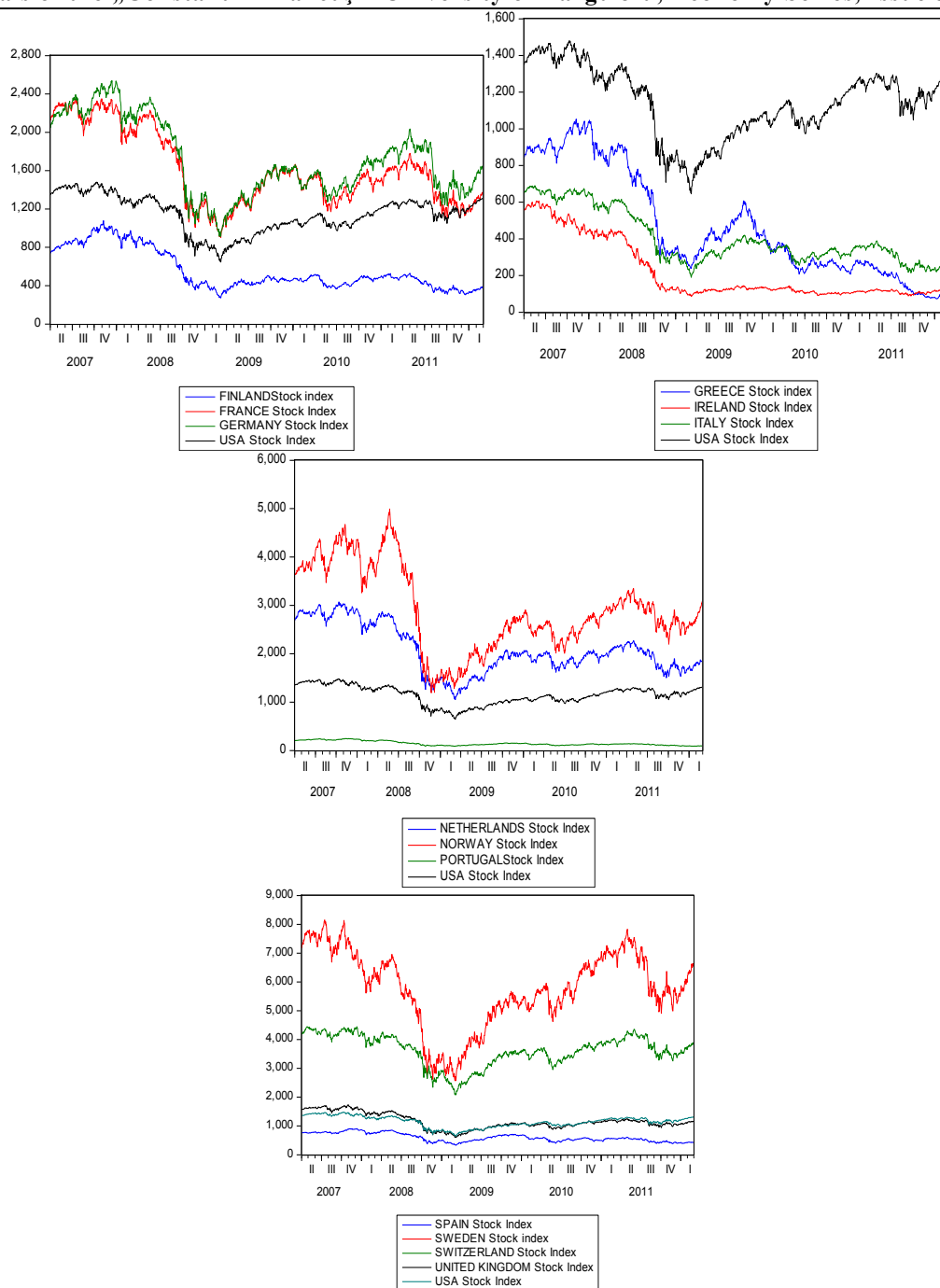
Data source: *www.bloomberg.com*

Table no. 1: International stock indexes returns' unconditional correlation coefficients

Country	Full period		Stable period		Turmoil period		t-test	Contagion?
	ρ	σ	ρ^*	σ	ρ^*	σ		
Austria	0.482	0.0261	0.169	0.0107	0.486	0.0269	11.9487	C
Belgium	0.514	0.0202	0.434	0.0084	0.515	0.0208	2.90523	C
Denmark	0.469	0.0196	0.394	0.0092	0.470	0.0208	2.72481	C
Finland	0.505	0.0232	0.389	0.0105	0.506	0.0238	4.21157	C
France	0.583	0.0213	0.530	0.0095	0.584	0.0219	1.93327	N
Germany	0.612	0.0207	0.445	0.0110	0.615	0.0212	6.16712	C
Greece	0.320	0.0285	0.331	0.0094	0.320	0.0294	-0.3933	N
Ireland	0.478	0.0266	0.308	0.0120	0.481	0.0274	6.27928	C
Italy	0.546	0.0224	0.449	0.0089	0.548	0.0231	3.55664	C
Netherlands	0.579	0.0198	0.437	0.0086	0.581	0.0203	5.20209	C
Norway	0.505	0.0274	0.390	0.0127	0.506	0.0281	4.17508	C

Portugal	0.444	0.0184	0.287	0.0075	0.446	0.0190	5.75735	C
Spain	0.538	0.0227	0.435	0.0096	0.540	0.0234	3.77452	C
Sweden	0.552	0.025	0.435	0.0126	0.554	0.0256	4.28459	C
Switzerland	0.514	0.0155	0.320	0.0082	0.517	0.0159	7.18335	C
UK	0.568	0.0191	0.461	0.0078	0.570	0.0197	3.92001	C

Source: Authors' calculations

The table reports the unconditional cross-market correlation coefficients and standard deviations for USA and each country in the sample. "C" indicates that t-statistic is greater than the critical value and therefore contagion did occur. "N" indicates that t-statistic was less than or equal to the critical value and therefore no contagion occurred. T-tests are significant at 10% level.

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