Volatility as a Transmitter of Systemic Risk: Is there a Structural Risk in Finance?

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This article discusses the role of volatility in the context of systemic risk in finance. The main argument is that volatility transmits risks within the financial system and beyond, shaking the financial system and threatening in particular small or vulnerable clients (SMEs, households, and also low- and middle-income countries). In addition, it is argued that volatility-induced threats result from structural characteristics of the financial markets themselves (reactivity, reflexivity, and recursivity). The article introduces the concept of volatility, and different approaches to understanding risks related to the financial system (e.g., financial analysis, systems analysis). Two cases related to systemic risk are presented. The first concerns the role of volatility in three major financial crises (stock crash 1987, Asian crisis 1996–1997, global banking crisis 2007–2008), documenting that volatility spillovers have become a “new normal.” The second case concerns the moderate reflection of systemic risk within The Journal of Finance (the leading financial journal). The two cases show that volatility plays a role in systemic risks, but that this role has not yet been examined in detail by the scientific community.

KEY WORDS: Finance; financial markets; reflexivity; systemic risk; volatility

Volatility refers to fluctuations in the prices of economic products. Volatility is like a wave, in that the outcomes depend on the amplitude and frequency of the event. A wave rolling onto a beach might be a considered pleasant by most families nearby; however, the same event can represent a major threat, a “tsunami” to smaller sandcastles. This article discusses the role of volatility in the context of systemic risk in finance. Volatility turns out to be not only a threat to finance as a system, but also to be caused, triggered, and/or amplified by structural components of the financial markets.

The article begins with a view on systemic risk in finance and then expands on the concept of volatility. On this basis, three approaches to understanding risks related to the financial system will be introduced, each with a different focus on finance and volatility. The core empirical part consists of two cases. The first case concerns the role of volatility in three major financial crises between 1987 and 2008, which show that volatility spillovers have become “normal.” The second case examines the reflection of systemic risk since 1994 in The Journal of Finance, the leading journal in this field. The analysis will reveal that the term “systemic risk” is rarely used, although discussion of “crisis” has become more common. It remains open to discussion whether there is a structural systemic risk in finance.

1. SYSTEMIC RISK AND FINANCE

There is considerable consensus that systemic risks are those that threaten a whole system and may cause systemic collapse. This definition was coined by the 2003 OECD report on “emerging systemic risks.” The report addresses systemic risks such as “those risks that affect the systems on which society
Volatility as a Transmitter of Systemic Risk depends—health, transport, environment, telecommunications, etc.” (OECD, 2003, p. 9). The report explicitly excludes “systemic risks to markets, notably to financial markets” (OECD, 2003).

In the financial literature, we find similar usages of the term “systemic risk.” A discussion of such issues started after the 1987 stock market crash. In his “Distinguished Lecture on Economics in Government: Central Banking and Systemic Risks,” Brimmer (1989) defined “systemic risk” as the spread of adverse effects that damage “the financial fabric of the country at large” (p. 4). Others such as Eisenberg and Noe (2001) understood systemic risk in the sense of contagion, namely, as “the exposure of a given node in the system to defaults by other firms” (p. 237). Benoit, Colliard, Hurlin, and Pérignon (2017) provided an overview of the literature. According to Acharya, Pedersen, Philippon, and Richardson (2017), systemic risk can be measured as the propensity for undercapitalization among agents in the financial system.

Systemic risks define a new class of risks that in principle require new forms of risk management (cf., e.g., Renn & Klinke, 2004). Renn, Lucas, Haas, and Jaeger (2019) reviewed the literature on systemic risk and provided a structured characterization. Renn et al. (2019) defined systemic risks through four properties. Systemic risks are: (i) “global in nature,” (ii) “highly interconnected and intertwined, leading to complex causal structures,” (iii) “nonlinear in the cause–effect relationships, often involving unknown tipping points or tipping areas,” and (iv) “stochastic in their effect structure, so that more than one future is possible” (p. 403). Risk management is specifically aware of any “bifurcation point” that may lead to catastrophe: “There, it depended on random events at the micro-level whether the previous trajectory would be continued, or a switch to some other trajectory—including the possibility of a breakdown of the whole system—would happen” (p. 406).

The global banking crisis of 2007–2008 seemed to provide a perfect example of systemic risk. In November 2008, the British monarch visited the London School of Economics and asked why nobody had foreseen this crisis. Subsequently, the British Academy convened an expert forum (Besley & Hennessy, 2009) whose response letter concluded with a reference to systemic risk, i.e., a risk to the system as a whole: “So in summary, Your Majesty, the failure to foresee the timing, extent and severity of the crisis and to head it off, while it had many causes, was principally a failure of the collective imagination of many bright people, both in this country and internationally, to understand the risks to the system as a whole” (p. 3).

A closer look into the financial literature related to systemic risks reveals a nuance that seems specific to finance: risks resulting from the structuring of financial markets. In 1991, the OECD released a report titled “Systemic Risks in Security Markets” (OECD, 1991). Clarifying the terms of reference, the report referred to “risks arising from the market structures and settlement systems” (p. 7). The seminal paper on “Financial Connections and Systemic Risk” by Allen, Babus, and Carletti (2010), pointed to the “importance of another type of systemic risk related to the structure of connections among financial institutions and their funding maturity,” linked in particular to “financial instruments in the form of credit default swaps and other credit derivative products” (p. 3). In a similar vein, Feinstein, Rudloff, and Weber (2017) understand system risk as referring to “the risk that the financial system is susceptible to failures due to the characteristics of the system itself” (p. 672).

2. VOLATILITY

This chapter provides a definition of volatility and its potential for crisis and transmission of systemic risk.

2.1. Definition and Characteristics of Volatility

Volatility is defined as the variation in prices, for instance of a share. Strong price fluctuations can be understood as a form of risk. However, volatility can also be understood as the typical variance within the random walk of a measure. These two interpretations—a risk to be avoided versus normal, random variation to be disregarded—dominate attitudes toward volatility. The “risk” interpretation has been the dominant viewpoint regarding investment in financial products since the publication of Markowitz’s portfolio selection theory (1952, 1959). The random-walk interpretation is visible in many economic market models, in which volatility is characterized as variance due to a complex world (Taleb & Goldstein, 2012).

In the economic literature, volatility is given narrow/broad definitions, ranging from (i) variation in prices of financial products such as shares or funds and stocks; or (ii) variation in aggregated economic figures, such as GDP; to (iii) variation in more-
less-measurable parameters, for instance humanitarian aid (cf., Hudson, 2015). An integration of different volatility measures was made by Bollerslev, Hood, Huss, and Pedersen (2018).

In mathematical finance, volatility is the standard deviation of the logarithmic returns for a series of trading prices (cf., e.g., Hull, 2018, pp. 348–349). In general, returns from securities do not show a Gaussian distribution. Their distribution, first, is leptokurtic (more “medium” returns) and, second, has a fat tail (more severe losses). Third, the volatility distribution suffers from heteroskedasticity: that is, the variances within subpopulations (e.g., losses vs. gains) may differ. Thus, volatility presents challenges for statistical analysis.

Furthermore, we must distinguish between historic volatility (i.e., the observed volatility calculated using real data) versus implied volatility (i.e., the estimated volatility of a share or another security). Most often, volatility is communicated for stocks—such as the VIX Index by the Chicago Board Options Exchange. In recent years, the economic literature has also been concerned with idiosyncratic volatility, i.e., the volatility of a single share indicating the fate of a company (cf., e.g., Ang, Hodrick, Xing, & Zhang, 2009). Not only investors but also CEOs monitor these two essentials: the company’s share price and its volatility.

2.2. Volatility and Crisis

“Crises can be regarded as particularly dramatic episodes of volatility” (Prasad, Rogoff, Wei, & Kose, 2005, p. 216). Volatility itself may impose stress on individuals and organizations. Many of us struggle to cope with volatility. At a personal level, income volatility may result in depression (Prause, Dooley, & Huh, 2009). At the company level, conditional volatility in downturns seems to be a major component of idiosyncratic volatility (Patton & Sheppard, 2015). At an international level, developing economies have to tackle volatility of capital flows, often leading to recessions deeper than those in developed economies and worsened by the social costs of crises and their distributional consequences (cf., Bekaert, Ehrmann, Fratzscher, & Mehl, 2014; Calvo & Reinhart, 2000).

The relationship between volatility in financial markets and disasters beyond financial markets could be at least threefold: volatility transmission as (i) a cause of disaster, (ii) as reinforcing disaster, or (iii) as a result of disaster. Usually, a stock market crash that involves problematic banks is accompanied by the risk of a credit crunch that may result in liquidity shortage and insolvencies. This would be a case of volatility caused by economic turmoil (condition (i)). In recent decades, research has intensified into idiosyncratic volatility; that is, the volatility of a single stock or company. Increased idiosyncratic volatility seems to reduce a company’s capacity to insure against shocks (Arellano, Bai, & Kehoe, 2016). However, the causal direction between volatility and crisis might not always be clear: As Schwert (1989) showed, stock market volatility remained high during the Great Depression (1929–1939)—with unclear causality. Moreover, as Danielsson, Valenzuela, and Zer (2018) demonstrated in their long-term analysis spanning over 200 years and across 60 countries, only periods of low volatility are predictive for economic crisis, as economic agents seem to take greater risks under conditions of low volatility.

Volatility has potential to transmit systemic risk. If we consider the four properties of systemic risks, defined by Renn et al. (2019), the fourth property most clearly fits volatility: Today, volatility is considered to be stochastic in nature and can be modeled, for instance, by a class of stochastic processes called autoregressive conditional heteroskedasticity (ARCH; cf., Engle, 1982) or their generalized version (GARCH; cf., Bollerslev, 1986). Moreover, in several studies, volatility is discussed as a trigger to reach tipping points—the third property of systemic risk according to Renn et al. (2019)—for instance, in stock markets (Yalamova & McKelvey, 2011), international food prices (Tadasse, Algieri, Kalkuhl, & von Braun, 2016), or insurance-linked derivative securities in climate risk management (Michel-Kerjan & Morlaye, 2008). The first and second properties of systemic risks concern global reach and interconnectivity. In that context, Section 4 of this article will clarify the role of volatility in recent global financial and economic crises. In preparation for that discussion, Section 3 provides a theoretical introduction.

3. APPROACHES TO UNDERSTANDING RISK AND VOLATILITY IN FINANCIAL MARKETS

If volatility plays a role in constituting or transmitting risks, how can we understand and model this role? For clarification, this section introduces three different modeling approaches (see Table I), here called financial analysis, reflexivity, and systems analysis.
### Table I. Approaches to Understanding Risks Related to the Financial Markets

| Rationale | Financial Analysis | Reflexivity | Systems Analysis |
|-----------|--------------------|-------------|-----------------|
| | Continuous improvement of tools for modeling and forecasting financial markets | Viewing financial markets as dependent on the interactions of human agents (who act upon their theories about the market) | Modeling the financial system as relations between agents (with a focus on banks) |
| Focus | Investments, finance | Interactions in financial markets | Networks (of banks) |
| Role of volatility | A risk component (due to uncertainty, complexity) to be explained and/or taken into account | Amplifier (due to the reactivity, reflexivity, and recursivity of financial markets) | No major role (epiphenomenon) |
| Methodological paradigm | Financial mathematics | Behavioral view | Physics, systems dynamics |
| References | Markowitz (1952, 1959); CAPM (Sharpe, 1964); Black and Scholes (1973); Hull (2018) | Shiller (1981, 2000, 2015); Haugen (1995); Mieg (2001); Soros (1987, 2013) | Battiston, Caldarelli (e.g., Battiston & Caldarelli, 2013); Haldane and May (2011); Renn et al. (2019) |
| Appraisal | Standard approach of professional finance | Nonstandard approach with focus on financial markets | Interdisciplinary risk analysis |

### 3.1. Setting Standards: Financial Analysis, Systems Analysis

The standard approach to volatility is financial analysis (see Table I) and is particularly marked by Markowitz’s portfolio selection theory (1952, 1959) and the capital asset pricing model (CAPM; Sharpe, 1964). The basic idea is to understand volatility as a risk component: the greater the risk, the greater the expected return. Portfolio theory and CAPM are both based on equilibrium assumptions as formulated in the hypothesis of efficient markets by Fama (1976, 1991). This hypothesis states that, in principle, securities markets are “rational” in that prices reflect the available information on securities—such as shares and bonds. The efficient-market hypothesis is an important working assumption for many financial professionals, as they consider market prices as best estimates for company values, including future return expectations.

Today, volatility is a key concern in hedging, that is, insuring eminent investments against fluctuations in the markets, for instance, in currency exchange rates. The core instruments are derivatives (e.g., options and futures) and a formula by Black and Scholes (1973) for pricing options by estimating risk and volatility (here: implied volatility). The Black–Scholes formula has become standard in financial economics and is the basis of the hedging industry (cf., Hull, 2018). Discrepancies between the volatility assumptions of Black and Scholes (1973) and real, observed volatility led to the development of the “volatility surface” (Gatheral, 2006), a multidimensional model for practical use in professional finance, which shows how implied volatility—contrary to the assumptions of the Black–Scholes formula—changes depending on the time to maturity (when an option has to be exercised).

There is much research into volatility in the context of financial analysis, particularly concerning its stochastic nature (e.g., Bandi & Renò, 2018; Gatheral, Jaisson, & Rosenbaum, 2018). It has become clear that different components of volatility might have to be analyzed separately, e.g., upside versus downside volatility (cf., Amengual & Xiú, 2018; Bekarta & Wu, 2000; Estrada, 2004). The general question remains unanswered: Can volatility be sufficiently explained as a homogeneous (Brownian) motion, for instance, caused by the comovement of assets of one industry? Or do we have to face “jumps” of volatility (e.g., Amiram, Cserna, & Levy, 2016), that is risk through the volatility of volatility (Huang, Schlag, Shaliastovich, & Thimme, 2019)? Basic research has been conducted into volatility and its components that even help resolve economic puzzles, e.g., by Wachter (2013) and Gabaix (2012).

After the global banking crisis of 2007–2008, considerable efforts have been made to model the system of finance, particularly the banking “ecosystems” (cf., Haldane & May, 2011). This systems modeling approach (cf., Helbing, 2013) is in line with
the global dynamic systems perspective proposed by Renn et al. (2019) for the analysis of systemic risks. Here, volatility plays no role or is considered an epiphenomenon (cf., e.g., Poledna, Molina-Borboa, Martínez-Jaramillo, Van Der Leij, & Thurner, 2015). The focus is on modeling contagion under complexity and interconnectivity of financial markets (e.g., Battiston & Caldarelli, 2013; Battiston, Caldarelli, May, Roukny, & Stiglitz, 2016). There is an explicit regard to systemic risk, which is understood as the risk of collapse of the financial system, and of its core function—to provide liquidity (liquid capital) for industries and communities. Unfortunately, there is not much overlap between the (systemic) risk literature from financial analysis on the one hand, and that from the systems analysis approach on the other, the first being discussed in The Journal of Finance and the Journal of Political Economy, the latter in Nature and Science.

3.2. The Nonstandard View: Reflexivity

A different view on volatility has long been proposed by Robert Shiller, who argues that there is more volatility in the markets than is explained by current models (cf., e.g., Shiller, 1981). In his Nobel Prize Lecture of 2013, Shiller remarked:

The history of thought in financial markets has shown a surprising lack of consensus about a very fundamental question: what ultimately causes all those fluctuations in the price of speculative assets like corporate stocks, commodities, or real estate? One might think that so basic a question would have long ago been confidently answered. But the answer to this question is not so easily found. (Shiller, 2015, p. 240)

We may depict Shiller’s approach as oriented on “overreaction,” a term coined by de Bondt and Thaler (1985) who investigated trading behavior that may lead to herding. In herding, financial experts orient one on another, which can create or intensify a trend (cf., Gärling, Kirchler, Lewis, & Van Raaij, 2009; Hirshleifer & Teoh, 2003). It is obvious that herding has sometimes played a role in market bubbles (cf., Shiller, 2015), from the Dutch “tulip bubble” of 1634–1637 to recent real estate investment bubbles (cf., Garber, 1990). In the following, I will address this view not as “overreaction,” but through the term “reflexivity,” coined by Soros (1987). As the next sections will show, reflexivity is about human interactions (basically cognitive and rational) in financial markets. I would like to expand on the interactions in financial markets by describing three characteristics: reactivity, reflexivity, and recursivity. They may provide an understanding of the kind of systemic complexity in financial markets that can produce and amplify volatility.

3.2.1. Reactivity

The trading and forecasting of stocks is highly reactive. Mieg (2001) showed that expertise concerning natural domains such as weather forecasting is fundamentally different from expert prediction processes within social systems. The difference is reactivity: The weather will not react to weather forecasts, whereas stock markets do react to expert forecasts, such as profit warnings or even rumors of such. Experimental evidence for interaction mechanisms leading to overreaction comes from Andreassen (1987, 1988, 1990), who conducted a series of experiments on how information provided by the financial press influenced investor behavior. He demonstrated that herding can result from causal attributions: The investor is given a reason (ex post) for why the change had to come (e.g., positive or negative news from a company), and acts on this information.

A great deal of the volatility in financial markets results from the microeconomic interactions of trading by the market participants (“diffusive” volatility, according to Amiram et al., 2016). Hull (2018), in his textbook on trading derivatives (that has become the reference work for professionals in that field), concludes his review of volatility studies: “The only reasonable conclusion from all this is that volatility is to a large extent caused by trading itself. (Traders usually have no difficulty accepting this conclusion!)” (p. 351). For instance, studies report that the introduction of a hedging instrument, mostly based on the Black–Scholes formula, increased volatility (Brock, Hommes, & Wagener, 2009; Sircar & Papanicolaou, 1998).

3.2.2. Reflexivity

The notion of reflexivity was introduced by Soros (1987, 2008, 2013), where “reflexive” means that two “functions” interact (Soros, 1987, p. 40): “the participants’ efforts to understand the situation” (cognitive function) and “the impact of their thinking on the real world” (manipulative function). Soros’ examples are boom–bust cycles (e.g., Soros, 2013, pp. 323–325), self-reinforcing market processes involving a bubble (boom), subsequently resulting in an accelerated crash (bust). Another example would
be investment theories, which can lose their competitive advantage when they become a standard strategy known to all traders. Haugen (1995) provided evidence that both classical approaches to investments in shares—first Graham and Dodd’s “Security Analysis” (1934/1951) and later Markowitz’s Portfolio Selection Theory (1952, 1959)—were valid until the moment they were published and became adopted as a new standard (however, Haugen’s view has remained unconventional). Following the 2008 crash of the global financial markets, the notion of reflexivity entered financial studies (cf., e.g., Shaikh, 2013; Wade Hands, 2013), with some studies employing tools derived from earthquake analysis (Filimonov & Sornette, 2012; Hardiman, Bercot, & Bouchaud, 2013).

Unexpected reflexivity in the market was a factor in accelerating the collapse of long-term capital management (LTCM), a US-based hedge fund (cf., Lowenstein, 2001). LTCM’s board of directors included Myron Samuel Scholes, Nobel Laureate and cooriginator of the Black–Scholes model. LTCM was founded in 1994 and invested in specific arbitrage deals. The Russian crisis of 1998, with fresh memories of the 1997 pan-Asian financial crisis, paralyzed the financial markets. Once rumors emerged concerning LTCM’s problems, other market participants—knowing LTCM’s strategy—left the arbitrage market or even bet against the LTCM strategy. In autumn 1998, as LTCM’s fortunes were intimately connected with those of all other actors on Wall Street, the Federal Reserve Bank of New York organized a bailout in order to prevent a collapse of the New York financial sector.

3.2.3. Recursivity

From a mathematical point of view, recursivity is based on a simple operation, consisting of a base (e.g., the number 0) and an iteration (e.g., add 1). The core mathematical operations (addition, multiplication, power function...) can be recursively defined, building one on another. In that way, recursive functions can become hypercomplex. The roles within financial markets also show recursive characteristics (cf., Hull, 2018; Mieg, 2001, pp. 38–40): If trading is considered the initial operation, then arbitrage would be a function of trading (capitalizing on differences in prices for a product traded in different locations or trading schemes), and hedging a function of arbitrage (relying on the ability to buy and sell derivatives used for hedging). Thus, we can say that most derivatives inherit recursivity to some extent, as they are derived from and based on other securities, such as options (based on shares) or a CDO (collateralized debt obligation), which is a financial instrument backed by an asset such as a mortgage or another CDO.

The main threat associated with recursivity stems from upscaling, i.e., leverage: By composing financial instruments, we can upscale financial activities, but with the potential for severe risks from default or downward price movements at higher levels (cf., e.g., Mirowski, 2012; Thurner, Farmer, & Geanakoplos, 2012). For instance, by leveraging equity of 4.72 billion USD, LTCM subsequently borrowed 124.5 billion USD (about 25 times equity) for derivatives with a notional value of 1.25 trillion USD (about 250 times equity). Similarly, the OECD (1991) feared that one cause of the 1987 crash might have been volatility spillovers from leveraged derivatives markets to the stock market. Spillovers from (even normal) volatility at a higher level can increase risks at any lower level.

4. CASE 1: VOLATILITY IN MAJOR FINANCIAL CRISES, 1987–2008

Sections 4 and 5 present two case studies on systemic risk in finance. The first case study focuses on the role of volatility in the three major financial crises of 1987, 1997, and 2007–2008. Table II provides an overview. As this case demonstrates, volatility spillovers have become a “new normal.”

4.1. The 1987 Stock Market Crash

On October 19, 1987, the U.S. stock market almost collapsed. The Dow Jones Industrial Average fell 508 points to 1,738.74. This 22.6% decline in a single day exceeded the 12.8% fall on so-called Black Friday (October 25, 1929) that triggered a worldwide economic crisis. The 1987 crash has since been widely analyzed. To summarize the findings using a metaphor: The 1987 crash was an earthquake within the global stock market system (cf., Arshnapalli & Doukas, 1993; Malliaris & Urrutia, 1992; Sornette, Johansen, & Bouchaud, 1996), which revealed and perhaps reinforced its global linkages. Volatility spillovers played a role within the system but did not really affect national economies. Conditions returned to normal levels quicker than expected (Schwert, 1990).

No single cause or set of causes has been identified for the 1987 crash. There is consensus that it
Table II. Major Financial Crises 1987–2008 and the Role of Volatility

| Description | 1987 Stock Market Crash | 1996–1997 Asian Financial Crisis | 2007–2008 Global Banking Crises |
|-------------|-------------------------|---------------------------------|-------------------------------|
| Causes      | On October 19, 1987, the U.S. stock market almost collapsed (Dow Jones Industrial Average fell by 22.6%). | Financial crisis of South Asian states (Thailand, Indonesia, South Korea, …); Devaluation of national currencies | Crash of the U.S. subprime mortgage market, followed by a global banking crisis |
|             | – Liquidity problem; – Malfunctioning of arbitrage; – Systems trading? | – Lack of institutional reforms? – Panic among international investors (herding) | – Misguided intervention in property market by U.S. Government; – Uncontrolled derived investments (CDO, CDS, overrating, …); – Distrust in the banking system |
| Consequences| – Affected the global system of stock markets; – Intensified the linkages between stock markets | – A regional economic crisis; – A subsequent global stock market crash | – Global economic recession; – Intensified networks of markets (e.g., stock markets and commodities); – Volatility spillover as “the new normal” |
| Role of volatility | – Spillover between stock markets | – Volatility contagion | – Intensifying the networks |
| Systemic risk: risk to the system | Confined to stock markets | Economic destabilization | Threat of a collapsing banking system |
| Systemic risk: structural (systemic) risk in finance | Role of arbitrage? | Herding | Amplifying effect of CDO, CDS, etc. |
| Conclusion | An “earthquake” (or a “cough”) within the global stock market system | A regional problem of economic and institutional transformation under the condition of globalization | Finance as a necessary but risky component of the globalized economy |

started with a growing liquidity problem in the preceding months (Amihud, Mendelson, & Wood, 1990; Carlson, 2007). In the days prior to the crash, stock prices were already decreasing. Problems were triggered or exacerbated by failure in the system that links stock markets and futures pricing, with arbitrage functions being disturbed (cf., Antoniou & Garrett, 1993; Carlson, 2007).

Volatility spillovers were discussed: they concern the inner-systemic association between the stock market and the futures market, in particular with reference to index futures (Antoniou & Garrett, 1993; Harris, 1989); that is, futures that cover the stock market index. As to volatility spillovers and arbitrage with index futures, the 1991 OECD report contains two totally divergent assessments:

(1) Index arbitrage supports the balancing of different financial markets; the absence of such arbitrage was one cause of the 1987 collapse (the London point of view);

(2) On the contrary, index arbitrage can be a source of market destabilization—by transmitting volatility from the derivative market to the cash market (the New York point of view).

4.2. The 1997 Asian Financial Crisis

The Asian financial crisis of 1997 was also a phenomenon of economic and institutional transformation. States such as South Korea and Thailand achieved considerable economic development during the 1980s, and had become accustomed to high growth rates and steady foreign investments. However, in the mid 1990s, some of the South Asian countries were found to be highly indebted. In July 1997, the Thai Baht came under pressure. This triggered panic among international lenders (cf., Boyer, Kumagai, & Yuan, 2006), who withdrew credits,
leaving the country almost bankrupt. The same happened to Indonesia and South Korea, and many South Asian countries were affected. In contrast to the 1987 crash of stock markets, this time the entire economies of these countries suffered, resulting in political crises.

The first postcrash analyses were published as early as 1998. Some focused on herding behavior among international investors, in combination with the unfortunate role of international institutions such as the International Monetary Fund (e.g., Khan & Park, 2009; Radelet, Sachs, Cooper, & Bosworth, 1998). Other analysts emphasized the region's fundamental economic problems at that time (e.g., Corsetti, Pesenti, & Roubini, 1999; Haile & Pozo, 2008). Some studies also examined issues of “financial contagion” (e.g., Kodres & Pritsker, 2002).

In the context of analyzing the volatility involved, we find studies on volatility “transmission” (In, Kim, Yoon, & Viney, 2001) or volatility “spillover” (e.g., Caporale, Pittis, & Spagnolo, 2006) mostly among South Asian stock markets. Some spoke of volatility contagion (Chakrabarti & Roll, 2002), and this metaphor emerged as the common denominator among analyses (Claessens & Forbes, 2001). Postanalyses showed that spillover even increased after the recovery period (Wu, 2005). More importantly, Baur (2003) demonstrated that contagion among the Asian markets was not simply correlated with movements in different markets but was indeed induced by high volatility.

4.3. The 2008 Globalized Banking Crisis

The financial crisis of 2008 can serve as a tale of how well-intentional political intervention—executed through a barely regulated financial industry—can lead to disaster, including a global banking crisis. In this case, the good intentions were to enable even low-income households in the United States to buy their own home, with the secondary benefit of providing old-age support besides pensions. The U.S. Government provided support for mortgages; the financial industry repackaged these mortgages into leveraged financial products and sold them worldwide. It was clear that these investment products were of poor (subprime) quality, due to comparatively high risk of default by the original mortgage borrowers. However, these efforts were backed on the one hand by the U.S. Government, and on the other hand by an instrument that appeared to provide insurance: credit default swaps (CDS). However, in contrast to a real insurance company, CDS were not backed by sufficient equity or capital. These again represented highly leveraged contracts built on trust. Not surprisingly, the collapse in the market for these subprime products immediately resulted in a banking crisis, as many of the banks also lacked sufficient equity. As the collapse of the banking system would heavily impact developed economies, governments around the world decided to bail out the banks with public money, leaving nations highly indebted after the crisis.

After the 2008 crisis, new techniques were developed to measure volatility spillovers (Diebold & Yilmaz, 2009, 2012). Several studies of the crisis showed how volatility was transmitted from New York to other financial centers (e.g., Zhou, Zhang, & Zhang, 2012) and to other markets such as commodities like wheat (Diebold & Yilmaz, 2012). Volatility spillovers are larger for developed markets than for emerging markets (Bala & Takimoto, 2017). Volatility itself returned to precrisis levels shortly after the 2008 crisis (Schwert, 1989, 2011). However, despite all efforts by national governments, the general levels of volatility spillovers between commodity and stock markets remain high, compared to precrisis levels, in many developed and emerging countries. Volatility spillover effects seem to have become “the new normal” (Varadar, Coşkun, & Yelkenci, 2018).

5. CASE 2: THE REFLECTION OF SYSTEMIC RISK IN THE JOURNAL OF FINANCE, 1998–2019

How is systemic risk reflected in financial analysis? For an in-depth analysis, all issues of The Journal of Finance were searched from 1998 to 2019.1 The Journal of Finance is one of the leading academic journals on financial analysis and is widely consulted by academic, governmental, and financial actors. The

1The analysis is based on a search of the Web of Science database beginning from the year 1998 (using search terms such as “systemic risk,” conducted in February and March 2020). A longer search period, starting in the 1970s, would have been even more interesting. However, in 1998 The Journal of Finance changed its publication strategy, including an increase from five to six issues per year. Moreover, articles before 1994 were not originally published electronically, and were made accessible only ex post with a reduced indexing. From 1998 onward, the number of items listed per year (mainly articles) ranges from 60 (in 2011) to 97 (in 2000 and 2003) with an arithmetic mean of 84.9. To get a broader overview, the search of The Journal of Finance was complemented by a general search of the terms “systemic risk” and “finance” or “financial markets,” respectively.
journal was established in 1946 and is published bimonthly on behalf of the American Finance Association. It published all the key papers on portfolio theory (Markowitz), the CAPM (Sharpe), and the efficient market hypothesis (Fama). If a concept seems relevant to finance, we would expect it to appear in The Journal of Finance.

To start with, “systemic risk” is not covered as a topic in The Journal of Finance, and is only listed four times during the search period, starting in 1986 with the review of the book “International Debt: Systemic Risk and Policy Response” (Cline, 1984). This was followed in 1997 by another book review; and, after the Asian financial crisis, with an article by Das and Uppal (2004), entitled “Systemic Risk and International Portfolio Choice.” The authors understood systemic risk in the terms of financial analysis, as “the risk from infrequent events that are highly correlated across a large number of assets” (p. 2810). The next topical paper (Caballero & Simsek, 2013) addressed “systemic events” but did not use the term “systemic risk” except with reference to the seminal paper by Allen et al. (2010). In contrast, “systematic risk” appeared 38 times since 1972 in The Journal of Finance (e.g., Babenko, Boguth, & Tserukevich, 2016). “Systematic risk” may appear similar to “systemic risk,” however, it is a technical term in finance, referring to covariance with a market or market segment; it presents a risk “that cannot be diversified away” (Hull, 2018, p. 859) and is key to the CAPM approach.

Even though the keyword “systemic risk” does not occur in The Journal of Finance, the topic of systemic risk is discussed, represented as the threat of collapse of the financial system, or as “risks to the system as a whole” (cf., Besley & Hennessy, 2009). As seen in Fig. 1, the topic of “crisis” (here synonymous with collapse, etc.) has a pronounced increase in frequency since 1998 in The Journal of Finance. Fig. 1 also shows that “contagion” plays a role, most often linked to the crisis category (16 of 26 articles during 1998–2019 refer to both contagion and crisis), but also linked to contagion in case of bankruptcy of single firms (e.g., Benmelech & Bergman, 2011). To provide a benchmark and baseline, Fig. 1 displays the coverage of volatility (the present topic) and liquidity (a basic topic in finance), which fluctuates but does not really increase.

The role of volatility in financial crisis seems a constant issue in The Journal of Finance. The frequency of “volatility” increases when articles address crisis (volatility occurs in 15% of all Journal of Finance articles during 1998–2019, and in 19% of crisis-related articles); however, the frequency of “liquidity” increases even more (from 18% to 28%). Examining the most recent papers on volatility and crisis, there is a great variety of ways in which

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2The situation is even more pronounced in The Journal of Political Economy (another top finance journal), which only mentions “systemic risk” once across all publication years. However, there is some coverage in The Review of Financial Studies, with 19 topical articles since 2002, including the seminal paper on “Measuring Systemic Risk” by Acharya, Pedersen, Philippon, and Richardson (2017).

3“Crisis” here includes the variants “catastrophe,” “collapse,” “crash,” “crises,” “depression,” “disaster,” “shock,” and “turmoil.” It does not include “bankruptcy,” as this term generally refers to the failure of single firms, being a necessary element of a capitalistic economy. The peak in 2013 is not, as one might assume, due to a special “crisis” issue; rather, it stemmed from an increase in crisis-related papers throughout the year.
Volatility might trigger crisis, covering for instance, intraday jumps (Bates, 2019), volatility-induced effects of political uncertainty (Kelly, Pástor, & Veronesi, 2016), or undiversifiable risks related to increased volatility induced by exchange-traded funds (ETFs) (Ben-David, Franzoni, & Moussawi, 2018).

6. DISCUSSION

The two case studies show that systemic risks are an issue in finance, without being consistently or specifically related to the term “systemic risk.” Moreover, volatility seems to play a variable role (being more or less systematic) in systemic risks; however, this role has not been addressed or clarified to date. We will discuss, first: Does volatility also contribute to systemic risk (Section 6.1)? Second: Do financial markets create structural systemic risks, and how is volatility involved (Section 6.2)?

6.1. Volatility as a Transmitter of Systemic Risk

The first case study, on the role of volatility in major financial crises, demonstrated that volatility can be considered as a trigger and cause of crisis, e.g., via spillovers to domains linked to financial markets (e.g., low- and middle-income countries). The 1987 crash appeared to be a technical breakdown of the financial system with no spillovers to the economies, whereas subsequent crashes revealed more links to economic crises; the 2008 crash resulted in a global recession. Some studies emphasized that it is the transmission of volatility that imposed wider troubles (e.g., Baur, 2003).

The risks transmitted through volatility can become systemic, as defined by Renn et al. (2019): they spread globally and are highly interconnected. We saw that with every large shock or crisis, the international and transboundary volatility channels deepened, spreading volatility from centers of global finance (New York) to the periphery. The volatility channels resemble wadis, i.e., dry river beds in a desert that come to life only in rare periods of rain, but which deepen each time water flows through them.

As both cases studies showed: The threat of volatility is at least twofold in its nature. One aspect is the sheer amplitude of fluctuations, which various agents (nations, individuals, companies) struggle to cope with. The other aspect is the triggering effect of volatility, for instance triggering intraday price jumps in securities (Bates, 2019) or contagion in less-developed economies (Bekaert et al., 2014; Calvo & Reinhart, 2000).

6.2. Is There a Structural Systemic Risk in Finance?

Is there a structural systemic risk in finance? There is consensus in the literature that leverage is a specific characteristic of financial markets that increases risk and volatility. This is corroborated by studies from the perspectives of both financial analysis—e.g., of ETFs as new leveraged investment tools (Ben-David et al., 2018)—and from a systems analysis view—e.g., on leverage in banking (Thurner et al., 2012). As discussed in Section 3.2.3, the possibility of leverage is based on recursivity, which increases complexity (cf., Elsner, 2017; Mirowski, 2012).

However, as the second case study showed, the role of volatility in triggering risk is not self-evident. More often the focus is on liquidity. From this perspective, volatility is just a signal for changes in liquidity provision (e.g., Glosten & Milgrom, 1985). For Asian states (during the Asian crisis of 1997) and banks (in the global banking crisis of 2008) liquidity provision was the most obvious problem.

Structural systemic risk in finance and its linkage to volatility become more obvious when we examine reflexivity. Reflexivity, that is to act upon the best (personally available) theory, is fundamentally human. Under conditions of complexity and competition, reflexivity may lead to counterintuitive (or at least unintended) effects, such as the decreasing validity of standard investment theories, as Haugen (1995) argued, or the increased probability of crisis in periods of low volatility (Danielsson et al., 2018), triggered by increased risk-taking. In connection to volatility, recursivity and leverage might constitute a more obvious risk factor; however, reflexivity, as argued by Soros (1987, 2013), might be the structural component that makes financial markets different from others, such as environmental systems.4

4A key to understanding reflexivity in finance could be to see that the system of finance appears to be based on the accumulation of wealth and value, but in reality is constructed as a contractual system of debts (cf., Mieg, 2001, pp. 107–109; Soros, 1987, pp. 81–88). That is, the system of finance has an implicit time- and uncertainty component: by when can a debt be repaid, if at all? Minsky (1995) argued that financial fragility is a normal consequence of risks in lending processes of a capitalist economy. No wonder, then, that the first mention of systemic risk in finance was concerned with debts (Cline, 1984).
To conclude: Volatility is linked to systemic risk; however, it is not an easy signal to act upon. We only know that we should avoid excessive volatility (and overreaction), as many actors struggle to adapt to such conditions. In the context of systemic risks, volatility—or volatility spillovers, respectively—might serve as a kind of precautionary signal for a system’s lack of resilience, both for financial markets and companies. Volatility is like the sound of the sea: we may be inclined to ignore it as mere background noise. Nevertheless, we must remain aware of volatility, or else risk being surprised by a tsunami.

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