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**Derivatives, financial fragility and systemic risk: lessons from Barings Bank, Long-Term Capital Management, Lehman Brothers and AIG**

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# **Derivatives, financial fragility and systemic risk: lessons from Barings Bank, Long-Term Capital Management, Lehman Brothers and AIG**

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## **Abstract**

This paper aims at analysing the relationship among derivatives, financial fragility and systemic risk by discussing the role played by these financial instruments in the collapse or near-collapse of Barings Bank, Long-Term Capital Management (LTCM), Lehman Brothers and AIG. We investigate in which ways derivatives contributed to the build-up of systemic risks in these experiences according to a Post-Keynesian perspective, which is focused on the Minskyian concept of financial fragility and Cardim de Carvalho's analysis of contagion and systemic risk. Our analysis points out that derivatives' embedded leverage played a pivotal role in fragilizing the financial positions of Barings, LTCM and AIG, and a supporting role in Lehman's failure, accelerating its financial debacle. While Barings' failure did not cause contagion nor systemic consequences via derivative markets, in the case of Lehman derivatives worked as a major mechanism of contagion and contributed to the materialization of a systemic crisis. Yet, concerns on potential contagion effects via derivatives in the cases of LTCM (indirect) and AIG (direct) provided reasons for setting up the bailouts that avoided the collapse of these institutions. Finally, we highlight that, if speculative and Ponzi financing positions are widespread, instead of cushioning financial shocks, derivatives might fragilize even more financial institutions and disseminate difficulties among the financial system, therefore contributing to a systemic crisis to take place.

**Keywords:** Financial Crisis; Financial Fragility; Contagion; Systemic Risk; Derivatives; Barings Bank; LTCM; Lehmann Brothers; AIG.

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## 1. INTRODUCTION

In 1995, one of the pioneers of merchant banking in the world, Barings Bank, declared bankruptcy after accumulating huge losses in derivatives (rogue) trades in its Singapore unit. Three years later, the far-famed U.S. hedge fund Long-Term Capital Management (LTCM) collapsed in the wake of the late-1990s emerging market crises, forcing the Federal Reserve Bank of New York to set up a bailout through 14 major U.S. banks to avoid a major financial disruption. In 2008, the 164-year old U.S. bank Lehman Brothers sought Chapter 11 protection, i.e. filed for bankruptcy, inaugurating the major economic breakdown since the Great Depression in 1929. Almost coincidentally with Lehman, the U.S. based insurance firm American International Group (AIG) was about to collapse when the U.S. government intervened and bailed AIG out, to avoid another round of financial meltdown.

Those episodes were determined by the huge changes that took place in the global financial system during the 1990s and the 2000s. Financial conglomerates were formed by the means of mergers and acquisitions, concentrating, at the same time, the provision of commercial banking, investment banking and insurance services. As part of the same process, they expanded their frontiers geographically developing activities outside of their original jurisdictions. Finally, there was also a tremendous increase in importance of new and more complex products, such as securitization and financial derivatives. Therefore, it is not a surprise that bank runs and stock market crashes that had threaten financial stability for centuries were replaced by other sorts of events, with other protagonists, and new and more complex problems.

This paper aims to analyse what is the role played by derivatives in episodes of (actual and potential) systemic crises through the lens of a Post-Keynesian analytical framework. With this purpose our methodology is to analyse the collapse or near-collapse of Barings Bank, LTCM, Lehman Brothers and AIG. All these four cases share two things in common. First, these events are commonly labelled as the most significant ‘systemic events’ originated in the financial system<sup>1</sup> in the last decades. Not all of them open the flood gates of a major financial crisis, but the mainstream view about those episodes suggest they posed an actual threat to global financial and economic stability. Second, it can be noticed that they were directly related to financial derivatives.

More specifically, we depict the four cases and analyse in more detail the participation of derivatives in the process and causes of those financial problems and their spill-overs. For this purpose, we develop an analytical framework based on the works of Minsky (1975; 2016) and Carvalho (2015), centred in the concepts of ‘financial fragility’ and ‘systemic risk’. This framework reflects the view that systemic crises are endogenously gestated and widespread financial fragility contributes to their materialization. Based on this framework, we discuss in which ways derivatives contributed to the build-up of systemic risk in each of the four experiences, focusing on their effects on financial fragility and their influence on contagion and systemic risk.

The remainder of this paper is divided as follows. Sections 2, 3, 4 and 5 depict, respectively, the cases of Barings Bank, LTCM, Lehmann Brothers and AIG. Section 6 presents the concepts of financial fragility, direct and indirect contagion, and systemic risk and discusses the role

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<sup>1</sup> Other systemic episodes that prompted financial instability in financial markets in the last decades, such as the emerging markets’ currency crises and the dot-com bubble, have different origins and are explained by different processes (e.g. capital account liberalization) in comparison to the episodes analysed herein (Aliber and Kindleberger, 2015: Chapter 15).

played by derivatives in each of the four episodes in the build-up of financial fragility and systemic risk, and in fostering contagion. The conclusion closes the article<sup>2</sup>.

## 2. THE FAILURE OF BARINGS BANK

Barings Bank was found in 1762 in the City of London. It was the world's second oldest merchant bank and one of the most respected banks in the City, due to its tradition in international finance, business loans and securities underwriting. Over time, Barings' activities evolved into other bank-related businesses, such as commercial activities. The bank expanded its business into securities trading and brokerage in 1984, when it purchased a securities firm and founded Barings Securities Limited<sup>3</sup>.

Among the aims of Barings Securities was the expansion of Barings' businesses into the Asia Pacific region, especially, Japan, a rising power in the global financial arena in the 1970-80s. The bank operated through subsidiaries in Asia mainly as a broker dealer to its clients, though also conducting proprietary trading. Subsidiaries were established at Japan, Hong Kong and Singapore<sup>4</sup>. In particular, the Singaporean unit, Barings Futures Singapore (BFS), was established in 1987, with a seat at the Singapore International Monetary Exchange (SIMEX).

It was due to this Singaporean subsidiary that, in the 26th of February, 1995, Barings' long-lasting history has come to an end<sup>5</sup>. The bank collapsed after accumulating huge losses in derivatives. Transactions from a single trader, Mr. Nicholas Leeson, BFS's general manager and head trader since 1992, were responsible to bring the two-hundred-years-old bank down.

Mr. Leeson's derivative trading activity was focused on futures and options based on the Nikkei (the main Japanese stock index) and Japanese government bonds (JGBs). At one front, Leeson's trading strategy consisted at arbitraging futures prices (Nikkei and JGBs) among Tokyo, Osaka and Singapore exchanges, a risk-free though margin-consuming strategy – labelled as 'switching' (Stonham, 1996a).<sup>6</sup> At another front, the trader pursued aggressive strategies, using a combination of options and then taking long proprietary unhedged positions on the Nikkei (Gapper and Denton, 1996: Chapter 1).

Leeson, which started to work at SIMEX in July 1992, reported increasing profits from late 1992 to 1994. Those profits apparently came out of the 'risk-free' arbitrage strategy. The trader accumulated a lot of prestige in the market and with the banks' management – those profits resulting in large bonus payments to Barings' board and staff, himself included. However, the sums declared by Leeson revealed to be fictitious: the daily reports sent by Leeson were a piece

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<sup>2</sup> Additionally, Annex I presents some basic definitions and concepts about derivatives and the derivatives market, and discusses the role played by those instruments in the financial system and in the economy in general.

<sup>3</sup> Stockbrokers Henderson Crosthwaite.

<sup>4</sup> Other two subsidiaries were established at London and New York. The organisational chart could be found in HMSO (1995: 290).

<sup>5</sup> Barings Plc, a parent company of Barings Group (HMSO, 1995: 290).

<sup>6</sup> Arbitrage involves buying futures on one market and, simultaneously, selling them on another. The strategy is not risky because the long position in the first market is offset by the short position at the latter. Nonetheless, in futures exchanges, margin requirements are used as a cushion of safety for transactions. Margins are adjusted daily, with arbitrage traders having to commit large sums to cover loss-making contracts. However, exchanges do not pay cash on profit-making contracts. Therefore, the arbitrageur needs to wait until the profit-making contracts matures to match the results, funding this gap in the meantime.

of fiction and the profitable risk-free strategy was merely a fantasy (Gapper and Denton, 1996: 29).

The aggressive, risk-taking front of Leeson's transactions registered increasing losses, which were hidden via an account named Error Account 88888. This account was created by the back-office with the aim at avoiding trade reconciliation problems created by small numerous errors in the original Error Account 99905 (Drummond, 2008: 37-8; Leeson, 1997: 53). All the details on Account 88888 would be managed and sorted out by the Singaporean unit, not London. Leeson used this account to hide his mistakes as an inexperienced trader during his first months at the trading floor (1992) and then, as the strategy showed successful, to conceal all loss-making positions held by his unauthorised trades in the following years (Gapper and Denton, 1996: Chapter 8).

As pointed out by Stonham (1996b: 269): 'Leeson's unauthorised trading began almost from the time he took up his appointment in Singapore'. From the onset, Leeson was apparently arbitraging on Japanese and Singaporean exchanges, though he was taking long or short unhedged positions on derivatives. Yet, he was only allowed to trade options on behalf of clients but took increasing proprietary positions on Nikkei options, using high-risk strategies.

Leeson's view was that the Nikkei index 'would continue trading in the same narrow range that it had traded over recent months' (Stonham, 1996b: 271). Thus, he engaged in a derivatives strategy known as *short straddle* or *straddle write* on the Nikkei. A *short straddle* consists in the combination of two option contracts, selling a call and a put on an underlying asset with the same strike price and expiration date. As pointed out by Hull (2018: 265): 'If the stock price on the expiration date is close to the strike price, a profit results. However, the loss arising from a large move is unlimited.' Due to the possibility of unlimited loss, one can label this strategy as a high-risk transaction<sup>7</sup>.

However, the course took by events was the opposite than the one imagined by Leeson. The trader had major setbacks in the end of 1993 and, after a more favourable scenario during the first months of 1994, the Japanese stock markets inaugurated a period of instability. The losses then were mounting on Account 88888. In January 1995, a major downturn followed an earthquake in Kobe, Japan. Some days after the quake, the Nikkei 225 stock index dropped 1,000 basis points and the Japanese stock market engaged in an unstable downward path.

These events engendered huge losses to BFS, hidden in Account 88888. Though the results of this account were not reported, they demanded increasing margin calls. In an attempt to revert those losses, Leeson started to open large long positions in Nikkei futures, believing that those trades would be able to move the market in a favourable direction. BFS exposures became even larger and the bank become more vulnerable to market setbacks, since if this strategy was not successful it would create additional losses due to long positions in the futures market.

In addition, aiming to reduce margin requirements on the BFS portfolio, Leeson wrote puts on the Nikkei index. His probable understanding was that, given the intensity in the drop of stock prices, the expectations of market participants were that stock prices will not reach the same

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<sup>7</sup> Zhang (1995: 113-4) depicts the payoff of short straddles, while Hull (2018: 265) shows the payoff of long straddles. The sum of the call and put option prices changes positively with market volatility; when market volatility increases, the holder of the long position of the straddle gains and the straddle writer losses (Zhang, 1995: 148-9). Those losses are unlimited because there is no cap to movements in spot prices, which can highly deviate from strike prices at maturity.

levels that prevailed before the earthquake, which will therefore increase the price of put options. This price increase in put options would reduce margin calls from SIMEX<sup>8</sup>. With this tactic, he was also betting that stock prices would not fall even more, since if this occurred it would increase the risk that counterparties will exercise the options, and therefore would lift margin calls, achieving the opposite result.

The Nikkei index continued to plunge. As one would expect, the huge long exposures in futures entered into by Barings were not able to revert the market trajectory and jeopardized even more the bank's financial position. The combined effect of long positions on Nikkei futures and put options on collateral needs resulted in a major setback on BFS's ability to leverage, i.e. these exposures entailed growing margin calls. Until February 24, 1995, the Barings Group sent cumulatively £742 million to BFS in order to meet those margin calls, which represented approximately two times the bank's capital (HSMO, 1995: 97).

BFS actual financial situation was unravelled as the growing margin calls in January and February revealed that Leeson's positions were not from clients, but proprietary, and internal audits started to scrutinise reports and accounting information. Rumours on Barings' likely bankruptcy started to pop up. Market participants started to speculate about the effects of its bankruptcy on the markets the bank operated. After a failed attempt to reach a deal to save the bank, Barings Plc declared insolvent. The numbers at February 27, 1995, the day in which Barings officially collapsed, revealed that Leeson positions caused £827 million in losses (HSMO, 1995: 59) –against a capital base of about £480 million (Drummond, 2008: 2).

The Bank of England did not set up a government-funded bailout to save Barings, because of the very nature of its troubles<sup>9</sup>, though the Bank coordinated efforts to sort out the situation. Nor there was an agreement on a private-funded 'bailout' due to the uncertainty that surrounded the actual numbers of BFS's losses<sup>10</sup>. But the systemic effects of Barings collapse were feared: the consequences for the City of London were unknown; a loss of confidence in other merchant banks might follow; the collapse could also have domino effects on BFS counterparties; and the diplomatic relationship between Singapore and Britain might be damaged (Gapper and Denton, 1996: Chapter 1).

In the aftermath of the collapse, Barings' counterparties accumulated losses, as the bank defaulted on its positions on derivatives, but they were partially mitigated by the futures

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<sup>8</sup> The price of a put option is perfectly and negatively correlated to the price of the underlying asset: the more the price of the underlying asset increases in the spot market, the lower the probability of exercising this option. SIMEX adopted the Standard Portfolio Analysis of Risk (SPAN) methodology, which assesses the global risk embedded in an institution's exposure to derivatives, comprising futures and options markets. In the case of put options in which the premium is bigger than the required collateral, the exchange allows the participant to use this excess to cover margin requirements from other contracts. The strategy adopted by Barings assumed that the premia on put options will rise, thus creating a positive excess that could be rearranged to lower margin needs.

<sup>9</sup> Among the reasons that explain the monumental risk assumed by Barings, one can highlight the fact that the bank's management team gave little attention to issues related to operational risk: Leeson's boss did not exercise a strict control on his activities; Leeson was in charge for derivatives transactions while his wife worked on the accounting department, which should monitor his operations and exposures; this fact facilitated the procedures to hide the losses, forge documents and make operations without prior approval; an aggressive compensation scheme, which distributed bonuses for traders based on positive results achieved by the bank, but that had no relationship with the risks of their transactions.

<sup>10</sup> The uncertainty of information was also a result from the regulatory fragmentation to which Barings was subject. There was a lack of coordination among regulatory authorities of the three different countries involved in Barings supervision (HSMO, 1995: Chapter 12).

exchanges' risk management mechanisms<sup>11</sup>. Some turbulence was felt at the City and Asian financial markets, reinforcing the plunge of the Japanese stock market, but a systemic crisis did not take place. The financially fragile position of Barings was perceived as idiosyncratic, with a great deal of blame put on Leeson and the bank's management team. Moreover, there was no small depositors threatened by its bankruptcy and it was not perceived as 'too big to fail' (Lewis, 1995). The consequences of the collapse were, then, contained (Körnert, 2003: 206). The major setback was felt by the two-hundred-years-old financial institution itself: it was sold to the Dutch ING Group, a solid bank with a capital base of £9,100 million, for the nominal amount of £1.

Barings's collapse showed that the leverage provided by derivatives might boost financial profits but could also result in the accumulation of huge losses that might erode quickly the capital of a bank. Its failure occurred not only because of the frustrated bets on derivatives markets, but also to flaws in operational controls and management, and cross-border business regulations.

In the competitive environment fostered by financial globalization, banks such as Barings turned their operations to new markets and instruments, especially financial derivatives, seeking to boost their profits. Trading desks on derivatives were set up and proprietary trading on derivatives markets revealed a potential to make huge profits. Banks started to trade derivatives as speculators and the potential to make huge profits also revealed the potential to make huge losses. The systemic consequences of the Barings event were, notwithstanding, limited.

### **3. THE COLLAPSE OF LONG-TERM CAPITAL MANAGEMENT (LTCM)**

Financial globalization also brought to the scene of financial systems new players such as the so-called hedge funds. A hedge fund is a pooled investment vehicle administered by professional managers that is typically characterised by active strategies to earn extraordinary returns (alpha) for their investors, frequently using derivatives and leverage to achieve this result (Chesnais, 2016: 224-5; Hull, 2018: 12). Those vehicles became popular<sup>12</sup> from the late-1980s on, in particular, when famous traders, such as George Soros, set up their funds and started to deliver notable returns<sup>13</sup>. Another element that explains the popularity of hedge funds was the complete absence of supervision by regulatory authorities, which means that these vehicles have no regulatory burdens and no restrictions to invest and carry on their transactions.

John Meriwether, the former vice-chairman of Salomon Brothers, a Wall Street investment bank founded in 1910, set-up the hedge fund Long-Term Capital Management (LTCM), incorporated at the U.S. state of Delaware and based on Connecticut. LTCM began trading at February 24, 1994. Mr. Meriwether recruited well-known traders and famous economists, such

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<sup>11</sup> See supra notes 3, 4 and 5.

<sup>12</sup> Among wealthy investors, such as wealthy individuals, institutional investors and financial institutions.

<sup>13</sup> There are registers from hedge-fund-like investment vehicles before the 1990s. The term hedged or hedge fund dates back to 1949 when Alfred W. Jones set up an investment pool to implement new portfolio management strategies, based on short selling, leverage and hedging. Nevertheless, hedge funds escalated in importance only when financial globalization took place. In a first moment, wealthy individuals were the main investors of these vehicles, but over time the set of investors expanded into other institutional investors, such as pension funds, and banks.

as Robert C. Merton and Myron S. Scholes, two of the main references in finance<sup>14</sup>, as LTCM's principals (Lowenstein, 2001: Chapter 2).

LTCM had a prominent position among hedge funds not only due to the stellar reputation of its team, but also because its large initial capitalization, US\$ 1.3 billion. This position was also influenced by the spectacular results achieved in the first two full years of operation: LTCM produced (net) returns on equity of 43% and 41%, respectively, in 1995 and 1996, results far greater than the returns of the main U.S. stock indexes<sup>15</sup>. The fund's capitalization had grown to over US\$ 7 billion by late 1997 (Edwards, 1999: 197). However, few months later, in the wake of the Russian moratorium in August, 1998, LTCM was about to collapse. This would be the course of events if 14 major U.S. banks, backed by the Federal Reserve, did not capitalize the fund, and avoid a major setback in global financial markets.

LTCM was an archetypal, traditional hedge fund (Walter and Krause, 1999: 20). The fund's strategy was *market neutral*, i.e. it seeks to profit from both increasing and decreasing asset prices, acting in numerous markets around the globe and transacting various asset types. LTCM looked for price anomalies among assets, focusing primarily on fixed-rate instruments, and exploit these anomalies with the help of derivatives and leveraged investments in securities. Due to this strategy, the fund's returns were (expected to be) highly independent of market developments (Walter and Krause, 1999: 21).

LTCM engaged in an investment strategy known as *convergence arbitrage* (Hull, 2018: 34). The fund speculated in narrower interest rate spreads in bond markets, among assets with different liquidity and credit risks<sup>16</sup>. Following Walter and Krause (1999: 26-7), LTCM's strategy can be described as the combination of long positions in assets whose prices it judged to be undervalued and have potential to rise (e.g. mortgage-backed securities), and short positions in assets whose prices are considered to be overvalued (e.g. U.S. government bonds). For instance, LTCM bet in a convergence between interest rates of on-the-run and off-the-run U.S. government bonds<sup>17</sup>, and among interest rates of U.S. government bonds and other emerging market bonds, Russia among them.

Derivatives instruments were also a centrepiece to LTCM's activities. LTCM took on interest rate and stock index futures positions on the major futures exchanges around the globe, and also entered into OTC derivative contracts with 'several dozen counterparties', via swaps, forwards and options on interest rates and equity markets (PWGFM, 1999: 11). According to the BIS (1999: 39), LTCM was 'perhaps the world's single most active user of interest rate swaps.' In particular, 'A few of the futures positions, both on U.S. and foreign exchanges, were quite large (over 10 percent) relative to activity in those markets.' (U.S. GAO, 1999: 198).

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<sup>14</sup> It is worth mentioning that, later on, Merton and Scholes won together the 1997 Nobel Memorial Prize in Economic Sciences, given by the Sveriges Riksbank, due to their contribution in derivatives pricing.

<sup>15</sup> For instance, the S&P yielded returns of 35% and 20%, respectively, in 1995 and 1996.

<sup>16</sup> Hull (2018: 34) provides the following example of convergence arbitrage: '[An investor] would find two bonds, X and Y, issued by the same company that promised the same payoffs, with X being less liquid (i.e., less actively traded) than Y. The market places a value on liquidity. As a result the price of X would be less than the price of Y. LTCM would buy X, short Y, and wait, expecting the prices of the two bonds to converge at some future time.'

<sup>17</sup> 'On-the-run' and 'off-the-run' refer to the benchmark status of a particular U.S. government bond. As Walter and Krause (1999: 27) define: 'Bonds with benchmark status (on-the-run) are included in bond indexes that several investors use. When a bond falls out of the index (off-the-run), trading and thus liquidity therefore often diminish.'



Those derivatives provided the leverage needed to set up some positions and allowed for adjustments on the risk profile of investments<sup>18</sup>. For instance, the convergence arbitrage strategy was operationalised directly in (spot) bond markets, but also ‘indirectly,’ by means of financial derivatives that replicated the strategy without compromising cash from the start (Edwards, 1999: 198). The fund’s managers also have taken positions on options betting on the decrease of volatility in equity markets, shorting options on the S&P 500 and the major European stock indexes (Lowenstein, 2001: 124) and using *short straddles* (Walter and Krause, 1999: 26-27).

One curiosity about LTCM’s over-the-counter derivatives portfolio was that the hedge fund often collateralised its bilaterally cleared transactions (PWGFM, 1999: 18; Hull, 2018: 34). As we have seen, margins are not used quite often in OTC derivative contracts but LTCM opted to add this cushion of safety to its transactions<sup>19</sup>. However, as Hull (2018: 3-5) argues: ‘They did provide credit protection, but [...] the high leverage left the hedge fund exposed to other risks.’ In a later moment, margin calls contributed to LTCM’s liquidity problems.

LTCM’s funding patterns also elucidate why the fund near-collapsed. Its investments were mainly funded by securities financing transactions, under the form of repos and reverse repos. The fund used repos to build-up positions with little capital investment. Repo is an abbreviation for ‘repurchase agreement’, a transaction that consists in selling a security to a third-party with the compromise to repurchase it in the future, at a given date and by a given price<sup>20</sup>.

In practice, repos are short-term instruments that resembles secured loans. They consist in a two-step operation. First, the seller, e.g. a bank, provides cash against the buyer’s collateral, securities that are deposited in the bank, the proper haircuts applied. Second, when the repo falls due, the seller returns the cash and pays a small interest rate, getting the securities pledged as collateral back. Walter and Krause (1999: 27-29) show that LTCM built up long positions in riskier bonds using repos, and short positions on less risky bonds using reverse repos<sup>21</sup>.

As long as repo markets worked smoothly, LTCM could achieve its positions with little capital investment. Traditionally, repos have been short-term instruments, with an average term to maturity from one to three days, but, under normal market conditions, they can be renewed and used as a constant source of funds. Then, the hedge fund relied on those short-term sources of finance at the cost of an increase in leverage and financial fragility.

The positions and actual exposures assumed by LTCM, including the degree of leverage, resulted a great deal from the use of statistical models based on historical data (Walter and Krause, 1999; Allington et al., 2012). The market turbulence derived from the Asian crisis and the Russian moratorium greatly frustrated LTCM’s forecasts and expectations. Following the Asian problems, volatility has increased, interest rate spreads widened and liquidity shrunk, whilst LTCM was short in volatility, betting in narrowing spreads and relying on short-term liquidity to finance its positions.

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<sup>18</sup> See Lowenstein (2001: Chapter 7) for a depiction of LTCM’s option and swap strategies.

<sup>19</sup> However, other risk-management mechanisms usually provided by exchanges/CCPs, such as contingent claims and clearing funds, were not in place (see supra notes 3, 4 and 5).

<sup>20</sup> From the viewpoint of the original seller, we can call this transaction a repurchase agreement (repo); from the viewpoint of the original buyer it consists in a reverse repurchase agreement (reverse repo).

<sup>21</sup> A reverse repo is a type of secured lending: the originator lends money to a third-party against collateral (a security), with the compromise to return the collateral when the borrower pays him back.

As Walter and Krause (1999: 36) argued: ‘The probability of a Russian debt moratorium and the resulting panicked flight to quality and liquidity in financial markets was certainly very small, according to calculations based on historical data – but it still happened.’ Speculative attacks on the ruble happened in the aftermath of the Asian crisis, at November 1997, April 1998 and August 1998, when the Russian government eventually ‘devalues the ruble, defaults on domestic debt, and declares a moratorium on payment to foreign creditors.’ (Chiodo and Owyang, 2002: 10).

The Russian crisis led to a flight for quality, in which agents seek to reduce their exposures to risks and move towards highly liquid assets. Market liquidity shrunk and volatility soared, with interest rate spreads widening among different asset classes. This turn of events prompted huge losses to LTCM. At the onset of 1998, LTCM’s net asset value was US\$ 4.67 billion<sup>22</sup>. By August, right after the Russian default, this indicator declined to US\$ 2.3 billion; by mid-September, the net asset value shrunk to US\$ 600 million – the hedge fund had lost about 90% of its equity (U.S. GAO, 1999: 39-40; Edwards, 1999: 199).

In view of the size of LTCM’s positions and the involvement of large banks in the funds’ transactions, there were fears that, if the fund collapsed, impacts would not only occur in balance sheets of its counterparties<sup>23</sup> but also might cause a major disruption in financial markets (PWGFM, 1999: 17). The breakdown would be felt on all the markets in which LTCM had operations. Margin calls and increasing haircuts would have forced market participants to wind down their more illiquid positions in favour of cash-like instruments, creating the possibility of fire sales and a massive asset deflation. This scenario would create even more pressure on the already disrupted financial markets, reinforcing financial instability and, potentially, prompting a systemic crisis.

As argued by Allington et al. (2012: 559-60), the Federal Reserve’s view was not that LTCM was too big to fail – direct exposures from major U.S. banks are not negligible but they are not that big to threaten the solvency of these institutions – but that the hedge fund was too-interconnected to fail – LTCM’s collapse would have spread through many markets, causing major disruptions<sup>24</sup>.

Therefore, concerns on those potential consequences led the Federal Reserve Bank of New York to organise a consortium of banks to recapitalize LTCM and, thereafter, allow LTCM’s positions to be sold in a controlled manner (Lowenstein, 2001: Chapter 10). The consortium, formed by 14 major U.S. banks, backed by the FED, injected US\$ 3.6 billion into the fund in the end of September and avoided the collapse of the institution (U.S. GAO, 1999: 44-5). The hedge fund was then able to progressively wind down its positions without greater impacts on financial markets and a major systemic crisis has been avoided. LTCM was officially liquidated and dissolved in early 2000.

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<sup>22</sup> At the end of 1997, when LTCM’s capital reached over US\$ 7 billion, the fund returned US\$ 2.7 billion to its investors, ‘claiming diminished investment opportunities’ (Edwards, 1999: 197).

<sup>23</sup> Moreover: ‘Those firms relying on collateral posted by LTCM, particularly the counterparties to OTC derivatives trades with the LTCM Fund, generally did not demand collateral based upon calculations of potential future exposure. If its collateral holdings did not reflect potential future exposure, then a firm selling collateral provided by LTCM in the event of a default would still have been exposed to the difference between the value of the collateral and the value of the closed-out financial contract at the time the collateral was sold. Given how much financial markets can shift — and the extremely unsettled market conditions last September — these types of losses could have been considerable in the event the LTCM Fund had defaulted on its obligations.’ (PWGFM, 1999: 18).

<sup>24</sup> See also Walter and Krause (1999: 41).

The LTCM experience shows that derivatives and repo transactions are instruments that may work as major sources of leverage and financial fragility, and potentially relevant mechanisms of contagion. These instruments allowed aggressive risk-taking by the fund, even though they are not the sole causes of the hedge fund near-collapse. As argued by Lowenstein (2001: 229): ‘Perhaps the fund’s entire strategy had been wrong, and the world’s (and Long-Term’s) perception of credit in 1998 had been a little too rosy.’

Other factors also played a role in this history. The obtuse volume of the major U.S. banks’ exposures to LTCM unveiled inappropriate counterparty credit risk management practices. The lack of transparency in hedge funds operations, as these vehicles were not under the regulatory umbrella of U.S. authorities, and in OTC derivatives and repo markets partly explains why banks were not able to correctly assess their exposure to LTCM’s risks. But, in a reasonable scenario, this lack of information would prompt conservative risk management practices, which did not happen (Walter and Krause, 1999: 36).

In addition, risk assessment models were unable to forecast unexpected market movements such as the Russian debacle, which break historical correlations. Allington et al. (2012: 563) argued that: ‘The difficulty was not that LTCM used the wrong underlying distribution when markets were normal, but that it could not model the probability of extreme events.’ Moreover, as many financial entities shared the same type of risk assessment models, all market participants tended to behave simultaneously in the same way (herd behaviour), strengthening market volatility<sup>25</sup>.

#### **4. LEHMAN BROTHERS BANKRUPTCY**

The U.S. bank Lehman Brothers started in 1845 as a small store in the business of cotton goods in the rural landscape of Montgomery, Alabama (Williams, 2010: Chapter 2). Lehman banking inclination started as a response to the lack of banking businesses and credit supply in its state, filling a gap by extending credit to its customers. The institution also started to trade on cotton markets, partly as a hedging activity to its business. By 1912, Lehman abandoned cotton trading and focused in securities underwriting, formally becoming an investment bank. In the 1960s, the bank ranked among the top four investment banks, a position that was lost only in 2008, when Lehman Brothers sought Chapter 11 protection, filing for bankruptcy, and ceased to exist.

In the securitization market, during 1990s, as the largest commercial banks had gained their own securitization skills, investment banks were impelled to move somehow into mortgage origination to guarantee a supply of loans they could securitize and sell. They then implemented different strategies. Lehman Brothers answered to the commercial bank competition that was established, particularly in the so-called subprime<sup>26</sup> lending, by pursuing, from 1998 to 2004, an aggressive strategy, under a vertically-integrated model. Lehman guaranteed its large mortgage origination arm by purchasing six different domestic lenders, including BNC and Aurora.

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<sup>25</sup> In the specific case of Value-at-Risk models, there is a significant emphasis on price movements that are close in time in order to calculate historical volatility, so that in an event of large swings in the market the limits for transactions are promptly exceeded, and the model will suggest to reduce risk exposures and sell those assets (Walter and Krause, 1999: 37).

<sup>26</sup> See Kregel (2008) and Dymski (2010) on subprime loans, credit origination, securitization and financial fragility.

Additionally, despite the fact the housing market had given clear signals of cooling down, by summer 2006, Lehman took a step ahead and acquired a major stake in Archstone Smith, in 2007, a publicly traded real estate investment trust, which was the largest commercial real estate investment bank. That represented, according to Lehman's CEO and other executives a shift from a 'moving' or securitization business to a 'storage' business, in which Lehman would make and hold longer-term investments (FCIC, 2011: p.177). The Office of Thrift supervision, that regulated Lehman through its jurisdiction over Lehman's thrift subsidiary issued a report warning that 'Lehman had made an "outsized bet" on commercial real estate – larger than by its peer firms, despite Lehman's smaller size; that Lehman was "materially overexposed" to the commercial real estate sector" (FCIC, 2011: 178).

Lehman Brothers became the major mortgage-backed securities (MBS) underwriter at Wall Street, progressively accepting lower credit standards to back those instruments, including subprime mortgages (Williams, 2010: 117). From 2006 to 2007 the mortgage-related assets on Lehman's balance sheets increased from US\$ 67 billion to US\$ 111 billion (FCIC, 2011:177).

According to FCIC (2011: 326), after JP Morgan acquisition of Bear Stearns on March, 2008, when the problems in the subprime market were evident:

'The chief concerns were Lehman's real estate-related investments and its reliance on short-term funding sources, including \$ 7,8 billion of commercial paper and \$ 197 billion of repos at the end of the first quarter of 2008. There were also concerns about the firm's more than 900,000 derivatives contracts with a myriad of counterparties.'

Besides that, some episodes were noteworthy in eroding, even further, market suspicions on Lehman's vulnerability, therefore contributing to worsen its already beleaguered situation. First, CDS's prices showed less confidence on Lehman's debt in comparison to Merrill Lynch and Goldman Sacks. Second, at the first quarter of 2008 Lehman's had to borrow from the FED's new lending facility, the Primary Dealer Credit Facility (PDCF) and also didn't show good performance in the regulator's liquidity stress test in the spring and summer of 2008. Third, investors were taking 'naked short' positions on Lehman's stocks, which means that they speculated that Lehman's would fail.

As it was noted, derivatives also played a role in this process. However, differently from the cases of Barings Bank and LTCM, there was not a particular strategy or market segment in which Lehman transacted that could explain its losses and, eventually, its failure. The bank's exposures in derivatives markets were originated in its activity as a derivative dealer, which operates both on behalf of costumers and on its own account, with numerous counterparties and several kinds of contracts.

Wiggins and Metrick (2014: 8) pointed out that 'Lehman derivatives were approximately 5% of the derivatives outstanding globally at the time.' Balance sheet numbers do not detail the types of contracts entered into by the bank, though show a concentration on the most relevant instruments, in particular, interest rate, currency and credit default swaps and options (Lehman Brothers, 2008).

The interconnectivity of Lehman in derivatives markets was perceived as an issue since concerns on the bank's financial soundness started to spread, as showed by an e-mail

exchanged between a Goldman Sachs executive and a high-scale employee from the New York Federal Reserve on September 11, 2008:

“It is not pretty, This is getting pretty scary and ugly again. [...] They [Lehman] have much bigger counter-party risk than Bear did, especially in Derivatives market, so [t]he market is getting very spooked, nervous. Also have Aig, Wamu concerns. This is just spinning out of control again. Just fyi, this is shaping up as going to be a rough day” (FCIC, 2011: 332).

As the negative perception on Lehman’s financial position and creditworthiness spread, resulting from concerns on mortgage-related businesses, the mechanics through which a run on a derivatives dealer did begin to operate. As a knock-on effect, the run reinforced the concerns on the bank’s financial fragility and actually created more pressure on the bank’s balance sheet. See below this mechanics as describe by Duffie (2010: 54):

‘Alpha notices that some of its derivatives counterparties (entities with whom Alpha has entered derivative contracts) have begun to lower their exposures to Alpha. Their transactions are more and more slanted toward trades that drain cash toward the counterparties and away from Alpha. In addition, other dealer banks are increasingly being asked to enter derivatives trades, called “novations,” that have the effect of inserting the other dealers between Alpha and its original derivatives counterparties, insulating those counterparties from Alpha’s default risk. As those dealers notice this trend, they begin to refuse novations that would expose them to Alpha’s default. This damages Alpha’s reputation. Further, the cash collateral placed with Alpha by its derivatives counterparties, which had been an extra source of financing to Alpha, is rapidly dwindling’ (Duffie, 2010: 54).

Additionally, other way counterparts usually react for reducing their losses or for obtaining cash is anticipating the liquidation of those contracts. In this case the dealer would expend or not receive the amount expected and also become exposed to an unintended unmatched derivative book, probably costly to hedge in those circumstances.

On the side of the numbers presented by the bank, the balance sheet of first quarter of 2008 didn’t improve confidence on its financial health. On the contrary, the numbers reinforced the perception that Lehman was full of exposures to real estate assets, whose prices’ decline are accentuating. Moreover, the bank continued to rely on short-term funding sources, especially the repo market. Investors then targeted Lehman, driving down the bank’s stock prices and echoing the perspective that Lehman was at risk of failure.

More pressures on Lehman’s balance sheet were made by the rating downgrade from Standard & Poor’s (S&P), from A+ to A, in June 2008, and the release of the financial results in the second quarter, which revealed a total loss of US\$ 2.8 billion derived from mortgage-related business (Williams, 2010: 158). The bank started to face funding difficulties, with many counterparties in the repo market withdrawing from business with Lehman (FCIC, 2011: 328).

Behind the scenes, U.S. authorities urged Lehman to start negotiations resembling the Bear Stearns deal with J.P. Morgan Chase but on the beginning of September, two negative news come to the fore: Lehman was not able to reach an agreement with KDB and would not receive any penny in investment, and the bank announced a US\$ 3.9 billion loss in the third-quarter.

The final run on Lehman then initiated and prompted the bank bankruptcy. According to Williams (2010: 169), this was ‘a highly visible event, reflected in the single-digit stock price, rising media attention, increase in CDS rates, volume of short sales, panic on the faces of Lehman executives, and mass exodus of large trading partners and customers.’

On September 11, Lehman’s clearing bank, J.P. Morgan Chase, cut off Lehman’s credit (Williams, 2010: 169). Duffie (2010) classifies it as the last stage in the failure of a dealer bank: ‘In the case of Lehman’s default, [...] JPMorgan Chase, invoked this right, refusing to process Lehman’s instructions to wire cash needed to settle Lehman’s trades with its counterparties.’ (Duffie, 2010: 68). At September 15, Lehman filled the documents and officialised the largest bankruptcy in U.S. history.

When Lehman failed, it was revealed the lack of transparency fragility aspects of over-the-counter derivatives markets. Authorities have no ways to know to whom and when disbursements related to derivatives must be accomplished (FCIC, 2011: 329). Investment banks were only required to disclosure to regulators the total number of OTC derivative contracts entered into and the total exposures derived from these instruments. There were no rules on the disclosure of contract details, such as contractual terms and counterparties. Lehman’s derivatives counterparties began to disclose millions of dollars in potential losses (Wiggins and Metrick, 2014: 17). A chaotic unwind of positions followed. Counterparties self-protection strategies escalated due to uncertainty regarding the extension of the Lehman issue.

Lehman Brothers was the first major derivatives dealer that went bankrupt. Lehman’s losses were significantly larger due to derivatives. Early terminations and margin calls created additional liquidity pressures on Lehman’s weakened balance sheet. The bank revealed too big to fail and too interconnected to fail. Nevertheless, it failed.

Lehman Brothers’ collapse inaugurated the most critical stage of the U.S. financial crisis, inducing the metamorphosis of a national crisis into a crisis which the impacts were felt over numerous markets and institutions around the globe. Additionally, among others immediate effects of Lehman’s collapse, one can highlight: the turbulence and runs in the U.S. and European money market funds (MMFs) markets, with the Primary Reserve Fund, which had direct exposures to Lehman, breaking the buck<sup>27</sup>; the contraction of short-term credit markets, including commercial paper and repo markets, with the cost of interbank lending soaring; the plunge of major global stock indexes and markets; fire-sales and flight-to-quality processes; major global financial institutions needed government support to avoid collapse; and, last but not least, the materialization of the greatest economic depression since 1929.

## **5. AIG (NEAR-)COLLAPSE AND BAILOUT**

The American International Group (AIG) Inc. was founded as a general insurance agency in 1919 at Shanghai, China and moved its headquarters to New York in 1939. The company had operations in numerous countries, with a huge network of agents and offices around the globe. In 2008, the firm was the largest insurance company at the U.S. (Sjostrom Jr., 2009: 944). Its near-failure happened at the same time of the problems of Lehman Brothers and its collapse was avoided only due to a massive bailout from the U.S. federal government.

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<sup>27</sup> Due to accounting standards (amortised cost valuation), the net asset value (NAV) per share of money market funds normally stays at US\$ 1. ‘Break the buck’ is the term used when a fund’s NAV per share drops below US\$ 1.

AIG stepped-in the derivatives markets selling protection through credit default swaps (CDSs). A CDS is a single-name contract that provides insurance against the risk of a default by, for example, one single firm. It pays off if this firm, or the *reference entity*, defaults, an occurrence that is known as a *credit event*. The counterparty buying credit protection pays an insurance premium, the CDS spread, to the seller for the life of the contract or until a credit event occurs (Hull, 2018: Chapter 25).

AIG transactions with credit derivatives are concentrated a great deal in selling credit protection in single- and multi-name derivatives, more specifically, on ‘super senior risk tranches of diversified pools of loans and debt securities’ (AIG, 2008), the so-called Collateral Debt Obligations (CDOs)<sup>28</sup>. Among those loans and securities, there were mortgage-related loans and instruments, including subprime mortgage loans, with AIG taking the exposure *against* a worsening in the credit quality of numerous asset-backed *securities*.

Under normal market conditions, i.e. when there are no financial fragile positions widespread, a credit event is a rare and idiosyncratic incident. If there is no credit event, the protection seller pockets the premium payments, or the CDS spread, and the counterparties go their separate ways. However, if there is a credit event, the seller needs to reimburse and compensate the protection buyer according to terms agreed in the contract, usually via cash settlement.<sup>29</sup>

However, those instruments can be used not only to hedge against credit risk but also to speculate on the credit quality of a firm or a portfolio. And AIG, is the one who took the exposure against the risk of default and, as CDS were traded on lightly regulated over-the-counter market, there were no requirements of protection to be met by the seller.

During the years the U.S. residential market was favourable, AIG’s derivatives strategy was successful. The financial arm of the company, AIG Financial Products, delivered US\$ 10.7 billion and US\$ 7.8 billion in revenues respectively in 2005 and 2006. When the mortgage market began to experience signs of disruption, defaults escalated and led to ‘massive write-downs in AIGFP’s CDS portfolio totalling \$11.2 billion in 2007 and \$19.9 billion for the first nine months of 2008.’ (Sjostrom Jr., 2009: 960). With delinquency rates soaring, rating downgrades of underlying securities and widening spreads, those CDSs required AIG to pledge more and more cash collateral, creating a liquidity pressure on the firm’s balance sheet.

In addition, as explained by Sjostrom Jr. (2009) and Peirce (2014), AIG’s liquidity difficulties were also reinforced by a securities lending program. Under the program put over by AIG Investments, the firm loaned securities from AIG life-insurance subsidiaries’ portfolios to numerous financial institutions. Then, AIG Investments invested the cash collateral in market instruments seeking to earn some extra profits. When the troubles in AIG Financial Products began to come to the fore, several counterparties opted to return lent securities and get collateral back, fearing about the general soundness of AIG. The result was that ‘The securities-lending program experienced a run at the height of the crisis, and AIG could not meet the massive repayment demands. Certain AIG life-insurance subsidiaries’ capital levels fell dangerously low.’ (Peirce, 2014: 4).

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<sup>28</sup> CDOs are a multi-name contract, representing not a single firm, but a portfolio of debt instruments, such as residential mortgages, organised under a complex structure.

<sup>29</sup> ‘If the CDS provides for cash settlement, the parties agree on a market value for the reference obligation. The protection seller then pays the protection buyer the difference between the market value and the par value of the reference obligation.’ (Sjostrom Jr., 2009: 949).

AIG's financial problems became imminent in September 2008. The firm's current liquidity position was deemed as precarious and this threatened the survival of the insurance company. The fear was that 'a [rating] downgrade, possibly after a rating agency meeting September 15, would trigger billions of dollars in collateral calls, liquidity puts, and other liquidity needs.' (FCIC, 2011: 347). A collapse of AIG would directly affect the counterparties that bought protection, in particular, European banks, and derivatives dealers, which could have their books unbalanced by a default from AIGFP.

In the very day that Lehman sought Chapter 11 protection, September 15, the meeting of rating agencies took place, and the announcements that followed indicated a situation worse than expected, with AIG sinking in the rating scales of S&P, Moody's and Fitch (FCIC, 2011: 348). As already mentioned, the problem was that AIG had massive exposures to 12 major dealer banks that would potentially witness a knock-on effect of defaults if the insurance company collapsed. The Federal Reserve recognised that this event 'could add to already significant levels of financial market fragility' (FRB, 2008), making serious harm to the already weakened financial system.

Authorities, then, set up a bailout program so that AIG could meet its immediate financial disbursements. In a first moment, the Federal Reserve loaned US\$ 85 billion to AIG, being followed by additional US\$ 49.1 billion from the Treasury, under the Troubled Asset Relief Program (TARP) and other minor operations. The estimations of the total funds used in AIG's bailout add up to US\$ 182 billion.

The conclusions of the Financial Crisis Inquiry Commission on AIG's near-collapse highlighted the deficient regulation of OTC derivatives markets. According to FCIC (2011: 352) interpretation:

'AIG's failure was possible because of the sweeping deregulation of over-the-counter (OTC) derivatives, including credit default swaps [...] AIG engaged in regulatory arbitrage by setting up a major business in this unregulated product, locating much of the business in London, and selecting a weak federal regulator, the Office of Thrift Supervision (OTS).'

As showed above, AIG did not collapse due to Lehman Brothers bankruptcy. However, it is noteworthy that they were somehow related: both institutions took part in the same process of financial innovation expansion and share some common elements in the process of fragilization of their financial positions<sup>30</sup>. In any case, Lehman's collapse was key to understand the decision to bailout the insurance company and avoid another round of market turbulence.

In the AIG episode, derivatives were not only a channel of propagation or an amplifier element: they are at the very core of the issue, revealing many aspects of how derivatives and systemic risk are linked.

## **6. DERIVATIVES, FINANCIAL FRAGILITY AND SYSTEMIC RISK**

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<sup>30</sup> In fact, the sharp increase of the CDO market stimulated the market of credit derivative contracts (CDS), which provided an insurance against default that could occur on those complex products, and, at the same time, the supply of CDS reinforced the process of expansion of securitization by reducing its risks and then amplifying its attractiveness.



While describing the collapse or near-collapse of Barings, LTCM, Lehman and AIG, we mentioned in several occasions that derivatives are somehow related to financial fragility, contagion and systemic risk. The present section aims at systematizing these relationships, discussing the role played by derivatives in the four cases and analysing the similarities and differences of their role in each case.

Table 1 presents a summary of the four episodes. The first part of the Table shows the mechanisms that were responsible for the general rise in leverage and financial fragility, while the second part describes the dynamics of direct and indirect contagion that might led to a systemic crisis.

The former points out the general financial exposures assumed by each institution, explicitly depicting derivatives strategies, describes the funding sources associated with each case, and provides a ‘preliminary diagnosis’ on the role of derivatives as creators or amplifiers of financial fragility in each case. The later presents the potential and actual – i.e. when no bailout secured an alternative course of events – dynamics of contagion and the spread of financial problems, highlighting the interconnectivity among counterparties and among derivative and other financial markets. Finally, the two final rows points whether there were bailouts or not, and whether a systemic crisis did take place or not.

**Table 1: Derivatives, Financial Fragility, Contagion and Systemic Risk in the Four Episodes**

Episode	Barings	LTCM	Lehman Brothers	AIG	
Market	Exchange-traded	OTC	OTC	OTC	
<b>Fragilization mechanisms/ Leverage</b>	<b>General Financial Exposures</b>	<ul style="list-style-type: none"> <li>• Derivatives: unhedged positions on the Nikkei index (short straddles and long position on futures)</li> </ul>	<ul style="list-style-type: none"> <li>• Bonds: convergence arbitrage</li> <li>• Derivatives: synthetic convergence arbitrage + short straddles on stock indexes</li> </ul>	<ul style="list-style-type: none"> <li>• Bonds: Mortgage-backed securities</li> <li>• Derivatives: OTC derivatives dealer</li> </ul>	<ul style="list-style-type: none"> <li>• Derivatives: Single- and multi-name CDSs</li> </ul>
	<b>General Funding Sources</b>	<ul style="list-style-type: none"> <li>• Own capital</li> </ul>	<ul style="list-style-type: none"> <li>• Repos</li> </ul>	<ul style="list-style-type: none"> <li>• Commercial papers (CP)</li> <li>• Repos</li> </ul>	<ul style="list-style-type: none"> <li>• Own capital</li> <li>• Securities financing transactions</li> </ul>
	<b>Role of derivatives</b>	<ul style="list-style-type: none"> <li>• Creator of fragilization</li> </ul>	<ul style="list-style-type: none"> <li>• Creator of fragilization</li> <li>• Amplifier mechanisms of fragilization</li> </ul>	<ul style="list-style-type: none"> <li>• Amplifier mechanisms of fragilization</li> </ul>	<ul style="list-style-type: none"> <li>• Creator of fragilization</li> </ul>
<b>Potential Systemic Crisis Materialization Mechanisms Due to Derivatives</b>	<b>Direct contagion</b>	SIMEX	Counterparties of OTC derivatives and repos: major U.S. dealer banks	Counterparties of OTC derivatives, repos and CPs: major U.S. dealer banks + myriad of counterparties	CDS buyers: major U.S. dealer banks
	<b>Indirect contagion</b>	No. The failure was deemed as idiosyncratic, due to Leeson.	<ul style="list-style-type: none"> <li>• Fire-sales and asset-deflation</li> <li>• Turbulence in corporate bonds, OTC derivatives and repo markets</li> </ul>	<ul style="list-style-type: none"> <li>• Other derivatives markets</li> <li>• US + EU MMFs</li> <li>• CP and repo markets</li> <li>• Stock markets</li> </ul>	<ul style="list-style-type: none"> <li>• Other OTC CDS markets</li> <li>• Domino effects from dealer banks contagion</li> </ul>
<b>Bailout?</b>	No	Yes	No	Yes	
<b>Systemic crisis?</b>	No	No	Yes	No	

Source: Authors' elaboration.

### ***6.1. Derivatives and financial fragility***

The first essential aspect of the use of derivatives in the four experiences depicted herein is that, given the specificities of each case, these financial instruments played a prominent role in creating and intensifying financial fragility.

Financial fragility is an essential property of each economic agent that is related to the rights and obligations associated with his assets and liabilities (Minsky, 1975: 70). Each agent manages cash flows composed of (expected) revenues and expenditures, and, depending on the rights and obligations assumed by him, he will have a greater or smaller *ability to discharge his financial obligations*.

The lesser the ability of a unit to discharge her financial obligations without assuming new liabilities, the more fragile its financial position is. Typically, the more leveraged a unit is, or the more borrowed money they use in relation to their own resources, the more fragile its financial position is. Yet, the shorter the maturity of its sources of funds comparing to the maturity of its obligations, as well as the less stable they are, the more fragile its financial position is.

Minsky (2016: Chapter 2) details this discussion, presenting three main positions regarding financial fragility: hedge, speculative and Ponzi. Hedge financing units are those that can satisfy all their contractual payment obligations by the due date employing only their current expected revenues (cash flows). Speculative financing units, in their turn, know that they will not be able to earn revenues enough to fulfil all of their contractual payment obligations by their due date, thus needing to roll over their liabilities. Finally, Ponzi units are a special case of speculative units, in which the degree of the disequilibrium between revenues and obligations is substantial<sup>31</sup>.

Unexpected negative movements in the economy may affect expectations on revenues and obligations, affecting negatively all kinds of units. Hedge units can become speculative units. Speculative units might unwillingly turn to Ponzi units for a period. However, Ponzi units will have no other choice than to renegotiate their liabilities, face turbulent market conditions when selling assets or issuing stocks, or wind down their operations, filing for bankruptcy.

The relationship between derivatives and financial fragility can be analysed by the lens of leverage. Derivatives embed leverage: a counterparty assumes rights and obligations whose values are typically far greater than the initial resources demanded in a transaction (Annex I). Moreover, the net creditor and debtor positions over the life of a derivative may vary, affecting the actual outcome of a hedging, arbitrageur or speculative strategy.

Therefore, how derivatives would fragilize an agent's financial position will depend on how the general financial strategy of an agent is set and the course of events in the underlying markets. A derivatives strategy could be set to reduce or increase the discrepancy between expected revenues and financial commitments, thus reinforcing or mitigating financially fragile

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<sup>31</sup> See Minsky (2016: Chapter 2) and Torres et al. (2018: 4-10) for a detailed discussion. Ponzi units are extreme cases of speculative units: expected cash flows are not sufficient to fulfil both the repayment of the principal and the interest due on outstanding debt.

positions. Yet, the actual outcome might deliver the expected or the opposite result of the strategy, also influencing on an agent's financial position.

In the four episodes analysed herein, derivatives played similar roles in the build-up of fragile financial positions via leverage. In the cases of Barings, LTCM and AIG this role was pivotal to their collapse or near-collapse, while in the case of Lehman this role was outshined by other instruments, as mortgage-related securities.

Barings Bank strategy in the Singaporean and Japanese derivative exchanges is a good illustration of how derivatives embedded leverage can rapidly fragilize the financial position of an institution, creating mounting liabilities and eroding its capital basis. The unhedged, directional positions assumed by Barings were directly responsible to the bank's failure.

LTCM and AIG stories resemble Barings in this aspect. The hedge fund's positions betting on narrowing spreads and against volatility built by means of derivatives transactions frustrated expected financial revenues and quickly escalated financial obligations after the Russian moratorium. At some point of LTCM's downfall, more specifically September 1998, the fund's financial fragility was so high that the 'leverage ratio reached an extraordinary 250:1.' (Allington et al., 2012: 559). AIG financial results on credit derivatives reversed as long as mortgage delinquency rates increased. Expected revenues gave room to actual losses and financial obligations mounted, as these CDSs required AIG to pledge more and more cash collateral. The financial position of the insurance firm was quickly fragilized.

The case of Lehman Brothers is somewhat different. There was not a particular strategy, such as in the cases of Barings and LTCM, or market segment, such as AIG's CDSs, in which Lehman transacted that fragilized the bank. Derivatives were not the main instrument responsible for Lehman's balance sheet fragility so they were not creators of fragilization. This role was played by mortgage-backed securities, being Lehman the major MBS underwriter at Wall Street.

Nevertheless, derivatives played a supporting role in Lehman's failure. The bank was an active dealer in the OTC derivatives market, with numerous exposures to several counterparties. For this reason in this case derivatives was an amplifier mechanism of fragilization. As highlighted by FCIC (2011: 343): 'Lehman, like other large OTC derivatives dealers, experienced runs on its derivatives operations that played a role in its failure.' Due to the dynamics of the OTC derivatives market, when Lehman's creditworthiness started to be challenged, a run on the bank's derivatives by their counterparties contributed to create new financial obligations to the bank.

Another very important element for the build-up of financial fragility in the four episodes discussed here is the funding pattern assumed by the institution. Only Barings had a more or less stable source of funds, the bank's own capital, which was eroded as long as the bank met increasing margin calls. LTCM, Lehman and AIG predominantly relied on short-term, renewable funding sources, such as repo markets. Thus, all the three entities heavily relied on market conditions to fund their leveraged balance sheet positions, engaging in more speculative financing patterns.

From these discussions, we can conclude that derivatives can contribute to build-up more fragile financial positions, as the cases of Barings, LTCM and AIG illustrate. In these episodes, derivatives were responsible for creating entirely – or partially in the case of LTCM – the

financial commitments that led to the collapse or near-collapse of these institutions. In the case of Lehman, OTC derivative markets worked to create new obligations, amplifying financial commitments – thus fragilizing even more its financial position – in a very unfriendly economic conjuncture.

## **6.2. Derivatives, contagion and systemic risk**

There has been a long-lasting discussion on whether derivatives – and, in particular, OTC derivatives – increase or reduce systemic risks to financial systems and the economy. Before diving into this discussion, it is fundamental to present the concepts of systemic risk and contagion, so we can properly analyse the relationship among derivatives and them in the episodes analysed herein.

There is not a single and universally accepted definition of *systemic risk* in the literature (Smaga, 2014). In this paper we adopt the broad definition suggested by Carvalho (2015: 96): ‘The risk of amplification of individual or local difficulties into a full-fledged crisis is what is called systemic risk.’ His definition is compatible with other more general definitions of the concept, such as the one provided by De Bandt and Hartmaan (2002). Nevertheless, his perspective rejects the view that systemic risks emerge from extreme events, which hit ‘naturally stable’ financial and economic systems, thus prompting major crises: alternatively, Carvalho (2015: 105) argues that a system might ‘continually builds disequilibria and becomes progressively more fragile until the point where even a small shock can generate a major crisis.’

At the very core of the concept of systemic risk is the notion of *contagion*. Contagion can be understood as the propagation of financial problems or failures from one institution, market or system to the others. De Bandt and Hartmaan (2002: 253) argue that contagion is characterised only when failures of other institutions follow an initial (strong) systemic event derived from a shock in one institution. Our definition, in contrast, is broader: contagion refers to the propagation or dissemination of financial problems, via financial fragility, that do not necessarily result in widespread failures, though this scenario continues to be a possibility.

We work with two types of contagion. *Direct contagion*, which is the main focus of the existing literature, arises from relationships derived from contractual obligations between two counterparties. It occurs ‘if one firm’s default on its contractual obligations triggers distress (such as illiquidity or insolvency) at a counterparty firm’ (Clerc et al., 2016: 1). However, this is not the only mechanism that works to spread financial distress: there is also *indirect contagion*. Indirect contagion does not derive from contractual obligations, but from market and information spill-overs that are inherent to the operation of financial systems (Clerc et al., 2016). In this case, the larger the share of the financial system that engage in financially fragile practices, the greater the chance that indirect contagion will be an issue.

The discussion above pointed that derivatives contributed, as a creator or as an amplifier, to the increase of financial fragility and leverage of Barings, LTCM, Lehman and AIG. Doing so they have played a very important role already in setting up a system that might builds disequilibria and becomes gradually more fragile. Therefore, the four experiences suggest that derivative contracts entered into by these institutions contributed to make the financial system more vulnerable to shocks and crises.

Now we intend to analyse further consequences of those derivative transactions: if, besides promoting a more fragile financial position to the institution that carry them on, they also

consist of a mechanism of contagion, propagating risks and financial problems to other institutions and markets, and, then, paving the way to a systemic crisis.

Concerns on risks derived from derivative contracts are in place since these instruments started to spread in global financial markets. Reports from the Bank of International Settlements (BIS) (1986; 1992; 1995), the U.S. General Accounting Office (GAO) (1994; 1996) and the Commodity Futures Trading Commission (CFTC) (1998) show that regulatory authorities were concerned on the potential negative effects of those instruments on financial systems and economies, associating derivatives with systemic risk. These concerns were also shared by some academics, such as Abken (1994), Duffee and Zou (1996), Kregel (1998), Fahri (1998; 1999; 2001), Stulz (2004), and Bliss and Kauffman (2006).

Nevertheless, in works such as BIS (1994; 1995) and U.S. GAO (1994), there seems to prevail an understanding that derivatives are not essentially different from other financial instruments, yet there is a perception that they are more complex than the regular instruments<sup>32</sup>. Their complexity and the substantial growth in derivatives markets were the main concern of authorities and posed challenges for the market participants' risk management practices and supervisory activities of regulators.

With the episode of LTCM, it became evident that the understanding of derivatives' risks required the acknowledgement of the fundamental role that these instruments have played in increasing the leverage of financial institutions, the financial fragility and, consequently, systemic risks (GAO, 1999). As highlighted by Farhi (1999: 111), due to their embedded leverage, derivatives provided flexibility and 'efficiency' to speculative behaviours, allowing agents to transact larger volumes.

Yet, particular concerns were set on OTC derivative markets, especially regarding the role they may play as mechanisms of contagion. For example, according to U.S. GAO (1994), these markets were particularly troublesome because of some features they present: OTC derivative dealers concentrate a great deal of counterparty credit risk; there is a huge concentration of transactions among a few large dealers; there are extensive linkages among derivative dealers and between dealers and other asset markets; there is a regulatory gap because of unregulated dealers (U.S. GAO, 1994: 3-17).

However, these worries were not a consensus and were not properly echoed on the economic view of derivatives that prevailed, and on actual regulatory measures. The dominant view was that these instruments have contributed to reduce systemic risk and there is no need of further regulations on this market (G30, 1993; Darby, 1994; Phillips, 1994; Edwards, 1995; Greenspan, 1999, 2004; USA, 2000; Schinasi et al., 2000; Geithner, 2006a, 2006b). This result derives from the interpretation of the risk-shifting property of derivatives by these authors: 'the use of derivatives may reduce systemic risk by diffusing market shocks. In providing a superior mechanism for the sharing risks, derivatives may cushion financial shocks by distributing the losses among a greater number of market participants.' (Edwards, 1995: 90).

Edwards (1995) himself doubted that those characteristics of the OTC market would cause systemic risks problems. For him, concentration and size might be due to the economies of

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<sup>32</sup> 'Derivative products pose the same risks (albeit often in more complex forms) as those associated with other financial instruments, e.g. credit risk, market risk, funding risk, market liquidity risk, legal risk and operation risk. These risks, as well as systemic risk, have been analysed in considerable depth by various authorities as well as by industry bodies' (BIS, 1994: 2).

scale requirements of the OTC market (for example improving risk management activities and facilitating risk diversification) and the extensive linkages observed would also contribute to reducing systemic risk by diffusing market shocks. Indeed, in 1995, it can be argued that there was a lack of clear empirical evidence to the contrary.

However, in his critics to GAO's concerns, Edwards (1995: 67) describes the sequence of hypothetical events of a derivatives-driven systemic crisis that is helpful to explain direct and indirect contagious mechanisms: first there is an initial shock due to the failure of a large end-user; this failure prompts the collapse of a large derivatives dealer; a dealer's default spread through the market, spilling-over other counterparties in the derivatives market (counterparty spill-over effects); a freeze-up in both OTC and exchange-traded derivatives follow (price effects in other derivatives markets); market linkages spread this 'price break' to other financial markets; and, eventually, credit disruptions and negative real economic effects take place. Direct and indirect contagion are clearly contemplated in this sequence of events.

The four experiences analysed herein differ substantially concerning contagion. In the case of Barings, contagion operated via direct exposures in derivatives markets, but as the bank's positions were novated by the SIMEX central counterparty, being these transactions subject to collateral requirements, and the bank honoured a significant portion of margin calls, the effects were contained. Moreover, indirect contagion via market spill-over effects did not occur because of the perception that Barings' difficulties were idiosyncratic.

It is more difficult to assess contagion in the cases of LTCM and AIG because bailouts avoided their failure. What can be told is that expected contagion fundamentally influenced the bailout decisions. Direct contagion, via large banks and dealers' CDS exposures to AIG, was more relevant in the case of the insurance firm. Indirect contagion, via market spill-over effects derived from OTC derivatives positions, was more relevant in the case of LTCM.

The experience of Lehman Brothers is the most emblematic. It reveals how derivatives can work as contagion-instruments. Lehman was a dealer in the OTC market, so the large portion of transactions did not have collateral requirements or other cushions of safety in place. Moreover, OTC derivatives opacity contributed to the 'run on derivatives' mentioned above. Derivatives were crucial to both direct and indirect mechanisms of contagion: directly, via Lehman's default on its counterparties<sup>33</sup>; indirectly, via the loss of confidence in other derivatives dealers. These instruments spread Lehman's difficulties to other counterparties and markets, directly contributing for the materialization of a systemic crisis. As put forth by FCIC (2011: 343), Lehman's 'massive derivatives positions greatly complicated its bankruptcy, and the impact of its bankruptcy through interconnections with derivatives counterparties and other financial institutions contributed significantly to the severity and depth of the financial crisis.'

The likeliness of contagion depends not only on the institution's own degree of financial fragility, but also on the financial positions from other agents in the financial system – and economic agents in general. The failure of one single firm, though relevant in size, would spread to other firms and markets, causing a financial crisis, due to the financial fragility of those other firms – otherwise they would be also to cushion this shock. The more speculative and Ponzi positions prevail, the more likely is the materialization of a financial crisis (Minsky, 2016: 32).

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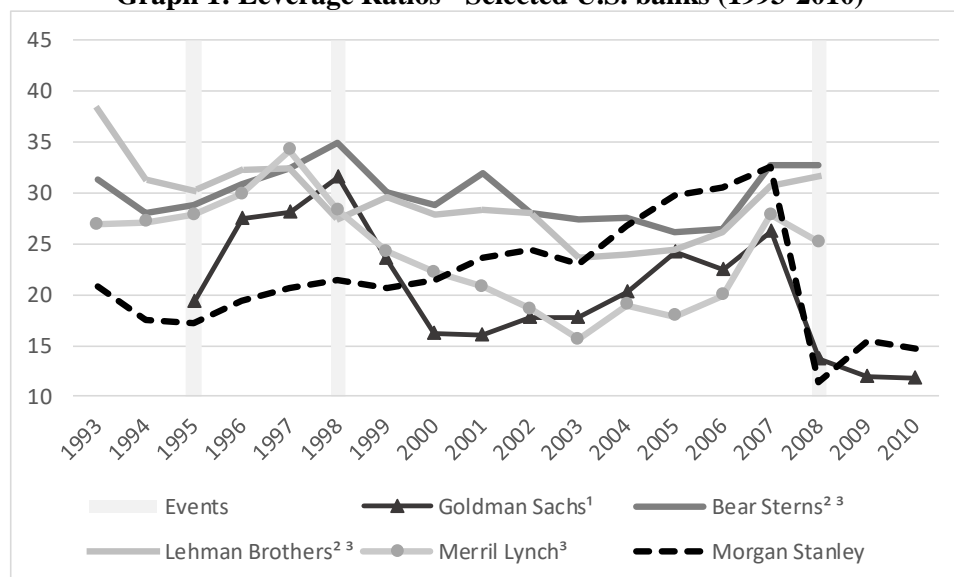
<sup>33</sup> At the brink of collapse, the Lehman's counsel provided the Federal Reserve with a document unfolding how its default on financial obligations would 'trigger a cascade of defaults through to the [subsidiaries] which have large OTC [derivatives] books.' (FCIC, 2011: 335).

In thesis, the view that OTC derivatives may cushion financial shocks by distributing the losses among OTC dealers and other market participants is not entirely wrong. However, whether it cushions the blow or not will depend on the combination of financial positions in the system. If other agents are engaged in robust financial positions (*hedge*), the ‘cushion effect’ might prevail and the lack of confidence may be contained. But if speculative and Ponzi financing positions of financial institutions and market participants are widespread, the result could be the opposite. If they are not able to absorb the financial disturbance that arises from one of the other institutions, huge concentration and extensive linkages of OTC derivative markets will just contribute to a wide and rapid contagious process by further fragilizing other dealers’ financial positions and then disseminating difficulties and lack of confidence among the financial system, triggering a systemic crisis.

This is exactly what occurred with Lehman Brothers and what potentially would have occurred with LTCM and AIG if there had been no bailouts. As is well known, during the 1990s and the 2000s, very high level of leverage was observed on the balance sheet of American OTC dealers institutions in a context of a high level of uncertainty caused by frequent currency crises in the 1990s and the subprime crisis in the 2000s (Graph 1).

One last aspect that also played a role in the episodes analysed herein is the lack of regulation and transparency in over-the-counter derivatives markets. Concerns on the opacity of OTC contracts were not a novelty. BIS (1995: 12) pointed out that: ‘An important potential source of systemic risk in OTC markets is associated with the lack of transparency of counterparties’ exposure to market and credit risks arising from derivatives and trading related activities.’ LTCM, Lehman and AIG had their derivative transactions concentrated in OTC markets. Barings was the only case in that transactions were made in exchanges – and perhaps not unexpectedly the only case when there were no major disruptions due to contagion.

**Graph 1: Leverage Ratios - Selected U.S. banks (1993-2010)**



Source: SEC Form 10K and 10Q filings from The Goldman Sachs Group, Inc., The Bear Stearns Companies, Inc., Lehman Brothers Holdings, Inc., Merrill Lynch & Co., Inc., and Morgan Stanley.

Notes: Leverage ratio is computed as total assets divided by equity capital (tangible shareholders’ equity). 1. Data not available for 1993-4. 2. As of February 29, 2008. 3. Data not available from 2008 on, due to merger/acquisition.

Moreover, there were investment firms and insurance companies, which were important non-bank derivatives dealers, that were not submitted to the same regulation of bank derivatives dealers like federally imposed capital standards and examination by federal regulators. In this case, Edwards (1995: 77) advocates that: ‘Unlike banks, affiliates of nonbanks are not beneficiaries of government deposit insurance, and taxpayers are not at risk for losses incurred by failed nonbank dealers.’ However, LTCM and AIG cases showed that, in practice, taxpayers money is at risk. Their bailouts were backed or funded by the Federal Reserve and the U.S. Treasury.

## CONCLUSIONS

How do the four episodes depicted in the paper shed light on the relationship among derivatives, financial fragility and systemic risk?

Our analysis concluded, based on the analysed experiences, that derivatives contributed to cause and intensify financial fragility and leverage: derivatives’ embedded leverage played a pivotal role in fragilizing the financial positions of Barings, LTCM and AIG, and a supporting role in Lehman’s failure, accelerating its financial debacle.

Doing so they have already played a very important role in the build-up of a system that, according to Carvalho (2015: 105), ‘continually builds disequilibria and becomes progressively more fragile’ and so vulnerable to shocks and major crises.

Analysing further consequences, specifically of OTC derivative contracts, we also conclude that, besides stimulating a more fragile financial position of an institution, they also consist of a mechanism of contagion, spreading risks to other institutions and markets, contributing, in this way, to the materialization of a systemic crisis.

As it was shown, OTC derivatives were a major channel of direct and indirect transmission of Lehman’s disruption to other institutions and financial markets (contagion). Concerns on potential contagion effects via derivatives in the cases of LTCM (indirect contagion, via market spill-over effects) and AIG (direct contagion, via counterparty spill-over effects) provided reasons for setting up the bailouts that avoided the collapse of these institutions.

As recognised by the FSB’s analysis of the recent financial crisis, which encompasses the failure of Lehman and the near-collapse of AIG:

‘The recent financial crisis exposed weaknesses in the structure of the over-the-counter (OTC) derivatives markets that had contributed to the build-up of systemic risk. These weaknesses included *the build-up of large counterparty exposures between particular market participants which were not appropriately risk-managed; contagion risk arising from the interconnectedness of OTC derivatives market participants; and the limited transparency of overall counterparty credit risk exposures that precipitated a loss of confidence and market liquidity in time of stress.*’ (FSB, 2010: 8; our highlights).

In this last case, it is important to highlight that, if speculative and Ponzi financing positions are widespread instead of cushioning financial shocks, as argued by some authors, derivatives



might fragilize even more and disseminate losses among the financial system, triggering a systemic crisis.

Summing up, we can point out that derivatives can contribute to the build-up of systemic risk: (i) through the build-up and intensification of the institutions' financially fragile positions that are on those contracts, and (ii) by providing interconnections that might work as mechanisms of contagion directly and indirectly promoting financial instability and a dissemination of risks to other institutions in the financial system.

Our conclusions drive us to ask why these institutions engaged in a very financially fragile positions and why the threat of contagion was so high. The lack of regulatory controls and of transparency and prudential requirements on derivatives – especially OTC derivatives – is relevant to explain LTCM, Lehman and AIG. The lack of appropriate risk assessment models and risk management practices, operational and antifraud controls, transparency requirements also play their part in explaining the collapse or near-collapse of Barings. Since Lehman's bankruptcy, new regulatory standards have been envisioned for derivatives markets (FSB, 2010), even though their effectiveness in reducing systemic risks is yet to be seen.

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## ANNEX I. FINANCIAL DERIVATIVES: CONCEPTS AND MARKET DEVELOPMENT

A derivative can be defined as a financial asset or financial instrument whose value depends on the values of other underlying assets (Norfield, 2012: 105; Hull, 2018: 1; Chesnais, 2016: 181). This instrument unbundles different types of risk inherent to financial transactions (credit risk, interest rate risk etc.) and allows the agents to transfer or trade of the risks that they might not want to bear to other agents that *believe* they are in a better position to cope with them.

One important aspect to bear in mind is that the derivative contract is not the underlying asset<sup>34</sup>. It is traded separately, in a different market, with different features, though its price maintains some relationship with the price of the underlying asset. While the notional value of the derivative, i.e. the principal or the value of the underlying asset, is not at risk, the cash flows that counterparties exchange during the life of the contract are. These cash flows constitute a debt of one counterparty to another and the net creditor and debtor positions over the life of a contract may vary: ‘One counterpart can be the net creditor (receiver of the cash flow) at the initiation of the contract, and because of, for example, changes in interest rates later become the net debtor (payer of the cash flow).’ (Schinasi et al., 2000: 41).

It is commonplace to classify participants in derivatives market according to the aims pursued by them. Hull (2018: Chapter 1) identifies three main types of participants: *hedgers*, *speculators*, and *arbitrageurs*. *Hedgers* operate in derivatives markets with the objective of mitigating or eliminating the risks they face, i.e. looking for hedging against potential futures movements in markets. *Speculators* use derivatives to bet on the future directions of market variables, aiming to profit from their positions. To these participants, derivative markets give the opportunity to magnify financial outcomes in comparison to spot markets – though this applies both to profits and losses. *Arbitrageurs* operate using a particular strategy, taking offsetting positions in two or more instruments seeking to lock in a profit.

Despite the differences in the aims of those agents, they are all guided by the formation of expectations on the future behaviour of asset prices – this is not an exclusive feature of speculative transactions and speculators. Actually, the speculative character of an agent or transaction needs to take into account the positions assumed both on spot and derivative markets. Speculative transactions are those that result in net positions (short or long) in a financial asset market (spot or derivative) without an offsetting position in the market of the same asset or a similar asset with a different temporality (Farhi, 1999: 104).

The higher the leverage ratio of an agent’s portfolio, the more speculative an agent would be. An agent that limits its investments to the size of its equity would be less speculative than an agent that has a portfolio that invests two or three times its equity. In the case of the former, the maximum losses are limited to the agent’s equity, while in the latter losses are not measurable *ex ante* and might achieve volumes that are far greater (many times) the agent’s equity.

According to Frazzini and Pedersen (2012: 2): ‘an important feature of a financial instrument is its embedded leverage, that is, the amount of market exposure per unit of committed capital.’ When entering into a derivative contract, the counterparty is essentially assuming a leveraged

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<sup>34</sup> Hull (2018: Chapter 1) describes the most conventional contractual forms of derivatives: futures, forwards, options and swaps.

exposure, i.e. derivatives embed leverage (IOSCO, 2011: 20; Hull, 2018: 15-6).<sup>35,36</sup> This is so because the settlement of a derivative contract occurs at some point in the future, so, at the beginning, a derivative requires the investment of a relatively small amount of cash (in comparison to the direct investment in the underlying). Nevertheless, the counterparty assumes rights and obligations whose values are usually far greater than those initial resources demanded in the transaction, and they may result in huge profits or losses As Lopes and Lima (2003: 95) argues, this is a very specific characteristic of derivatives and rarely found in other (financial or non-financial) products and activities.

Derivatives found a conducive environment to their dissemination in the 1970-80s. The disruption of the Bretton Woods system, the adoption of floating exchange rate regimes and the exercise of restrictive monetary policies prompted a huge increase in financial market volatility. International financial markets were also influenced by the processes of financial deregulation and capital account liberalisation: a global financial system was about to emerge (Helleiner, 1996).

Derivatives allowed the unbundle and trade of those currency and interest rate risks, providing hedging instruments to internationally active firms and financial institutions, and worked as mechanisms to anchor international asset prices to U.S. interest rates and the dollar. In other words, derivatives ‘have made possible to create positions that span many market segments, and that would have been considered too expensive, risky or unwieldy if created in cash market instruments.’ (BIS, 1992: 26). Yet, the volatility embedded in this new environment also created opportunities to speculate on the future movements of interest and foreign exchange rates and to exploit pricing inefficiencies, and derivatives were also used for these purposes.

In the onset of the 1980s, there was a huge development of exchanged-traded derivatives (initially futures, and then options) as the instability to which markets are subject shared ‘common’ causes. With the decrease in inflation rates and changes in the orientation of monetary policy, those common risks became less important and idiosyncratic risks acquired more relevance. More sophisticated instruments, better suited to the specific needs of counterparties, known as over-the-counter (OTC) derivatives then blossomed. From the 1990s on, OTC derivative markets accounted for the largest portion of trading activity in the global derivatives market.

Exchange-traded and OTC derivatives have distinct features. Exchange-traded derivatives are standardised contracts negotiated under the operational rules and safeguards of an exchange. These rules typically comprise an infrastructure for the central clearing of contracts<sup>37</sup> and

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<sup>35</sup> More specifically, Hull (2018: 15) points out that: ‘The futures market allows the speculator to obtain leverage. With a relatively small initial outlay, a large speculative position can be taken.’ Yet, in the case of options: ‘Options like futures provide a form of leverage. For a given investment, the use of options magnifies the financial consequences. Good outcomes become very good, while bad outcomes result in the whole initial investment being lost.’ (Hull, 2018: 16).

<sup>36</sup> For differentiating from the term leverage which refers to loans and is directly reflected on the balance sheet numbers some authors define this as synthetic leverage (e.g. CVM, 2016), a indirect way to leverage which is not entirely reflected on balance sheet values since the exposure of notional value of underlying assets can be not registered.

<sup>37</sup> Typically, central counterparty (CCP) arrangements are in place. A CCP ‘stands between the two parties to the derivatives transaction so that one party does not have to bear the risk that the other party will default.’ (Hull, 2018: 3). A complete description of how a CCP works can be found in Hull (2018: 33).

include margin requirements to provide a cushion of safety to derivatives settlement<sup>38</sup>, among other risk management instruments<sup>39</sup>.

OTC derivatives are non-standardised, tailor-made contracts negotiated bilaterally among financial institutions and end-users. They are cleared bilaterally, in financial institutions' own books, being therefore characterised by their opacity. Important to say that the more tailor-made they are the more illiquid they are. That means that the counterparties would not easily eliminate the position by liquidating it or by establishing an offsetting position. Additionally, they do not resort to cushions of safety such as margin requirements quite often.

Internationally-active banks were a centrepiece to the OTC derivatives engine. In the wake of financial globalisation, as we have already mentioned, the competitive environment faced by banks substantially changed, with disintermediation and the universal banking model gaining ground. Banks also initiated a process of strategic diversification, seeking for sources of revenues other than traditional loans (Kregel, 2008; Dymski, 2009). The supply of risk management services to clients dawned as one major new source of income, via fees and commissions earned on product structuration and financial advising. With idiosyncratic risks escalating, banks started to structure tailored solutions to help clients (*end-users*) in managing their risks, derivatives products among them.

However, OTC derivatives' structuration required that banks act as counterparties to their clients, then exposing their balance sheets to risks that they are not necessarily willing to bear. As a consequence, banks' ability to off-set risks in derivatives instruments become crucial to the success of their activities. They started to develop their own risk management techniques, so they are able to off-set risks by engaging in multiple clients' OTC contracts and to hedge the residual (net) exposures through exchange-traded derivatives. In addition, the major banks engaged in derivatives transactions started to actively trade among themselves in order to achieve a matched book on clients' positions.

Another competitive front in which banks struggled with the decline of traditional banking was trade itself. The strategic diversification of banking activities also involved the serious engagement in proprietary trading. Investing the bank's money was a solution to boost profits and large trading desks were set up to carry on this activity. In a first moment, banks' strategies focused on traditional securities and were funded by traditional balance sheet items (equity, certificates). But as time passed by, those banks invested in riskier, leveraged instruments, and engaged in more risky financing patterns seeking to increase even more trading profits.

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<sup>38</sup> Margin requirements are one of the mechanisms used to minimize counterparty credit risk. When two participants enter into a future contract, both needs to provide collateral to face an initial margin requirement, which will be the same for the buyer and the seller of the derivative. A participant can pledge collateral in the form of cash or other highly liquid assets. Typically, the values deposited as initial margin are a small portion of the overall value of the transaction. According to market behaviour, for instance, an increase in market volatility, the exchange might require additional margin, via margin calls. Besides that, the daily adjustments in the value of the exposures by the closing prices of underlying assets might generates profits and losses for each part of the derivative in a daily basis, also impacting on the margins required by each part. This is called variation margin. These daily adjustments are usually settled in cash.

<sup>39</sup> Margin (or collateral) requirements consist in the first layer against default risk. However, one participant's losses might exceed the amount of collateral posted by itself. Therefore, CCPs usually have other mechanisms in place to avoid the risks of a default, such as: contingent claims on non-defaulting participants, clearing funds (to which the CCP's participants contribute), insurance contracts, and the CCPs' own capital (CPSS-IOSCO, 2004: 20).

Bank's proprietary trading depended a great deal on their ability to trade derivatives. These instruments were decisive to speculate on the future behaviour of financial asset prices without compromising huge amounts of cash from the beginning, allowing banks to boost profits and, simultaneously, avoid additional funding pressures. They were also important to banks by allowing them to hedge their own investment portfolios against numerous risks.

Our depiction of bank's growing activities in derivatives markets, combining clients' brokering-related activities and proprietary trading, shows that these institutions epitomize the three main types of derivative markets participants, acting simultaneously as a *hedger*, a *speculator* and an *arbitrageur*. As this 'threefold' participant, banks assumed the role of *derivatives dealers*, being responsible for intermediation and market-making<sup>40</sup> in derivatives markets, especially in the OTC segment (Duffie, 2010).

From the viewpoint of economic functions, the role played by derivatives in risk management is often emphasised as the main benefit of this kind of financial instrument. As Darby (1994: 22) points out, 'the growing size of the market has led to the development of new risk management techniques and skills in dealer financial institutions.' By redistributing risks, financial derivatives help economic agents in coordinating and adjusting their expectations, and in taking their productive and financial decisions.

Some authors – such as G30 (1993), Darby (1994) and Phillips (1994) – advocate that the improvement in risk management practices that followed derivatives mitigate the effects of financial instability on the real economy and act as a stabilizing element of modern economies. In his turn, Masera (1993: 104) stress that these instruments can improve the informational content of capital markets and lower transaction costs. Those authors see derivatives as instruments that improve market efficiency and mitigate financial instability.

However, Roe (2011) noticed that the redistribution of risks in the economy does not mean the *elimination* of risks. Neither it does mean that the transfer of some type of risk from one agent to another more willing to bear it assure that the ultimate risk-bearer will be able to better cope with it. In addition, derivatives can be associated with leverage and the creation of new risks, such as counterparty credit risk, which might aggravate financial fragility and instability.

For instance, numerous currency crisis took place in the 1990s: Mexico, a number of Asian countries, Russia and Brazil (Kregel, 1998; Farhi, 2001). Derivatives played a role in those events, as they were relevant to speculators' strategies that prompted speculative attacks on those currencies. Speculators were able to build up large exposures betting on the devaluation of emerging market currencies by means of derivative contracts without creating funding pressures on their balance sheets. In the absence of derivatives, they would not be able to leverage without the burden of finding funds to their speculative bets. So, in this case, it seems that derivatives have helped in destabilizing financial markets by amplifying volatility.

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<sup>40</sup> A market maker is 'An intermediary that holds an inventory of financial instruments (or risk positions) and stands ready to execute buy and sell orders on behalf of customers at posted prices or on its own account. The market maker assumes risk by taking possession of the asset or position'. (Schinasi et al. 2000: 66).