## 13. THE EFFECTS OF DERIVATIVES ON UNDERLYING FINANCIAL MARKETS: EQUITY OPTIONS, COMMODITY FUTURES AND CREDIT DEFAULT SWAPS

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### 13.1. INTRODUCTION

Financial innovations deeply affect the behavior of investors in all financial markets worldwide. As a result, investors appear to be constantly adapting to new financial products, practices, and institutional arrangements. Indeed, most market participants have to engage in a painstaking and costly cognitive process aimed at learning the implications and benefits of new financial instruments. Many financial innovations have been related to the development of derivatives for the last decades.

In this chapter we focus on three main categories of derivatives: equity options, commodity futures, and credit default swaps (CDS). These three types of derivatives have expanded rapidly over the last decades. The option markets have been growing since 1973, as soon as Black and Scholes found a straightforward formula to price them. Commodity futures have also happened to soar since 1973, as the oil crisis introduced a sudden instability in a previously tranquil market; they have surged again since the start of 2000s, when exchange traded funds began to invest in commodity-index based instruments. As well, the credit derivatives have been developing since the beginning of the 2000s in line with the securitization of banks' loans.

All these derivative instruments share common features that raise important issues for financial stability. First, although they were initially designed for protecting investors against losses that may result from adverse market price fluctuations on the underlying market, be it an equity, a commodity, or a bond, derivatives are also widely used by speculators. Consequently, protection for hedgers also goes with more risk-taking by speculators. Second, trading is often more intensive on the derivatives markets than on the spot markets. As a result, derivative markets may have taken the lead over their underlying market in the price discovery process. Although the evidence is mixed, the question is raised by a number of studies, especially for commodities and corporate CDS. Consequently, evolutions on these derivative markets have important implications for financial stability as well as for the real economy.

## 13.2.    EQUITY OPTIONS AND THE EFFECTS ON MARKET QUALITY AND INFORMATIONAL EFFICIENCY

Equity option listings are common financial innovations (in the sense that they can be observed multiple times per year) in which completely new option contracts are introduced onto the market for the first time by option exchanges. For instance, the number of stocks with option contracts has grown on average 20% per year between 1973 and 2009 in the United States alone. In 2009 over 3,366 million contracts were traded on more than 3,500 stocks, in contrast to the 911 contracts that were traded on 16 underlying stocks on the first day of trading on the Chicago Board Option Exchange in April 1973[1].

Currently, there are several empirical studies that examine the consequences of the development of equity options. The rising importance of option markets in modern economies, as well as the rapid rate of innovation in that sector, has generated interest among academics, practitioners and regulators. The first step in understanding the effects of equity options on financial markets is to answer the following questions:

i.    how is the *ex-ante* selection process from option exchanges to choose a stock which will be used as underlying for option contracts?; and

ii.    which are the factors that affect the *ex-post* adoption process among the investors?

In relation to the *ex-ante* stock selection process, Mayhew and Mihov (2004) and Danielsen *et al.* (2007) find that stock volume and volatility are the most important factors that may lead a stock to be selected as an "optionable" one, i.e., a stock on which derivatives may be written. Option exchanges are member-owned organizations in which listing decisions are made by the members whose profits are an increasing function of the trading activity. Thus, anticipating a strong option trading in the newly listed options plays a key role in the option exchanges' choice of which options to introduce.

Firstly, option exchanges select equities to introduce new option contracts using the stock volume, because volume will simply migrate from the spot to the derivatives market when investors view option contracts as substitute for taking directional positions in the underlying stock, as in Easley *et al.* (1998b). Volume will spill over in a positive-sum-game from the stock market to the option market when additional demand for options trading is generated by investors who own the underlying asset and wish to write covered calls or buy protective puts (see, e.g., Kaul *et al.* (2004)). Secondly, option exchanges also select stock with high volatility since it implies that new information hits financial markets at a faster

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rate thus creating a higher potential for divergence of opinions among agents and for hedging by investors holding long-term positions. Moreover, as emphasized by Mayhew and Mihov (2004), newly opened option markets also serve as venues for trading between investors with differences in volatility beliefs.

Regarding the ex-post adoption process, despite the enormous expansion observed in option markets, it is also true that new equity options listed by option exchanges have presented diverse adoption levels among investors. Moreover, some of the options introduced have disappeared in a de-listing process due to low demand for these securities. For instance, 20% of all the equity option listings between 1996 and 2009 in the United States were de-listed in the two years following their introduction dates[2]. In fact, option listings offer an excellent opportunity to study the adoption process of security innovations since the number of option contracts traded is endogenously determined by investors. In an equity option listing a set of standardized and brand new (i.e. never traded before) option contracts with the same underlying stock are introduced and allowed to be traded in an option exchange. However, for each option contract there is no initial 'established number' of contracts that should be traded in the exchange, which is contrary to other financial offerings where the number of assets is determined exogenously by an institution (e.g., a company decides the number of stocks or corporate bonds to be issued). Instead, in option markets investors themselves create the contracts in an endogenous process based on their demands and following the characteristics of the standardized contracts that offer the option exchange. For instance, an investor has to buy a call option contract while another one has to sell it in order to create that call option contract, which is coordinated by an option market maker[3].

Recently, Bernales and Guidolin (2013) show that options exchanges appropriately select stocks with high stock volume and liquidity as was reported by Mayhew and Mihov (2004) and Danielsen *et al.* (2007). Nevertheless, Bernales and Guidolin (2013) also find evidence that high levels of asymmetric information also predict the ex-post option adoption. For instance, Table 13.1 (which was taken from Bernales and Guidolin (2013)) presents a positive and significant relationship between different measures of asymmetric information in the year prior to the listing date (Columns 1 and 3) and option adoption levels measures by the option dollar-volume after the option listing. In addition, the results presented in Table 13.1 (columns 4 to 7) show that the levels of option adoption are positively and significantly related to the prior stock volume and volatility, which is consistent with the 'ex-ante' selection policy by option exchanges of introduc-

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[2]   Information obtained from the Option Clearing Corporation.
[3]   For a global view of option listings, see Mayhew and Mihov (2004), and for an understanding of the current option market structure see Battalio *et al.* (2004).

ing option contracts based on stocks with high stock volume and volatility, as mentioned above.

The intuition behind the relationship between option adoption and asymmetric information is that heterogeneous levels of information also generate differences of opinions among investors. On the one hand, the general public of investors may wish to hedge the adverse effects of informed trading on their equity positions by trading options written on the stock. In this case, options markets will be perceived as venues in which uninformed investors try to shield themselves from the existence of informed investors. On the other hand, informed investors may be eager for options markets to be created on the stocks for which they have access to superior information: options offer cheap ways in which private information may effectively be turned into profits. In fact, the literature (see e.g., Anand and Chakravarty (2007); De Jong *et al.* (2006), and references therein) tells us that there is strong empirical evidence of informed investors adopting fragmented trading strategies within option markets to try and maximize the trading profits from their private information. Thus, option listings enjoy higher chances of ex-post realized success when the listings concern underlying stocks that are characterized by pervasive information asymmetries. This is also consistent with the theoretical literature (see e.g., Brennan and Cao (1996); Vanden (2008)) that has emphasized how information asymmetries will normally increase both the demand and the traded volume of option-like derivatives.

### Table 13.1: Regression Analysis of the Impact of Different Factors on Ex-Post Option Adoption Rates[a]

| $PIN_{0Y}$ | $AdjPIN_{0Y}$ | $InvAnlst_{0Y}$ | $Ln(DVlm_{S,252,0Y})$ | $\dfrac{DVlm_{S,21,0Y}}{DVlm_{S,252,0Y}}$ | $SDev_{S,252,0Y}$ | $\dfrac{SDev_{S,21,0Y}}{SDev_{S,252,0Y}}$ | $Ln(Size_{0Y})$ | Const. | Obs. | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dependent Variable $Ln(DVlm_{OP,1Y})$ | | | | | | |
| 0.45 (2.02)** | | | 0.91 (11.73)*** | 0.40 (10.76)*** | 1.29 (3.91)*** | -0.26 (0.97) | -0.22 (1.03) | -9.28 (9.83)*** | 891 | 0.41 |
| | 0.49 (2.72)*** | | 0.83 (11.83)*** | 0.41 (11.23)*** | 1.18 (3.16)*** | -0.31 (2.78) | -0.15 (0.77) | -10.24 (11.31)*** | 891 | 0.43 |
| | | 0.83 (3.16)*** | 1.04 (12.16)*** | 0.48 (11.02)*** | 0.71 (3.63)*** | -0.46 (1.81)* | -0.08 (0.85) | -11.51 (11.20)*** | 891 | 0.48 |

a.  This table is taken from Bernales and Guidolin (2013). The table reports regressions of a measure of success of new and recently listed stock options on a range of explanatory factors. The dependent variable is the averages of the daily option dollar-volume in the first year after the option listing ($DVlm_{OP,1Y}$). From the independent variables side, $PIN_{0Y}$ is the probability of informed trading in the year prior to the option listing date (Easley *et al.* (1996)), which has been widely used in the literature as measure of asymmetric information. $AdjPIN_{0Y}$ is the adjusted probability of informed trading in the year prior to the option listing date, an alternative measure of informed trading proposed by Duarte and Young (2009) to correct the fact that the standard PIN may often capture spurious liquidity effects. $InvAnlst_{1Y}$ is the inverse of the average of the number of analysts also in the year prior to the option listing date. The use of the number of analysts is however also supported by Easley *et al.* (1998a) who state that: "(...) high analysts stocks face a lower probability of information-based trading (...)" (p. 200). The other independent variables used are: underlying stock volume, distinguishing between long-term ($DVlm_{S,252,0Y}$) and a short-term ($DVlm_{S,21,0Y}$) components, which are calculated as the average daily stock dollar-volume using the 252 and 21 trading days preceding the listing date, respectively; the underlying stock return volatility, distinguishing between long-term ($SDev_{S,252,0Y}$) and short-term ($SDev_{S,21,0Y}$) components, calculated as the annualized standard deviation of daily log returns over the 252 and 21 trading days preceding the listing date, respectively; and distinguishing between stock market capitalization ($Size_{0Y}$) calculated with reference to the year to listing. ***, **, and * denote significance at 1%, 5%, and 10%, respectively (*t*-statistics are in parentheses).

Once new option contracts are listed and traded by market participants, this new market affects importantly the underlying asset market from different edges. For instance, the finance literature has emphasized that derivatives improve market efficiency by lowering transaction costs (e.g., Merton (1998)) and by reducing the overall level of aggregate, systemic risk (e.g., Darby (1994)). Furthermore, there is evidence that equity options improve information flows (e.g., Cao (1999); De Jong et al. (2006); Kumar et al. (1998))[4]. For instance, option listings generate incentives for an increase in the number of market analysts since multiple option contracts on the same underlying asset are introduced simultaneously, and thus investors are willing to pay for additional information about the underlying asset's properties and payoffs (e.g., Cao (1999) and Massa (2002)). Therefore, option listing should induce an increase in the number of market analysts (e.g., Skinner (1990)), which should induce improvements in the quality of informational flows. For example, Figure 13.1 shows the evolution of the average number of analysts in the year prior to the listing date and for the following year, where the month zero is the month in which option contracts were introduced. In Figure 13.1, 12 months before the listing date, the number of analysts for optioned securities is on average 3.6; while that 12 months after option listings, the average number of analysts is 7.1 (an increase of 197%).

Equity options also induce a reduction in the asymmetric information through a learning process based on the private information revealed in the new option market. The learning explanations for the asymmetric information reductions involve two main informational origins. First, option trades (which provide an additional source of private trading information since two markets are now available) should accelerate the rate of disclosure of information from informed investors as result of the new observable market activity (e.g., Jennings and Starks (1986) and Diamond and Verrecchia (1987))[5]. Second, the increasing tendency in the number of analysts (as shown in Figure 13.1) is also fundamental for changes in the levels of asymmetric information, since more skilled and specialized people facilitate the detection of private information disclosed in trades of informed agents[6]. In fact, recently Bernales and Guidolin (2013) show that equity options reduce standard measures of information asymmetry as used in the microstructure literature. For instance, Table 13.2 shows that the asymmetric information of stocks is reduced once option contracts are listed. Out of a sample of 891 pairs
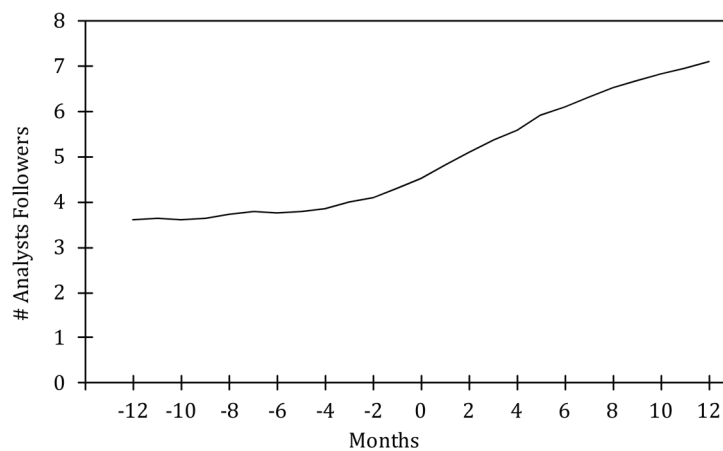
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[4] Empirical evidence shows that the U.S. national system of options exchanges has become progressively more informationally efficient and better integrated with the underlying spot equity markets (see e.g., Battalio et al., 2004).

[5] This is also supported by Kumar et al. (1998) and De Jong et al. (2006), who show that option listings are related to improvements in the market quality of the underlying asset.

[6] The main cognitive mechanism followed by uninformed investors is a learning-by-observing process which assumes that agents do not live in an isolated environment; and for that reason their surroundings should be a source of knowledge as well (e.g., Bikhchandani et al. (1998) and DeLong and DeYoung (2007)). Therefore, after an option listing uninformed investors might use the new information disclosed by informed agents in the option market activity to acquire this knowledge, and thus to make trading decision.

of matched levels of asymmetric information (before and after option listings) of equity option listings, 558 have smaller levels of asymmetric information after listings than in the year prior to the option introductions. Consequently, option trading is expected to improve the informational efficiency of the security market as a whole, in the sense that option trades contribute to reveal private information and improve flows of information (e.g., Chern *et al.* (2008); De Jong *et al.* (2006); Kumar *et al.* (1998); Senchack and Starks (1993)).

**Figure 13.1: Evolution of the number of analysts before and after the option listing[a]**



a.   This plot is based on the same data-sample used in Bernales and Guidolin (2013). This figure present the evolution of the average of the number of analysts making annual earnings forecasts for the company that issued stock that was selected by option exchanges to list option contracts. The data was obtained from the I/B/E/S database. We present the evolution of the cross-sectional monthly average of the number of analyst followers in the year prior to the listing month (month zero) and for the following year.

**Table 13.2: Reduction in Asymmetric Information after Option Listings[a]**

| | Obs. | #($AdjPIN_{0Y} > AdjPIN_{1Y}$) | %($AdjPIN_{0Y} > AdjPIN_{1Y}$) | Median $AdjPIN_{0Y}$ | Median $AdjPIN_{1Y}$ | Median % Change ($AdjPIN_{1Y}/AdjPIN_{0Y}$- 1) |
|---|---|---|---|---|---|---|
| | | | Differences in *AdjPIN* between the Year Prior to and the Year Following Option Listings Using Multiple Sub-Samples | | | |
| | | | Complete Sample | | | |
| *AdjPIN* | 891 | 558 | 62.63% | 0.16 | 0.13 | -19.96%[aaa,bbb] |

a.   This table is taken from Bernales and Guidolin (2013). The table presents a matched sample analysis of the effects of option listings on changes in the asymmetric information using the *AdjPIN* measure defined in Table 13.1. The matched pairs contain *AdjPIN* estimates from the year before and the year after option listings. The table reports results for both the paired-sample sign test and the Wilcoxon signed-rank test applied to the change from $AdjPIN_{0Y}$ to $AdjPIN_{1Y}$. The null hypothesis of no change in *AdjPIN* is tested against the one-sided alternative of $AdjPIN_{1Y}$ being inferior to $AdjPIN_{0Y}$. aaa, aa, and [a] denote significance at 1%, 5%, and 10%, respectively, for the paired-sample sign test. bbb, bb, and [b] indicate significance at 1%, 5%, and 10%, respectively, for the Wilcoxon signed-rank test.

Additionally, the literature has long debated whether option listings ought to affect the liquidity and volatility of the underlying stock market., Branch and Finnerty (1981), Conrad (1989), Damodaran and Lim (1991), Skinner (1989),

and Sorescu (2000) have tested whether option listings influence stock volatility but also warned that if exchanges list options in response to or in anticipation of changing volatility, selection bias may introduce a spurious relation between listings and volatility. Using a control-sample design that allays the endogeneity concerns, Mayhew and Mihov (2004) report that optioned stocks tend to experience a larger volatility increase, or a smaller decrease, than options in their control sample; however their result remains mixed. Interestingly, similar ambiguous theoretical (see Cao (1999); Massa (2003)) and empirical (see e.g., Damodaran and Lim (1991); Skinner (1989)) findings concern the effects of option introductions on the volume of the underlying stock, because in a few cross-sectional studies it has been reported that the increase in volume may disappear after controlling for aggregate market volume.

Although empirical studies have confirmed weak results concerning the impact of listings on volumes and volatility of the underlying stocks in option data, the causal link that this section wants to emphasize has, after all, a "happy ending", if we assume that the goal of capital market is to improve the market efficiency. As we mentioned previously, there is evidence that the more successfully adopted equity option listings are the ones in which the underlying stock has high levels asymmetric information. However, equity options reduce the original levels of asymmetric information, in the sense that in the underlying stock market there are less information-driven trades. Even more, there is also evidence that equity options improve the market efficiency by decreasing transaction costs and market risks. These links of the chain have a classical Grossman and Stiglitz's (1980) flavor: informed traders are rewarded for their activity of acquiring information and taking it to the market; as they perform this role, they cause their privileged information to depreciate and to be incorporated into prices. The only, to us rather major, difference in the story – as a result of this virtuous mechanism – in the end the financial system finds itself enriched of a new and useful conduit for these information flows, the newly created option market.
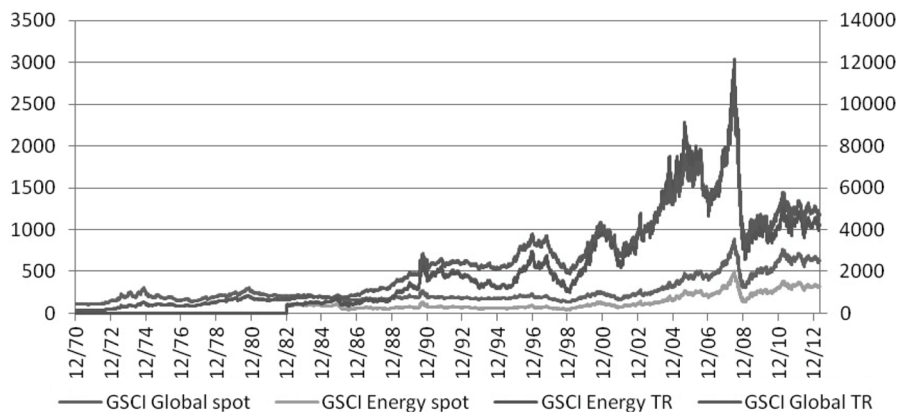
## 13.3.    COMMODITY FUTURES

Commodity derivative markets have approximately followed the same pattern as equity derivatives as concerns their sudden expansion during the seventies. This may seem puzzling considering the fact that this kind of instruments has been used since the dawn of history, as attested by a great number of tablets found in Mesopotamia and that commodity futures have been traded in Chicago since the nineteenth century. However, in the aftermath of World War II, the restrictions of capital movements imposed by the Bretton Woods system as well as the financial

stability experienced during this era did not foster the development of derivative markets, commodity futures or others.

The market was first revived when the convertibility of the USD to gold collapsed in 1971, which encouraged the trading of gold derivatives. Then the oil crisis in 1973 which drastically raised the volatility in previously stable oil prices, boosted oil derivatives, as agents became more inclined to hedge against adverse price movements.

In the 2000s, as the commodity prices surged again after two decades of relative decline, commodity derivative markets experienced a huge expansion. As a matter of fact, the development of commodity derivatives is in line with these price hikes and volatility peaks (Figure 13.2). The causality can be both ways. The more volatile the prices, the greater incentives are for agents to hedge as well as to speculate. On the other hand, it can be argued that more developed derivative markets may have a part in the surge of commodity prices and the higher volatility in the 2000s.

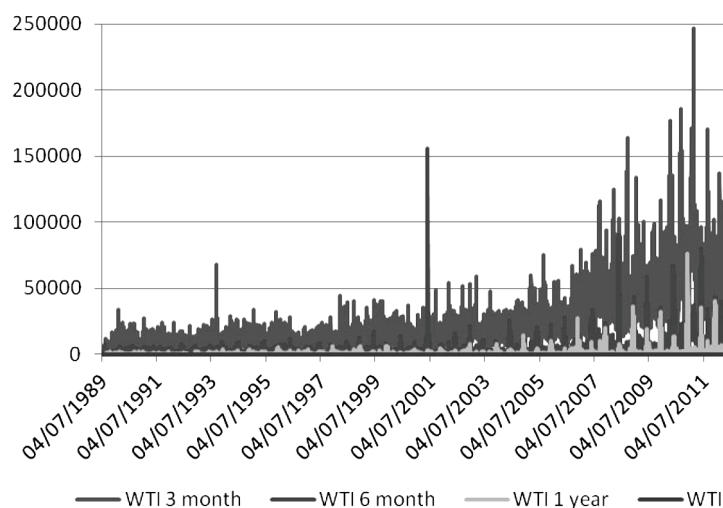**Figure 13.2: SPGSCI Commodity index, spot and future total returns**



*Source*: Bloomberg.

## 13.3.1. The Rise in Commodity Derivatives in the 2000s

The volume of derivative market transactions on OTC and organized markets largely exceeds that of physical market transactions (Domanski and Heath (2007)). For example, on the oil market, the number of derivative transactions represents 35 times the transactions traded in the physical market (Chevalier (2010)). Contracts on the WTI (West Texas Intermediate) used as a benchmark for oil pricing surged in the 2000s, especially on the 3-month maturity (Figure 13.3).

Transactions on indices and/or exchange traded funds (ETFs) of commodities also posted a spectacular development. The main commodity indexes are the Standard & Poor's and Goldman Sachs Commodity Index, (SPGSCI) and the Dow-Jones-UBS (DJ-UBS). Both include a large share of energy among the retained commodities. Between 2003 and March 2008 the volume of transactions on commodity-index based instruments acquired by institutional investors rose from USD 13 billion to USD 260 billion (Master (2008)). Numerous other studies point to this rapid development (Petzel (2009); Mayer (2009), Tang and Xiong (2010)).

**Figure 13.3: Number of contracts on the WTI**



Financial operators, banks, hedge funds and specialized traders, have been increasingly active in these markets. There are basically two types of players in this domain: (i) 'index traders' who systematically take long positions on forward markets and roll them over before the delivery date, and (ii) the 'money managers', like hedge funds, which have a more active management since they conduct arbitrage from both sides of the market, often following the trends (Greely and Currie (2008); Currie *et al.* (2010); Mayer (2009)). Indeed, commodity futures are attractive for investors as they generate higher yields than the risk-free rate with little or no correlation to the yields from other asset classes and their performance cannot be replicated by any combination of other assets (Mongars and Marchal-Dombrat (2006)).

### 13.3.2.  The Reasons behind the Market Expansion

Investing in commodity futures is less profitable in the long-run than equity indices, although the volatility of returns is approximately similar on the two types of assets. As a matter of fact, passive allocations in individual commodities do not generate much alpha on average, but a tactically weighted portfolio can produce returns similar to equities (Erb and Harvey (2006)). The returns can also be improved by selecting commodities based on their inventory levels (Gorton *et al.* (2007)). On the whole, the main reasons to invest in commodity futures are not high profitability or small volatility. The rationales behind investing in commodity derivatives are: first that they offer a protection against inflation and second that they provide a portfolio diversification.

First, commodity futures are supposed to provide protection against inflation in the long term (Bodie and Rosansky (1980)). Taylor (1998) finds a similar result for precious metals as do McCown and Zimmerman (2007) although the degree of protection varies from one period to another. As commodities offer a certain level of protection against inflation, they are sought by long-term investors whose charges are indexed to inflation (pension funds, endowments, etc.). Nijman and Swinkels (2003) show that the addition of commodities to their portfolio improves the strategic allocation for pension funds with inflation-indexed liabilities. This is not necessarily the case for pension funds with nominal liabilities, except under certain macro-economic conditions. Kat and Oomen (2006) also find that the returns on commodities futures are positively correlated with unexpected inflation. However, their protective capacity is variable from one commodity to another.

Second, the other major advantage of commodities is to diversify portfolio risk thanks to their relatively low correlation with equities and bonds (Bodie and Rozantsky (1980)). In addition, Gorton and Rouwenhorst (2006) have shown that the SPGSCI index has an average positive return during periods of entry into recession, just when equity prices are falling. The negative correlation with equities during these periods is an incentive to include commodities in an equity portfolio. Coudert and Raymond (2012) also find this property for gold futures, which may be seen as safe haven to protect investors against their losses on equities during bear markets and recessions. More generally, commodity futures are not correlated to equities and bonds, although the correlations vary depending on the phases of the business cycle according to Kat and Oomen (2006). A de-correlation with equities is also shown in the case of oil (Geman and Kharoubi (2008)).

For Silvennoinen and Thorp (2010), the diversification property of commodities futures may fade away with the massive arrival of financial actors on the

commodity markets. According to these authors, correlations have increased between commodities and financial assets (equity indices in different countries and US bonds) since the late nineties. However, this result is controversial. For other authors, financialization of the commodity market in the 2000s has not brought about an increase in the correlation between commodities and equities (Buyuksahin and Robe (2010)), which is evidenced by the dynamic correlations between the yields from commodities index – the Goldman Sachs Commodities Index (GSCI) and those from US equity indices (the S&P 500). Buyuksahin *et al.* (2009) also show that this rise in the correlations is not a trend, as it only occurred during the crisis in 2008.

In addition to the diversification provided by commodities relatively to bonds and stocks, another source of interesting diversification relies inside the commodities themselves. In this matter, most studies point to a rise of the correlations between the prices of different commodities over the past decades. In their 1980 study, Bodie and Rosansky did not find any significant correlation between the future prices of the 23 commodities in their sample. In contrast, for Pindyck and Rotenberg (1990), the correlations between different commodities are very strong. These high correlations cannot be explained by common macroeconomic factors, but are attributed to the herd mentality of financial operators. For Kat and Oomen (2006), the correlations are very high indeed within each category of commodity, but low between the categories. More recent studies show that there may well be an increase in the correlations between commodities, particularly between oil and agricultural raw materials. Casassus *et al.* (2009) also observe an increase in the correlations between commodities, but consider this phenomenon to be caused by common economic factors.

An interesting hypothesis is that these rising correlations between the prices of different commodities is due to the massive investments in commodity indexes. This hypothesis stated by Tang and Xiong (2010) is comforted by their empirical observations. According to their results, the correlations between the commodities belonging to the major indices (SPGSCI and DJ-UBS) are substantially stronger than for the other commodities not included in the indices.

### 13.3.3. Speculators, Hedgers and the Difference between Spot and forward Price

For Keynes (1930), risk-averse commodity producers seek protection from price contractions by selling on the futures markets. In so doing, they exert a downward pressure on the futures prices compared with the spot price. This leads to a lower futures price than the expected spot price, a situation described as 'normal backwardation'. Speculators, by acquiring these assets at lower forward prices,

benefit by extracting a risk premium. By extension, a 'backwardation' situation is defined as a future price below the spot price, a scenario that is often observed on commodity markets. Working (1949) considers that the spreads between future prices and spot prices depend above all on inventory levels. The 'backwardation' situation characterizes a market in which available stocks are low; but the situation can reverse (into a "contango") if stocks are high. Hence future prices and spot prices are linked by a trade-off relationship that depends on stock levels. This stock-based hypothesis is still the dominant theory (*cf.* notably Fama and French 1987; Gorton *et al.* (2007); Geman and Ohanna (2009)).

Speculation may be considered excessive when it exceeds hedging requirements (Working (1949)). Excessive speculation can be measured by the ratio between the observed speculation on the market and the requirements for hedging protection, which is called Working's T-index. Since a certain level of speculation is necessary for market liquidity, the preferred ratio is slightly higher than 1. CFTC data, which distinguishes between commercial agents and non-commercial agents, allows the calculation of this index. By analyzing these data, Till (2009) concludes that speculation was not excessive on oil derivatives market (futures and options) from June 2006 to October 2009, compared to historical benchmarks. Irwin and Sanders (2010) consider 12 main agricultural commodities markets for the period June 2006 to December 2009 and find that a majority of them had a T-index under 1.15 on average over this period.

Acharya *et al.* (2010) show with a theoretical model that the risk-averse producers may be forced to pay more for their hedges if speculators are capital constrained. When speculative activity contracts, the risk premium associated with a hedge increases. This result is confirmed by an empirical analysis. The influence of futures markets on spot prices results from the fact that these futures markets allow producers to adjust their inventories to demand shocks. The consequences of the limits of arbitrage are also analyzed by Etula (2009). As the OTC market is very large, the capacity of broker-dealers to carry the market risk is a key factor in hedging costs. In a theoretical model, Etula (2009) shows that the risk premium decreases with the leverage of brokers and dealers. He also provides some empirical evidence to support this relation.

Sanders *et al.* (2008) show that in the domain of agricultural products, the arrival of new players on the market via index trading has been balanced by the simultaneous arrival of new sellers. This suggests that index management is beneficial to a market whose hedging requirements are traditionally governed by sellers. Chinn and Coibon (2010) show that future prices are unbiased predictors of spot prices in the energy market. This is not the case with other commodities, particularly those with low levels of market liquidity. However, as transaction volumes have grown, future prices have become more reliable predictors of spot prices in recent years.

### 13.3.4. Two Opposite Views on the Consequences of Derivatives Expansion on Commodity Prices

As the prices of commodities surged in the 2000s, especially from 2006 to 2008, a number of observers have argued that the *financialisation* of the commodity markets through derivatives trading was at the root of these anomalies. However, this view is far from being unanimous and is still debated in the literature (Arrata and Coudert (2011a)). Let us review their arguments of the two sides.

On the one hand, financialisation was responsible for the surge in commodity prices in 2006-2008 according to Masters (2008)' testimony before the US Senate. The considerable flows channeled by index funds increased demand and pushed up prices. He bases his view on the simultaneous rise in the purchases by index traders and in the price of commodities since 2000. The US Senate (US Senate Permanent Subcommittee on Investigations (2009)) takes up this argument and deems that the surge in wheat futures prices is due to index funds. In his testimony before the CFTC, Petzel (2009) also considers that the long positions taken by index funds increase demand in derivatives markets. Even if buyers find speculators to be short-term counterparties to sell to them, if the long position is held for a long time, at some point it will probably find a commercial counterparty. This counterparty will deliver at maturity or will roll its position forward if storing the commodity is more profitable. Thus, index funds' entry into the market has led to rising spot prices combined with the build-up of inventories by futures sellers. However, Petzel warns the CFTC against banning financial investors' access to futures. Such a ban would prompt them to operate directly in the physical market, with even more serious consequences for final consumers given the lack of experience of these players in the management of inventories. In his report for the CFTC, Mayer (2009) likewise concludes that index trader positions were at the root of the 2006-2008 price rises. Using Granger causality tests, he shows that index trader positions "cause" price fluctuations, particularly for agricultural products. In their study, Caballero *et al.* (2008) link the surge in oil prices in 2006-2008 to global imbalances and to the shortage of financial assets available for investors. This shortage led to the subprime crisis and then to the formation of a bubble in commodity markets.

On the other hand, some economists consider that commodity prices are formed above all in the physical markets – derivatives are therefore not responsible for market volatility. The price rises in 2006-2007 can also be explained by real factors: (i) the unexpected increase in global demand due to strong growth in the emerging economies, notably China and India; (ii) the low short-term price elasticity of supply and demand; (iii) the reluctance of oil producers to augment their production capacity (Krugman (2008a, 2008b); Kilian (2009); Kilian et Hicks (2009); Hamilton (2009)), (iv) the increasingly intensive use of agricultural land

to produce biofuels, which contributed to the surge in prices of agricultural products. Conversely, the turnaround in prices in the summer of 2008 was due to the global recession or to its expected onset.

Krugman (2008a, 2008b, 2008c) reacts vigorously to Masters' report (2008) and strongly denies the idea that financialisation has increased market volatility, as he is convinced that price fluctuations are due solely to interventions on physical markets. In his view, the high volatility of commodities is attributable to the short-term inelasticity of supply of and demand for most commodities. Players in the futures market have no impact on the spot price of commodities as long as their transactions neither change the physical quantities bought and sold on the spot market, nor the level of inventories. Kilian and Hicks (2009) estimate demand shocks using the revisions by professionals of GDP growth forecasts. They show that during the period in which oil prices rose there were large upward revisions of expectations of growth in emerging countries, which constituted shocks regarding expected demand. These adjustments of expectations largely account for the surge in oil prices that occurred during the mid-2003 to mid-2008 period and the subsequent turnaround. Hamilton (2009) analyses the link between financialisation and the spot price of oil. He judges that demand from index funds does not necessarily cause prices to rise. This might happen solely if a number of conditions arose simultaneously: (i) the presence of index funds increased forward prices; (ii) the price elasticity of demand was zero or close to zero; (iii) and inventories increased or production fell. Yet, according to the statistics available, inventories did not increase in 2006-2008. However, it is possible that oil producers did not wish to increase their output sufficiently. If this was the case, financialisation is not really implicated. Rather it was the speculative behavior of producers with their underground stocks that pushed up prices. Irwin and Sanders (2010) show that the positions taken by index traders have not led to an increase in prices on agricultural commodities markets. Moreover, larger long positions by index traders lead to lower volatility. These results are obtained through Granger causality tests over the 2006-2009 period for the main agricultural commodities. Buyuksahin and Harris (2009) show that price fluctuations lead the positions taken by noncommercial traders on the crude oil market, rather than the other way round. They obtain these results using a Granger causality test over the 2000-2008 period.

## 13.3.5. The Role of Derivatives in Volatility of Commodities Prices

Both fundamentals and financialisation are likely to explain the evolution in prices. For Currie *et al.* (2010), economists at Goldman Sachs, the formation of commodity prices takes place above all on the physical spot markets. However,

they admit that speculation partly contributed to the rise in oil prices in 2006-2008 and calculate its impact to be USD 9.50 per barrel. But contrary to the above-mentioned analyses, index investors only appear to have slight impact because, due to their passive management, they provide little information to the markets. Hence, changes in their positions are not likely to move prices. Conversely, active investors' positions may have had an impact on prices. These conclusions are consistent with those of a previous study carried out for Goldman Sachs by Greely and Currie (2008).

Volatility in commodity prices significantly increased in the 2000s compared to the previous decades, even if we remove the 2008 crisis episode (Arrata and Coudert (2011b)). However, it is hard to incriminate the growth of derivatives markets for this movement because climatic considerations may also have played a role. Indeed, compared with very long periods, it is also not sure that the volatility in commodity prices has really increased as agricultural prices have been volatile since the dawn of time. This is precisely evidenced by Jacks *et al.* (2009) that study commodity prices going back to 1700. Volatility in commodity prices was even a key characteristic of the economy in the 18th century. In fact, globalization and the integration of markets have reduced price volatility. Admittedly their data stop at 2005, which does not include the peak of volatility observed during the 2007-2009 crisis. Yet, most studies that show a rise in volatility do so precisely on the basis of this crisis.

On the whole, the role of financialisation in market volatility remains tenuous, despite the strong positions taken in different papers. However, since volatility creates a climate of uncertainty that is detrimental to growth in supply, efforts should be made to reduce it through increased market regulation.
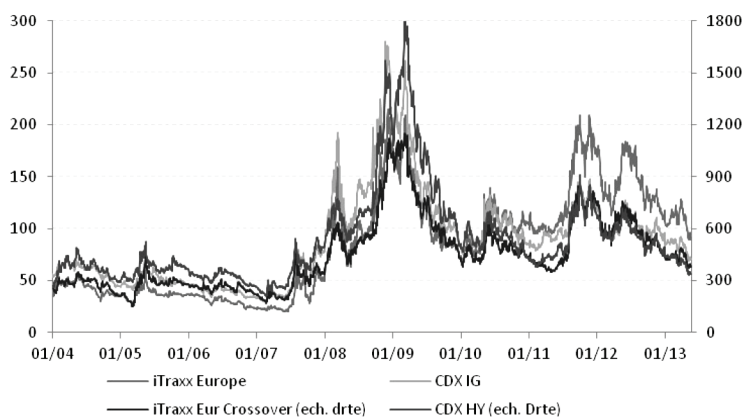
## 13.4.    CREDIT DEFAULT SWAPS

Credit derivatives are more recent instruments, aimed at protecting bondholders against the risk of a borrower's default. The most popular is the credit default swap (CDS), the market of which surged in the early 2000s. CDSs are over-the-counter (OTC) instruments, contrary to a number of commodity futures and options that are traded on organized markets. Indeed, OTC markets are less regulated and more prone to counterparty risk than organized markets. Hence, a number of initiatives have been taken since 2008 in order to mitigate the counterparty risk on the OTC markets, especially by introducing more collateral requirements and clearing through central counterparty.

For corporates, the CDS market is now more liquid than the underlying bond market, which gives much importance to the CDS quotations. For sovereigns,

although bond markets are more liquid, the CDS market has also became a major indicator for the sovereign default risk.

CDSs are designed to hedge against default risk, but as any other derivatives, they can also be used to speculate. The stunning increase in the price of protection for corporates, especially banks in the 2008 crisis, has raised interrogations about the role of speculation on this market (Figure 13.4). That CDSs were traded over-the-counter in a rather opaque way has contributed to fuel fears on this market. Later on, in the sovereign crisis in the euro area, the rise in the CDS premia of the peripheral countries (Figure 13.5) has triggered new criticisms on the speculative use of the market, ending up to the European governments banning the use of "naked" sovereign CDS (buying a CDS without holding the underlying bond). Indeed, bond and CDS prices are now completely interconnected, to such an extent that it is hard to disentangle which leads the other (Coudert and Gex (2010a)).

**Figure 13.4: Corporate CDS indexes for Europe and North-America**



*Source:* JPMorgan 21/05/2013

## 13.4.1.  The functioning of the CDS

Three parties are involved in a CDS: a buyer; a seller; and a reference entity, which is the borrower, corporate or sovereign. The CDS allows the buyer to hedge against the risk of a default by the borrower over a given horizon (often 5-year) for a given face value *F*. To do that, he (she) agrees to pay a premium as a percentage of the face value to the seller until maturity, or until default, if one occurs during the period. Premiums are usually paid quarterly. In return, the seller agrees to compensate his (her) loss in full in case of default.

**Figure 13.5: Sovereign CDS index in for Europe**



*Source:* JPMorgan 21/05/2013

In case of default, two settlements are possible: first, a physical settlement, where the CDS holder delivers the underlying security to the seller, who pays him (her) the full face value $F$; second a cash settlement, where the seller pays the buyer the amount $F \times (1 - R)$, where $R$ is the recovery rate; the buyer then does not deliver the underlying security.

In theory, under both options, a CDS buyer who holds a bond with the same face value is fully protected by the CDS against the risk of default. This is obvious in the case of physical settlement. It is also true if there is a cash settlement and if the CDS market is in step with the bond market. The buyer will be able to recover $F \times R$ by selling his bond on the secondary market and the remainder $F \times (1 - R)$ from the CDS seller.

Though most derivatives, whether swaps or options, are theoretically designed to provide risk protection, they are also widely used to speculate on the future values of the underlying assets. CDS are no exception: many CDS buyers do not hold the underlying securities. You can buy a CDS on entity X without holding the underlying debt, thus recovering $F \times (1 - R)$ if X defaults. You could also buy a CDS on X without expecting a default. For example if you think that X's probability of default will increase, you can make a profit by buying a CDS now and unwinding the position later. For buyers, it is not a risky practice, since the cost is known when the contract is agreed and is confined to the premium payments. Like for equity options, the risk is taken on by the seller.

At any rate, the number of participants on the CDS market far exceeds the number of holders of the underlying bonds. As an example, in the 2005 Delphi failure, the notional value of CDS (USD 28 billion) exceeded actual bonds and
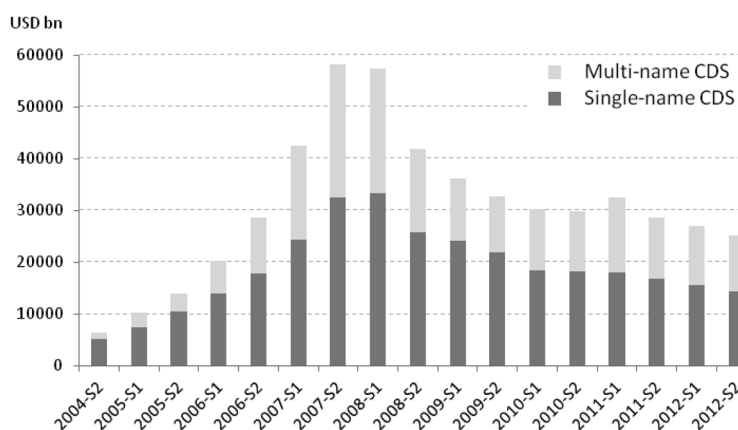
loans (USD 5 billion) by a factor of 5.6. Collins & Aikman, Delta Airlines and Northwest Airlines had even higher ratios (Coudert and Gex (2010c)). Because the amount of protection far exceeds the deliverable underlying assets, the default settlement process has changed. Settlement can no longer be exclusively physical, because this would artificially boost the price of the underlying bonds over the normally expected recovery rate. Furthermore, because some CDS on defaulting entities belong to indices, it became necessary to have a single recovery rate so that all investors with a position on the index could be treated fairly. After the 2005 failures involving automotive parts manufacturers and airlines, an auction system was introduced to provide fair treatment and to link the two settlement methods (Coudert and Gex (2010b, 2013b)).

## 13.4.2. The Rise and Fall of the Market

The CDS market soared from the beginning of the 2000 up to 2008, its notional amount reaching USD 58 trillion. Different compartments of the market expanded in line: the single-name CDSs, which concern one entity of reference as well as the CDS indexes that regroup a number of borrowers. The main indexes for investment grade firms are the CDX-IG for the US and the iTraxx for the euro area, which include 125 entities in each zone. The indexes for the high-yield corporate, are respectively the CDX-HY and the iTraxx Europe Crossover for the same area. Moreover, since the beginning of the 2000s, the sovereign CDS market expanded strongly first for the emerging countries, and then after the 2008 crisis for the advanced countries. Sovereign CDS indices were also created.

Before 2008, the expansion of the CDS market was partly due to some double accounting. For example, if a CDS holder wanted to sell back its CDS, most of the time, she had to sell another CDS on the same entity on a close maturity. After the bankruptcy of Lehman Brothers, some observers feared that the fragility of a CDS market would collapse in the settlement of such a large default. In fact there was a netting of the position, which drastically reduced the amounts of CDS to settle (Coudert and Gex (2010b)). From 2008 on, there was a fall in the notional amount outstanding due to the compression process, designed to consolidate the gross positions of the different participants. The fall of the market from USD 58 trillion to 25 trillion in 2012 is partly explained by this compression.

**Figure 13.6: CDS notional outstanding**



*Source:* BIS Statistics OTC Derivatives

## 13.4.3. CDS Premia and Bond spreads in a Default-Free Risk Portfolio

Obviously, the CDS premium should increase with the probability of default of the borrower and decline with the expected recovery rate, just like a bond spread. In theory, the CDS and bond spreads should be approximately equal for the same borrower and maturity (Duffie (1999); Hull and White (2000)). To see this, let us consider a portfolio including these two assets: a bond with a yield of $y_t$ and a CDS with a premium of $c_t$ issued by the same entity and with the same maturity. By purchasing this portfolio, an investor is covered against the default risk linked to the bond; her annual return is $y_t - c_t$. By arbitrage, this return should be equal to the risk-free rate of the same maturity denoted $r_t$. This means that the CDS premium should be equal to the bond yield minus the risk-free rate: $c_t = y_t - r_t$. As the bond spread $s_t$ is also defined as the bond yield less the risk-free rate, this implies the approximate equality between the two spreads.

However, the strict equality does not hold, due to the imperfect match between the two types of contracts (Blanco *et al.* (2005)) and liquidity effects (Cossin and Lu (2005); Longstaff *et al.* (2005)). The "basis" $b_t$, defined as the difference between a bond spread and the CDS premium on the same entity and same maturity, is different from zero, although close to it.

In particular, Hull and White (2000) emphasized the role of accrued interests. In case of default, CDS holders can get the par value of the bond but not the accrued interests. The arbitrage relationship must be adjusted for this factor. Other factors also hinder complete arbitrage (Olléon-Assouan (2004); De Wit (2006)). Some

factors make the basis positive: (i) in the event of borrower default, the CDS holder may supply the cheapest to deliver bond; the seller therefore ends up with the most discounted securities. In this case, the CDS seller suffers a loss. To compensate for it, she will ask for a premium higher than the spread. (ii) Short positions are difficult and costly to take on the bond market. If economic agents expect the borrower to default, it is easier to buy CDS. (iii) The CDS contract makes a provision for payment in the event that the borrower should default; however, the default may concern only part of the bonds, which implies that the CDS seller is more exposed to risk than the bond holder.

Conversely, apart from accrued interests, other factors make the basis negative. (i) The CDS buyer is exposed to counterparty risk, if the protection seller defaults; this risk is all the more high as defaults may be correlated, preventing sellers from meeting their payments. (ii) On the CDS market, investors may sell protection at a price $c_t$ without any initial outlay (apart from margins); this is not the case for an investment on the bond market, which must be financed through a loan. The plain arbitrage described by equations (1) and (2) assumes that investors are able to borrow at risk free-rate. In reality, it depends on the cost of the loan – the higher the cost, the less profitable the investment in bonds. For high yield investors, it may be more profitable to sell protection than to buy a bond. The CDS premium should therefore be lower than the bond spread. (iv) Securitization via collateralized debt obligation (CDO) issuance encourages banks to sell CDS, which contributes to reducing the basis.

## 13.4.4. CDS Premia and Bond Spreads in Empirical Studies

Several studies try to explain the determinants of the CDS premium empirically. Alexander and Kaeck (2006) study the variations of the sectoral components of the major European CDS index, the iTraxx. They show that these variations can be partly explained by the implied volatility of the DJ Eurostoxx 50. Moreover, according to these authors, the iTraxx is subject to regime switching and is more sensitive to the variations of stock market variables during periods of stress. Andritsky and Singh (2006) also show that the pricing of CDS could be affected by financial turmoil, especially concerning recovery rates, that turn out to be a key determinant in distressed periods.

Another issue relates to which market has the lead on the other in the price discovery process. In several studies, the CDS market has been evidenced to have the lead on the bond market. In other words, innovations on the CDS market have a greater tendency to spill over to bond spreads than the other way round (ECB (2004); Norden and Weber (2004); Blanco *et al.* (2005); Zhu (2006); Baba and Inada (2007); Coudert and Gex (2010a)). Crouch and Marsh (2005) show that

this link is especially strong for the auto sector. According to them, the CDSs of General Motors, Ford and DaimlerChrysler tend to lead their bond spread. These CDS also lead the CDS premia of the other firms of the sector, especially over the periods when the premia of the carmakers globally rise.

The links between CDS and equity are more controversial. A priori, as a rise in a CDS premium is linked to the firm's financial difficulties, it should go with a decline in its stock price, as consistent with the framework of Merton's model. Some studies find that the equity market has a lead over the CDS (Norden and Weber (2004); Byström (2005)), although results are mixed.

## 13.4.5. CDS Premia and Bond Spreads during Crises

Bond and credit default swap spreads have been particularly high and volatile since the onset of the 2008 crisis. They surged dramatically for financial institutions in the immediate aftermath of the bankruptcy of Lehman Brothers; later on, spreads on sovereign debt also soared across the board. On the one hand, these movements could be attributed to the normal reactions of markets: as defaults are expected to be more frequent during crises. On the other hand, credit derivatives markets have possibly overreacted during the crisis through speculation, driving the bond market into more bearish territories.

A key question is then to know whether the CDS market has a tendency to fuel rises in bond spreads during financial turmoil. This may well happen as holding long positions in CDS comes down to shorting bonds, which is not always possible on the corporate bond market. Therefore, once they have sold out their long positions in debt on a risky borrower, bearish market participants are more likely to be found trading on the CDS market. Consequently, the lead of the CDS market could be enhanced during crises. Are the relations between markets disrupted or accentuated during episodes of financial turmoil? Indeed, some papers hint at an impact of financial stress on the CDS market. For example, Alexander and Kaeck (2006) evidenced that the implied volatility of the DJ Eurostoxx 50 has an impact over the sectoral components of the iTraxx, the European CDS index. Andritsky and Singh (2006) also show that the pricing of CDS could be affected by financial turmoil, especially concerning recovery rates, that turn out to be a key determinant in distressed periods.

In the first half of 2010, while CDS and bond spreads soared for several European states, some observers blamed the CDS market and called for a ban on naked positions, arguing that they can result in rising costs for government debt (see for example: Portes (2010)). As a matter of fact, this is a relevant issue, as the information conveyed by bearish participants on the CDS market may accelerate the process of rising interest rates.

According to Coudert and Gex (2013a), the relationship between the CDS and the bond market may exacerbate some transmission channels between the two markets, although in a very different way for corporates and sovereigns. For corporates, the CDS market has a lead on the bond market in the price discovery process and the financial crisis has significantly amplified this role. This results from the greater liquidity of the CDS market than the bond market for corporates and can be rationalized in the following way. Once they have sold out all their bonds, pessimistic participants end up trading on the CDS market, as short selling of bonds is less easy. In those conditions, debt crises and risk aversion have a tendency to fuel the CDS market. On the other hand, for low-yield sovereigns, the bond spread is still leading the CDS spread, which is in line with the huge size of the government debt compared to that of the CDS market. However, this result does not hold in high-yield countries, where the default risk has surged and the CDS market has been growing very rapidly since the recent crisis.

## 13.5. CONCLUSION

Derivatives represent one of the most notable and influential innovations of the last decades in financial economics. In this chapter, we examine the evolution and the potential effects on the underlying market of three important instruments: equity options, commodity derivatives, and credit default swaps. Understanding the impacts of these three types of derivatives on financial markets has enormous importance for both policy and practical perspectives, in particular in assessing their costs and benefits.

As is often the case in economics, we can see pros and cons to the use of these derivatives and there is no consensus among economists on their overall effects on welfare. On the one hand, derivatives clearly play a useful role as long as they allow market participants to hedge against future price fluctuations. Moreover, a number of studies reviewed in this chapter concur to show that derivatives help produce information on the price of the underlying market. First, there is some evidence that equity options reduce the levels of asymmetric information among agents, and improve market efficiency by decreasing transaction costs and market risks. Second, commodity futures are also useful, not only to protect producers and final users against uncertainty in prices, but also because they allow investors to diversify their portfolio (due to their low correlation with equities and bonds), in addition, they may as well provide a protection against inflation in the long term. Third, by offering protection against the risk of a borrower's defaults CDSs contribute to reduce creditors' risk, hence allowing them in some cases to continue lending to risky borrowers.

On the other hand, when it comes to volatility, the jury is still out. The case is not clear yet whether derivatives absorb or amplify volatility. In addition, the expansion of insurance types of derivatives may feed the false impression of being protected as individual investors while, collectively, systemic risk has effectively increased. This is a sound warning against complacency as we are still recovering from the sub-prime crisis.

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