6 Other derivatives

6.1 Learning outcomes

After studying this text the learner should / should be able to:

1. Comprehend the existence of derivatives that are not classified under the traditional derivatives (forwards, futures, swaps and options)
2. Describe the derivative product: products of securitisation
3. Elucidate the derivative product: credit derivatives
4. Explain the derivative product: weather derivatives.

6.2 Introduction

The mainstream derivatives were discussed above. As stated before, derivatives are instruments that cannot exist without their underlying instruments and their value depends on the value of these underling instruments; and the traditional underling instruments are share prices, share indices, interest rates, commodity prices, exchange rates, etc.

Over the past decades, and in some cases over the past few years, other derivatives have been developed that are based on the prices of other underlying variables. For example, the following derivatives are available in international markets):

- Securitisation.
- Credit derivatives.
- Weather derivatives.
- Insurance derivatives.
- Electricity derivatives.

Insurance derivatives have payoffs that are dependent of the amount of insurance claims of a specified type made during the period of the contract. *Electricity derivatives* have payoffs that are dependent on the spot price of electricity. Here we briefly discuss the other three mentioned.

6.3 Securitisation

The products of securitisation *may also be seen as "derivatives"* because they and their prices are derived from debt or other securities that are placed in a legal vehicle such as a company or a trust. Some analysts will insist that these products are *not derivatives*. However, the jury is still out in this respect.

Securitisation amounts to the pooling of certain non-marketable assets that have a regular cash flow in a legal vehicle created for this purpose (called a special purpose vehicle or SPV) and the issuing by the SPV of marketable securities to finance the pool of assets. The regular cash flow generated by the assets in the SPV is used to service the interest payable on the securities issued by the SPV.

There are many assets (representing debt) that may be securitised, and the list includes the following:

- Residential mortgages.
- Commercial mortgages.
- Debtors books.
- Credit card receivables.
- Motor vehicle leases.
- Certain securities with a high yield.
- Equipment leases.
- Department store card debit balances (examples: Edgars card and Stuttafords card).

For the banks, securitisation amounts to the taking of assets off balance sheet and freeing up capital[67]. For companies, securitisation presents an alternative to the traditional forms of finance. An example of the latter is the securitisation of company's debtors' book.

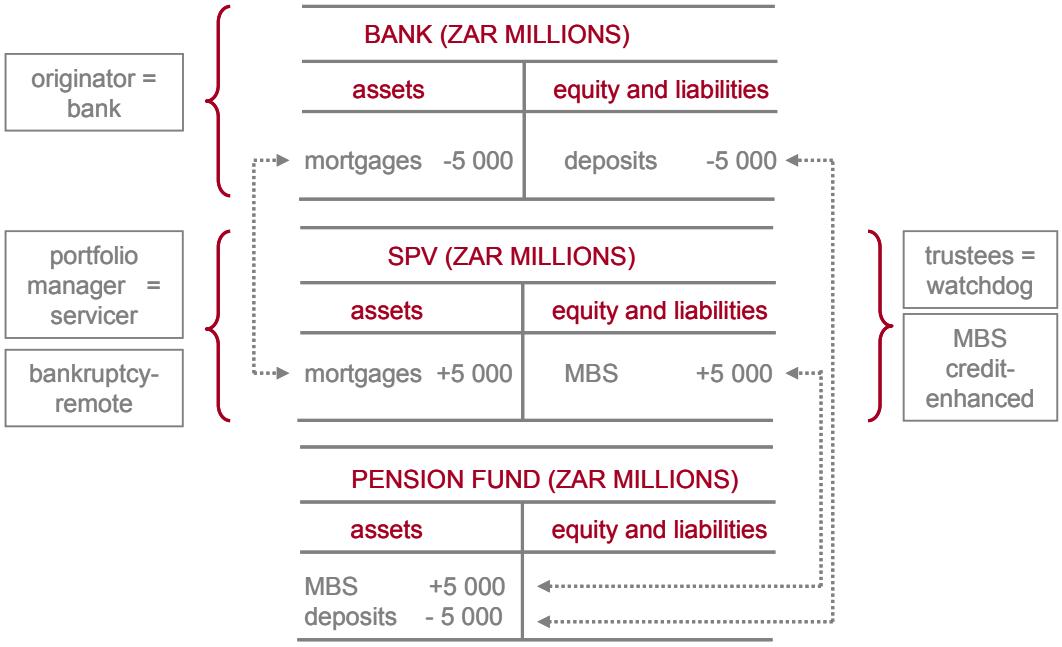

Figure 1: example of bank securitisation of mortgages

A typical securitisation (of mortgages) may be illustrated as in Figure 1. In this example, the bank decides to securitise part of its mortgage book, in order to free up the capital allocated to this asset. It places R5 billion of mortgages into a SPV, and the SPV issues R5 billion of mortgage-backed securities (MBS) at a floating rate benchmarked to the 3-month JIBAR to finance these assets. A portfolio manager manages the SPV, and trustees appointed in terms of the scheme monitor the process on behalf of the investors (in this case assumed to be pension funds) in the MBS.

It should be noted that the details of the above securitisation have been ignored, in the interests of understanding the basic principles of the transaction. In real life, the scheme is extremely lawyer-friendly, and the MBS issued are rated AAA by the rating agency/agencies in order to attract investors. This is achieved by the credit-enhancement process, by which is meant that the SPV is properly "capitalised". The latter in turn is achieved by the SPV issuing 3 streams of MBS in the following manner (this is an example)[68]:

- AAA rated MBS: 90% of the total (i.e. R4 500 billion).
- BBB rated MBS (called mezzanine debt): 7% of the total (i.e. R350 million).
- Unrated MBS (called subordinated debt): 3% of the total (i.e. R150 million).

The AAA rated paper, as noted, is sold to the market, while the BBB paper is usually purchased by one of the sponsors at an excellent rate of interest.[69] The management company usually holds the unrated paper in portfolio, and a mixture of equity / shares and debt finances this company.

The variable rate of interest paid on the underlying assets (and the cost of the credit enhancement) determines the rate payable on the three streams of paper created by the SPV.

6.4 Credit derivatives

6.4.1 Introduction

Credit derivatives emerged in the 1990s, and the market and the range of products have grown significantly since then. A credit derivative may be defined as "…a contract where the payoffs depend partly upon the creditworthiness of one or more commercial or sovereign entities."[70] There are a number of credit derivative contracts, such as *total return swaps* (e.g. where the return from one asset is swapped for the return on another asset), *credit spread options* (e.g. an option on the spread between the yields on two assets; the payoff depends on a change in the spread) and *credit default swaps*. The latter is the most utilised credit derivative[71], and we focus on this one below.

6.4.2 Example of credit default swap

A credit default swap is a bilateral contract between a *protection purchaser* and a *protection seller* that compensates the *purchaser* upon the occurrence of a *credit event* during the life of the contract. For this protection the protection purchaser makes periodic payments to the protection seller. The *credit event* is objective and observable, and examples are: default, bankruptcy, ratings downgrade, and fall in market price.

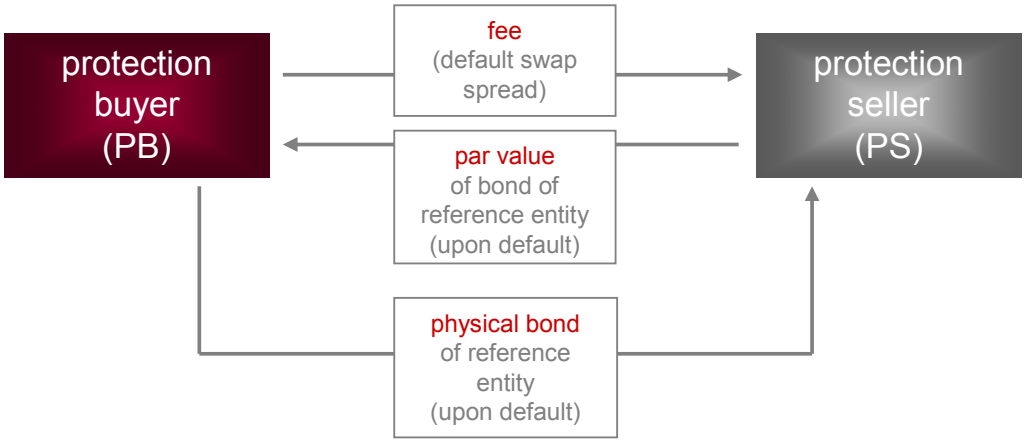

Figure 2: example of a credit default swap

An example is required (default by an issuer of a bond): a credit default swap contract in terms of which INVESTCO Limited (an investor; called the *protection buyer*) has the right to sell a bond[72] issued by DEFCO Limited (a bond issuer; called the *reference entity*) to INSURECO Limited (an insurer; called the *protection seller*) in the event of DEFCO defaulting on its bond issue (the specified *credit event*). In this event the bond is sold at face value (100%).

In exchange for the protection, the protection buyer undertakes to settle an amount of money (or fee) in the form of *regular payments* to the protection seller until the maturity date of the contract or until default. The fee is called the *default swap spread*. This contract may be illustrated as in Figure 2.[73]

As noted, the fee is payable until maturity of the bond or until default. If default takes place, the protection buyer has the right to sell the bond to the protection seller at par value. It is then up to the protection seller to attempt to recover any funds from the defaulting bond issuer. The following are the details of the contract:[74]

Protection buyer	= INVESTCO Limited
Protection seller	= INSURECO Limited
Reference entity (issuer)	= DEFCO Limited
Currency of bond	= ZAR
Maturity of bond	= 3 years
Face value	= ZAR 30 million
Default swap spread	= 35 basis points pa
Frequency	= Six monthly
Payoff upon default	= Physical delivery of bond for par value
Credit event	= Default by DEFCO Limited on bond.

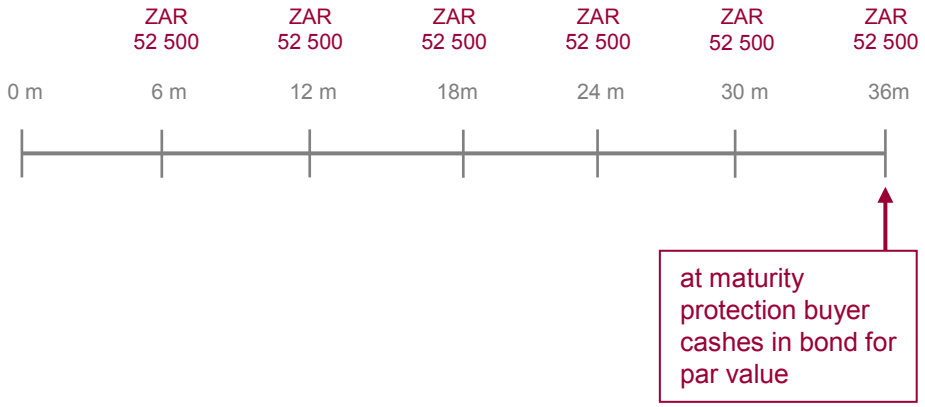

Figure 3: cash flows with no default (to protection seller)

The cash flows in the event of no default and default are as shown in Figure 3 and Figure 4.

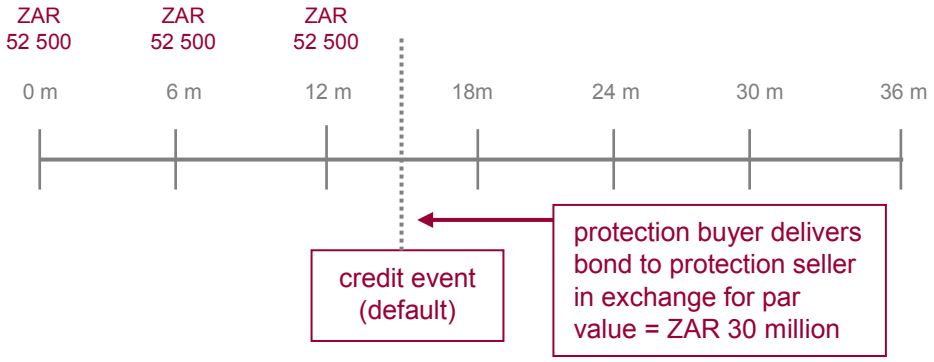

Figure 4: cash flows in event of default

6.4.3 Pricing

The pricing of credit derivatives is straightforward. The fee payable on the swap, i.e. the default swap spread (DSP), should be equal to the risk premium (RP) that exists *over* the risk-free rate (rfr = rate on equivalent term government bonds). In other words, the DSP should be equal to the RP which is equal to the yield to maturity (ytm) on the DEFCO bond less the rfr:

$$DSP = RP = ytm - rfr.$$

This is so if the credit default swap is priced correctly. If this is not the case, arbitrage opportunities arise. For example, if rfr = 10.0% pa and RP = 5.0% pa then ytm = 15.0% pa. If the market rate (ytm) of the reference bond is 17.0% pa, and DSP = 5.0% pa, it will pay an investor (protection buyer) to buy the bond at 17.0% pa and do the credit swap (cost = 5% pa) because he is getting a 200bp better return than the rfr (10% pa) on a synthetic risk-free security.

Conversely, if the ytm of the reference bond is 13.0% pa, and DSP = 5.0% pa, it pays the protection seller to short the reference bond and enter into the swap. This means that the protection seller is borrowing money at 13% pa (the ytm at which the reference bond is sold), and investing at the rfr (10.0% pa) and earning the DSP of 5.0% pa, i.e. a profit of 200 bp.

Clearly these examples point to the fact that arbitrage will ensure that in an approximate sense DSP = RP.

The main participants in the credit derivatives market are the banks (63% of protection buyers and 47% of protection sellers), securities firms (18% of protection buyers and 16% of protection sellers) and insurers (7% of protection buyers and 23% of protection sellers).[75] The other participants are the hedge funds, mutual funds, pension funds, companies, government, and export credit agencies.

6.5 Weather derivatives

The weather derivative is a relatively new instrument, but it is growing in popularity because many businesses depend on or are affected by the weather. Examples are:

- Retailers in London (example: loss of sales in bad weather).
- Agricultural concerns (example: loss of crops).
- Insurers of agricultural concerns (example: claims for hail damage).
- Construction enterprises (example: loss of time spent on a contract as a result of inclement weather).
- Football stadiums (example: lower turnstile takings as a result of bad weather).
- Large landlords (example: additional heating costs in cold periods).

According to Applied Derivatives Trading Magazine[76], 75% of the profits of enterprises rise and fall as a result of changes in the weather. The magazine also reported that in the first 18 months since weather derivatives were introduced some 1 000 contracts were signed.

Weather derivative contracts are usually structured as futures, options (caps, floors, collars) and swaps, and are settled in the same way as these. The contracts have a number of parameters as follows[77]:

- Contract type (cap, floor, swap).
- Contract duration.
- Official weather station (often weather service data stations located at major airports).
- Definition of underlying weather index (temperature, rainfall, snow, frost).
- Strike for options or index for swap.
- Tick for linear payout or fixed payment for binary payment scheme.

As seen, weather hedges can be based on temperature, rainfall, etc. The most common is contracts based on temperature. The underlying "instrument" or "value" in the case of temperature-related weather derivatives is Celsius-scale temperature as measured by "degree days" (DD). A DD is the absolute value of the difference between the average daily temperature and 18°C. The winter measure of average daily temperature below 18°C is called heating degree days (HDDs), and the summer measure of average daily temperature above 18°C is termed cooling degree days (CDDs). If for example the mean temperature of a day in December were 3°C, the HDD would be 15. The number for the month is the total of the daily HDDs (negatives are ignored).

Examples of temperature contracts:

- Caps (also known as call options) establish a DD ceiling. The holder is compensated for every DD above the ceiling up to a maximum amount.
- Floors (also known as put options) establish a DD minimum. The holder is compensated for every DD below the floor up to a maximum amount.
- Collars or swaps establish a DD ceiling and a DD floor. The holder is compensated for every DD above the ceiling or below the floor.

An example is required[78]. A London retailer reviews historical weather and revenue data to uncover the correlation between temperature and sales. They find that 225 HDDs in December is the point below which *winter apparel sales* start to fall. Each DD below 225 corresponds to a potential GBP 10 000 in lost sales. The retailer decides to buy a weather floor for December of 225 HDDs, with a payout of GBP 10 000 per DD and a maximum of GBP 1 million. The weather index used is the weather station at London Weather Centre. The premium is GBP 85 000.

December passes and the data is available on 3 January. The December cumulative number of HDDs is 200 (i.e. 25 below the floor of 225), i.e. it was warmer and winter apparel sales were indeed down. The seller of the hedge pays out:

$$\text{GBP } 10\,000 \times 25 = \text{GBP } 250\,000,$$

and the total income of the retailer is:

$$\text{GBP } 250\,000 - \text{GBP } 85\,000 \text{ (the premium paid)} = \text{GBP } 165\,000.$$

6.6 Carbon credit derivatives

In order to comprehend carbon credits, some background information is required. In 1979 an international climate conference took place. This led to the formation in 1992 (at the Rio Earth Summit) of the *United Nations Framework Convention on Climate Change* (UNFCCC), which became operational in 1994. The countries which ratified the UNFCCC (now close to 200) are called *Parties to the Convention* and their frequent meetings are called *Convention of the Parties* (COP). Each meeting is given a COP-number and a name, for example, the *Kyoto Protocol* (COP3), and the 2011 *Durban Platform for Enhanced Action* (COP17).

The ultimate objective on the UNFCCC is to stabilise greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system." It further states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."[79]

According to the UNFCCC, by 1995 "countries realized that emission reductions provisions in the Convention were inadequate. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed countries to emission reduction targets. The Protocol's first commitment period started in 2008 and ends in 2012."[80] In essence, the Kyoto Protocol sets binding emission reduction targets for 37 industrialised countries and the European Community. On average the target is an emissions-reduction of 5% compared to 1990 levels over the period 2008–2012.[81]

At the latest Convention, COP17 in 2011, the parties agreed on a pathway to a legally binding instrument that will compel all countries to take action to slow the pace of global warming. It is to be agreed by 2015 and implemented by 2020). The parties also agreed to a second commitment period of the Kyoto Protocol starting in 2013.

What is a carbon credit? Unfortunately, the answer is not a short one. In terms of the the Kyoto Protocol[82] the *developed* countries are assigned *quotas* (aka *caps*) for greenhouse gas (GHG) emissions, termed *assigned amounts*. The initial assigned amounts are made up of units termed *assigned amount units* (AAUs). Each AAU is an *allowance* to emit one metric ton of CO_2 (or CO_2 equivalent GHGs), and each developed country has a National Registry of its AAUs. The AAUs are known as carbon credits (and they can also be created – see below).

The developed countries, in turn, set quotas for the GHG emissions of local private and public enterprises (called operators), managed through their National Registries (and required to be validated and monitored for compliance by the UNFCCC). Thus, each operator has an *allowance* of carbon credit units, and each carbon credit unit represents the right to emit one ton of CO_2 (or other equivalent GHGs).[83]

In addition to the AAUs, another tradable carbon credit exists (created under the *Clean Development Mechanism* (CDM) of the Kyoto Protocol): an *offset of emissions*, termed *certified emission reductions* (CERs), when approved by the UNFCCC. A developed country can fund a GHG reduction project in a developing country (which has ratified the Kyoto Protocol), and the developed country would be allocated credits for meeting its emission reduction targets.

Operators that are about to exceed their quotas can buy carbon credits (AAUs and / or CERs) from operators that have not used up their quotas. This can be done on the open market or privately. Each transfer is reported to and authorised by the UNFCCC.

In addition to the UN-regulated market a voluntary market exists, elucidated by Nadaa Taiyab as follows: "Parallel with the CDM market, there has emerged a voluntary market for carbon offsets. The voluntary market consists of companies, governments, organisations, organisers of international events, and individuals, taking responsibility for their carbon emissions by voluntarily purchasing carbon offsets. These voluntary offsets are often bought from retailers or organisations that invest in a portfolio of offset projects and sell slices of the resulting emissions reductions to customers in relatively small quantities. As retailers generally sell to the voluntary market, the projects in which they invest do not necessarily have to follow the CDM process. Free of the stringent guidelines, lengthy paper work, and high transaction costs, project developers have more freedom to invest in small-scale community based projects. The co-benefits of these projects, in terms of, for example, local economic development or biodiversity, are often a key selling point."

There are a number of exchanges that trade in carbon credits: Chicago Climate Exchange, European Climate Exchange, NASDAQ OMX Commodities Europe, PowerNext, Commodity Exchange Bratislava and the European Energy Exchange.[84] There are spot markets and futures and options markets. The trading unit is one allowance / carbon credit.

6.7 Freight (or shipping) derivatives

At times the volatility of rates in the freight markets is high, i.e. a high level of risk exists for commodity producers and traders, ship owners, ship operators and other participants in freight. This led to the creation of *forward freight agreements* (FFAs) in the early nineties.[85] A FFA is a contract between two parties, which stipulates an agreed future freight rate for carrying commodities (wet and dry) at sea. The contract does not involve any actual freight or any actual ships. It is a financial agreement which is cash settled.

The underlying asset is a freight rate (the contract rate) for a specified route (the contract route) over a specified period (the contract period). The rates on the routes are "assessed"[86] daily and published by the Baltic Exchange (there are also other smaller publishers of rates, such as Platt's). The rates are published as indices [e.g. the Baltic Exchange Panamax Index (BPI)] or rates. Thus, FFAs have four main terms:

- The agreed route.
- The settlement/expiry date.
- The contract size.
- The contract rate at which differences will be settled.

FFAs are OTC products made on a principal-to-principal basis, As such they are flexible and are not traded on an exchange. Brokers are involved in deals but:

- Settlement is between the principals (in cash usually within a few days after the settlement date).
- Commissions are agreed between the principal and the broker.
- The broker acts as an intermediary only, and is therefore not responsible for the performance of the contract.[87]

There are two types of FFAs: OTC swaps and OTC "futures". The latter are actually forwards, but are called "futures" by market participants, because they enjoy clearing facilities [by the London Clearing House (LCH), the Norwegian Futures and Options Clearinghouse (NOS), the Singapore Exchange (SGX) and the Chicago Mercantile Exchange (CME)].

In essence FFAs are cash-settled, privately negotiated (via non-principal brokers) bespoke financial contracts between two parties in terms of which one party agrees to pay the other party an amount equal to the difference between the contract price of the underlying index / rate of a specified route and the settlement price of the index / rate of the route.

The participants in the freight derivatives market are the abovementioned commodity producers and traders, ship owners, ship operators, etc (i.e. those that wish to shed risk / hedge), as well as the speculators in the freight market (those that take on risk), including investment banks and hedge funds.

Variations of FFAs have emerged, including container-freight derivatives[88], options and spread dealing.[89]

6.8 Energy derivatives

Energy derivatives is the term for forwards, futures, swaps and options on energy products, that is, the underlying assets of these derivatives are energy products, including oil, natural gas and electricity. The derivatives trade either on exchanges or OTC. We touched on the derivatives on commodities in the body of this text and present this section merely for the sake of completeness.

6.9 Summary

The mainstream derivative instruments are forwards, futures, options and swaps with which financial and commodity risk can be hedged. In addition to these there is a demand for hedging other risks such as weather risk, energy price risk and credit risk; the hence the development of weather, energy, credit, etc derivatives. Securitisations are not hedging products but the marketable liabilities of SPVs are derived from other non-marketable assets.

In conclusion, we present a summary of the derivatives covered in this course (excluding the exotic options) in Table 1.

	SPOT MARKETS			
Derivatives	Debt market	Equity market	Forex market	Commodity markets
Forwards				
Forward interest rate contracts	Yes			
Repurchase agreements	Yes			
Forward rate agreements	Yes			
Outright forwards	Yes	Yes	Yes	Yes
Foreign exchange swaps			Yes	
Forward forwards			Yes	
Time options (obliged to exercise)			Yes	
Forwards on commodities				Yes
Forwards on swaps[1]	Yes			
Futures				
On specific instruments ("physicals")	Yes	Yes	Yes	Yes
On notional instruments (indices)	Yes	Yes	Yes	Yes
Swaps	Yes[2]	Yes[3]	Yes[4]	Yes[5]
Options				
Options on futures	Yes	Yes	Yes	Yes
Options on swaps	Yes			
Options on specific instruments	Yes	Yes	Yes	Yes
Options on notional instruments	Yes	Yes	Yes	Yes
Interest rate caps and floors	Yes			
Warrants (retail options)	Yes	Yes	Yes	Yes
Warrants (call options)	Yes	Yes		
Callable and puttable bonds	Yes			
Convertible bonds	Yes			
Other				
Products of securitisation	Yes			
Credit derivatives	Yes			
Weather derivatives				
Carbon credit derivatives				
Freight derivatives				
Energy derivatives				
1. On interest rate swaps. 2 = Interest rate swaps. 3 = Equity swaps. 4 = Currency swaps. 5 = Commodity swaps.				

Table 1: Spot markets and derivative instruments

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