Futures markets (overview)

INTRODUCTION

This article is an introduction to futures markets. After a description on futures contracts, we examine the market rationale for trading futures, detailing major futures exchanges and contracts. We then explain the trading mechanism of futures contracts as well as their pricing.

INTRODUCTION TO FUTURES

A futures contract is an exchanged traded financial instrument that gives the obligation to buy (or sell) a specific asset (financial or not) at an agreed price at some specific date in the future. The specific date is called the *maturity date* of the contract. The date at which the payoff of the contract is determined is called the *settlement* date. The contract can be *cash* or *physically settled*. , *Physical settlement* means that at the settlement, the asset changes hands, while for *cash settlement* it is an equivalent amount of cash that is exchanged. In the case of a *physical settlement*, the date at which the asset is delivered is called the *delivery* date, while it is called the payment date for cash settled futures.

Futures contracts are in some sense very similar to forward contracts. Forward contracts are also an agreement to buy or sell a specific asset at an agreed price at some specific date in the future. However, forward contracts are OTC contracts, while futures are exchange traded. Futures contracts have been precisely created to eliminate the credit risk of forward contracts. In a

futures contract, the counterparty is always the exchange-clearing house. This exchange-clearing house guarantees that the term of the contract would be honoured at maturity. Indeed, to protect against any credit default, the exchange-clearing house requires market participants to provide margin calls linked to the mark-to-market value of the futures contract. Hence, this daily calls offer some protection against a systemic market collapse. In contrast, forward contracts are bilateral OTC contracts, offering much more flexibility in terms of size, type of the underlying traded, expiration date, settlement type. This customisation comes at a price of a non-negligible credit risk as well as cost to unwind the position. There is one exception to the rule. It is in the foreign currency and swap markets[1]. In these particular markets, most of the contracts are forwards and provide less credit risk because of the notable liquidity.

RATIONALE FOR TRADING FUTURES

Futures Markets have grown tremendously over the last decade and have represented almost half of all derivatives transactions in the year 2000-2002. To understand this tremendous growth of the futures market, it is important to examine the rationale for trading futures.

Futures contracts are traded mainly for three different uses:

- Hedging: e.g., one can hedge a long-term oil transaction by entering a short position in futures market.

[1] Swap can be effectively seen as a strip of forward contracts.

- Speculation: either as a directional bet using the leverage of futures contracts, or as a spread bet between the spot and the futures, referred to as trading the basis.
- Arbitrage between the futures and the spot markets. This requires to synthetically create a futures position and to carry the position up to maturity. This requires in particular the immobilisation of capital during the arbitrage trade.

Futures were originally created as hedging instruments. Futures contracts are the answer to the basic economic problem of monetizing or hedging future production and more generally future investment or production. One of the simplest examples is the case of an agricultural production. On one side, a grain producer may predict reasonably well when planting and harvesting of crops will occur. Unfortunately, she/he may not be able to sell the crop in a standard market until harvest. What if she/he wants to hedge the sell price of the crop? On the other side, a grain buyer may be worried that grain prices might rise. In a standard transaction, she/he would not be able to buy agricultural products if they haven't even been planted yet.

Futures contracts solve this problem in a remarkably efficient way. The producer (farmer) and the consumer (say, a food producer) will enter in an opposite position on futures contract, where both parties lock in a mutually convenient transaction, the price on future production at some date convenient for both parties. By selling a futures contract, the producer hedges

her/his profit on the future production. By buying a futures contract, the customer hedges her/his cost on the purchased goods. This system was highly developed in the U. S. Midwest almost 130 years ago. With the development of the financial markets, futures markets which originally concerned only agricultural goods, progressively extended their scope to other assets, such as Treasury bond and notes, equity indexes, metal and oil.

For instance, an investor who owns a particular underlying (stock, commodity or bond) will make some profit if the underlying price rises, and lose money if it falls. By being short (selling) a futures contract, she/he can protect herself/himself against losses in a down market: Short a futures contract can be seen as an insurance policy against downfall.

Speculation and arbitrage using futures will be revisited after explaining in more details the margin mechanism. Let's mention that futures are a very powerful tool for directional bet or speculation because of their natural leverage.

Arbitrage using futures contracts will be explained after having seen their valuation and in particular the concept of convexity correction.

TRADING VOLUMES

The growth in the futures market has been astounding with 20 millions contracts per year in 1972 to over 200 million in the 1990s for the US market alone and to 616 millions of contracts for the US market for the year 2001

(source: Futures Industry Associations, FIA). As a comparison, the total volume of other exchange derivatives (options) for the US for the year 2001 has only been of 890 millions with 160 million for options on futures and of 730 millions of options on securities for the same year. This implies that 43% of the derivatives are futures. In terms of notional, total traded futures contracts represent around 80 trillions dollars.

According to the FIA 2001 Futures survey (source: FIA, www.futuresindustry.org), the futures market is highly concentrated. A few contracts represent most of the market trading volume. For the United States, and for the year 2001, the biggest contracts by absolute volume were:

- the mainstream interest futures contracts: the 3 month Eurodollar futures, the US T-bond futures, the 10 year T-Notes futures and the 5 year T-Notes futures.
- the futures on usual stock indexes: the Nasdaq 100 futures, the S&P500 Index futures.
- the Crude Oil futures.

All together, the contracts mentioned above represented about 70% of all futures contract traded in the US for the year 2001.

This spectacular growth of the volume of futures contracts is primarily due to the need to hedge the increased volatility risk on underlying assets.

Last but not least, over the years, exchanges have started both modernizing their trading platform (going from outcry market to electronic traded goods) and enlarging their market scope by introducing, with more or less success, futures contracts on new underlying like weather, electricity and other energy-type futures contracts.

MAJOR FUTURES EXCHANGES AND CONTRACTS

Below is given a list of the major futures exchanges as well as of the most traded contracts:

MAJOR FUTURES EXCHANGES

- CBOT (Chicago Board of Trade)
- CME (Chicago Mercantile Exchange)
- Eurex (European Exchange)
- Liffe (London International Financial Futures Exchange)
- Matif (International French Futures Exchange)

MAJOR CONTRACTS

- Commodity futures on any agricultural products, oil and metals.
- Interest Bearing Assets (most explosive growth)
    - Treasury Bills, Treasury Bonds, Treasury Notes, Municipal Bonds, and Eurodollar Deposits
    - Foreign exchanges also trade debt instruments
- Equity:
    - Stock index futures: S&P 500, Nasdaq-100, FTSE100, Eurostoxx 50

- Single stock futures:

- Foreign Currencies: US dollar versus Canadian dollar, Japanese yen, British pound, Euro, Swiss Franc

Below is given a table of the most common futures contracts with their tick value (see the description of the futures mechanism).

Contact	*Tick Size*	*Tick Value*
US T-Bond	$31.25	1 basis point
Uk Gilt	£10	1 basis point
Bund	10	1 basis point
Sterling 3Month	£12.50	1 basis point
EuroDollar 3Month	$25	1 basis point
S&P100	$25	0.1 point
S&P500	$25	0.1 point
Eurostoxx	10	1 point
Nikkei225	$5	1 point

Table 1: Tick value of some common Futures contracts

REGULATION

In addition to standard market regulators, two American associations are specifically regulating trading of futures contracts:

- National Futures Association (NFA): this association regulates all the futures contracts that are non agricultural.

- Commodity Future Trading Commission (CFTC): this association regulates all the Commodity futures contracts, and in particular the ones of the Chicago Board of Trade.
- European and Asian Futures are regulated by their national regulatory entity

FUTURES TRADING MECHANISM

MARGIN AND MARK-TO-MARKET

The valuation, also called the mark-to-market of a futures contract is carried out on a daily basis. This leads to margin payments as will be explained in what follows. These payments are required by the exchange-clearing house to provide some financial protection against the default of the counterparty of the futures contract. Before trading any futures, the buyer or seller (trader, in what follows) would need to open an accredited trading account with an initial sum of money credited on the account. This amount is called the *initial margin*. This is usually calculated as a certain amount (usually between 1 to 10 times the maximal daily change of the contract, or between 5% to 25% of the nominal value of the contract) per contract times the number of contracts the trader wants to be allowed to trade. It does not represent a pre-payment on the futures contracts to come but rather a good faith deposit to ensure that the terms of the contract will be honored. The trader would also need also to assert in written that she/he is fully aware of the leverage and risk embedded in futures contracts and she/he knows futures' daily mechanism. In addition, she/he might need some specific exams, regulated by the exchange and the regulation authority.

While trading, the total deposit on the trading account has to be above a certain level called the *maintenance margin* (usually equal to 75% of the initial margin). If not, a new deposit of some extra funds, known as the variation margin, has to take place to restore the balance to the initial margin before the next business day. If the trader does not top up her account (i.e. pay the variation margin), the broker can wind up the position. Note that traders may be allowed to deposit other asset (say, treasuries) instead of cash on their margin account.

In order to limit the risk, the exchange imposes two major *circuit breakers*:

- daily price limits, and
- position limits

Daily price limits is a restriction on the price change in order to prevent any dramatic variations of price. When, during a day, prices fall or rise by as much as the limit down (or limit up), the clearing-house of the exchange would usually cease the trading for the day. Similarly, *position limits* stipulates the maximum number of contracts a trader may hold. Obviously, when used for hedging purposes, this upper limit on the number of contracts does not apply.

These circuit breakers limit the daily payment/receipts from to the trading account and have been created to ensure that the balance in the trading account does not fall below zero before the broker closes out the position.

Let us describe a typical trading day. As mentioned already, all margin requirements are calculated on the basis of the total number of contracts held. The calculation is done on a *net basis* so that, for example, a trader long 10 contracts and short 8 contracts will have her margin calculation based on long 2 contracts. The corresponding value of 1 unit of the underlying is called the *tick value* of the futures contract. It corresponds to the smallest move of the futures contract.

Let us now look at the concrete case of a long position on one, say, December 2002 futures on the S&P 500. In this case, the initial margin is US $10,000 while the value of one point change of the S&P 500 index is worth $250. Suppose the first day the value for the December 2002 SP500 futures was 1,479.00, at the beginning of trading, and closes at 1,471.00. The mark-to-market of the contract is -US $2,000 (= (1,471.00-1,479.00) * $250). The trader's margin account net result is now $8,000 ($10,000 - $2,000). The maintenance margin is $7,500 and therefore the trader does not need to pay for the variation margin of the first day. Suppose that the second day the contract is again down and closes at 1,465.00. The mark-to-market is for the second day -$1,500 (= (1,465.00-1,471.00)*$250). The net result on the trader's margin account is now $6,500, that is, it went below the threshold of $7,500. This time the trader needs to pay up to the initial maintenance level again. Suppose for the third day the contract is up to 1480.00. The mark-to-market for this day is +US $3,750 (= (1,480.00-1,465.00)*$250). At this stage, the trader can decide to short the futures contract and take the profit above the initial margin.

DELIVERY MECHANISM

As said before, there exits two types of delivery: physical delivery and cash delivery. The type of delivery is of extreme relevance for bookkeeping and trade management systems.

PRICING AND RISK MANAGEMENT

SPOT FORWARD RELATIONSHIP

Using the standard cash and carry arbitrage, it is easy to value a forward contract. One can show that buying spot the underlying asset and carrying over up to the maturity, synthetically replicates long a forward contract. A forward contract by no arbitrage should therefore be equal to

$$Fwd = Spot\,price + CostOfCarry$$

Mathematically, we have that a forward contract is equal to the expectation under the risk neutral measure of the future cash flow. For an asset paying continuous dividend yield q_s, and with a spot interest rate r_s, up to maturity date T, with $B(0,T)$ being a zero coupon bond with same maturity, this would be equal to:

$$B(0,T).Fwd = E^Q\left[e^{-\int_0^T r_s ds} S_T \right] = S_0 e^{-\int_0^T q_s ds}$$

Table 1, below, gives examples of the computation of the fair value of various forward contracts.

Case	Value of the Futures
Cash Flow(s) with present value I	$(S_0 - /) \quad e^{rT}$
Know continuous dividend yield q	$S_0 \quad e^{(r-q)T}$
Storage cost g	$S_0 \quad e^{(r+g)T}$
Foreign currency forward	$S_0 \quad e^{(r^{dom} - r^{foreign})T}$
Convexity correction (this is added on top of the normal value of the forward)	$Exp(\frac{-1}{2}\sigma\rho(IR,U)TT_U)$
Quanto correction (this is added on top of the normal value of the forward)	$Exp(\rho(X,U)\sigma_X\sigma_U T)$

Table 1: Example of computation of Forward contracts

The notations used for the table are

- r is the rate used to compute the cost of financing, close to the risk free rate as read from the standard interest rate curve and adjusted by the funding cost of the trading desk
- q is the continuous yield dividend of the underlying asset of the futures contract
- g is the yield of the storage and transportation costs also called the convenience yield for commodity futures
- I is the present value of the different cash flows generated by the underlying asset of the futures contract
- $r^{foreign}$ is the foreign funding rate while $r^{dom} = r$ is the domestic one
- σ_{HL} is the yearly Ho&Lee volatility (typical values are around 1%)

- T is the time to maturity of the futures contract
- T_U is the time to maturity of the rate underlying the futures contract
- $\rho(FX,U)$ is the correlation between the FX rate X and the underlying asset U of the futures contract
- $\rho(IR,U)$ is the correlation between the spot interest rate IR and the underlying asset U of the futures contract
- X is the rate used to compute the quanto futures. The futures pays $S^{foreign}$ in domestic currency and X is domestic/foreign
- σ_X is the yearly volatility of the foreign rate
- $\sigma_{S^{foreign}}$ is the volatility of the foreign asset underlying the futures contract

In contrast to forward contracts, futures contracts pay margin calls. It can be easily shown that the mathematical translation of the zero cost of a futures contract (the discounted value of the margin calls should be worth today zero), a futures contract is indeed equal to expected value under the risk neutral expectation of the asset price at maturity. Summarizing the difference between futures and forwards, we have

$$Futures = E^Q[S_T]$$

while $$Forward = \frac{1}{B(0,T)} E^Q\left[e^{-\int_0^T r_s ds} S_T \right]$$

Because a discounted asset is a martingale under the risk neutral measure, forward are easier to value. Futures need to take into account convexity

correction coming from the joint move of interest rates and the underlying asset. We can modify the computation of the futures into the following:

$$E^Q\left[e^{+\int_0^T r_s ds}.e^{-\int_0^T r_s ds}S_T\right]=Cov\left(e^{+\int_0^T r_s ds},e^{-\int_0^T r_s ds}S_T\right)+\frac{1}{B(0,T)}E^Q\left[e^{-\int_0^T r_s ds}S_T\right].$$

This says in other words that the difference between futures and forwards comes from the covariance between the discounted underlying asset at maturity and the money market account.

$$Futures=Cov\left(e^{+\int_0^T r_s ds},e^{-\int_0^T r_s ds}S_T\right)+Forward.$$

We can also say that the futures prices is equal to

$$E^Q[S_T]=\frac{1}{B(0,T)}E^Q\left[e^{-\int_0^T r_s ds}\right]E^Q[S_T]$$

$$=-\frac{1}{B(0,T)}\left[Cov\left(e^{-\int_0^T r_s ds},S_T\right)-E^Q\left[e^{-\int_0^T r_s ds}S_T\right]\right]$$

$$=-\frac{1}{B(0,T)}Cov\left(e^{-\int_0^T r_s ds},S_T\right)+Forward.$$

To summarise the difference between futures and forwards contracts, futures are martingale under the risk neutral measure while forwards are under the forward risk neutral measure.

HEDGING WITH FUTURES

Most of the traded derivatives are hedged with futures contract. The advantages of futures contract are that hardly any capital is used, hedge is very liquid and transaction cost quite small. In order to work out the equivalent

amount of futures needed for the hedge, one just needs to compute the ratio of the delta of the position to hedge over the one of the futures contract.

ACCOUNTING AND TAX TREATMENT

We provide below, only some general understanding on accounting and tax treatment for futures contracts, as it has become very relevant when trading futures. Full details on tax and accounting are out of the scope of this article. Reader should consult an accountant and or a tax specialist for further details.

ACCOUNTING

The two major accounting statements for derivatives have been the FAS 133 (for the U.S.) and the IAS 39. Issued in June 1998 by the Financial Accounting Standard Board (FASB), the FASB Statement No 133 (entitled *Accounting for Derivatives Instruments and Hedging Activities*), replaces the two statements for accounting, FASB Statement No 52 Foreign Currency Translation, for foreign currencies futures and the FASB Statement No 80, Accounting for futures Contracts. FAS 133 has a much wider scope than its predecessors as it applies to all derivatives contracts, from swaps, forwards, futures, to options and has been effective for fiscal years beginning after June 15, 1999. FAS 133 rule requires all derivatives to be valued at fair market value and reported on the balance sheet. It also requires full reporting of methodologies used in determining fair market value.

If the derivative qualifies as a hedge, gains or losses on the derivatives are generally recognized and reported at the same period as the gains or losses

on the hedged financial or non-financial asset. Otherwise, gains and losses have to be reported as they occur. To explain the importance of the difference, let us examine an example. An insurance company has a 10-year debt exposure hedged by a 10-year swaption. The company will only report the gain or losses on the derivatives contract in 10 years time. This is very different from having to mark-to-market every year the swaption. To qualify as a hedge, a derivatives needs to be highly effective in offsetting the risk and exposure of the instrument to be hedged and reports on this effectiveness have to be provided every three months. The FAS 133 has contributed to a significant change in the use of derivatives as it has forced firms to modify internal accounting policies and procedures. This has also been a real challenge as the internal accounting systems have been forced to satisfy three new functions (if not implemented before): first, be able to mark-to-market the different derivatives used by the company; second, test the effectiveness of a hedging strategy, according to various criteria; third, monitor the hedge over the course of its life cycle.

The International Accounting Standard, IAS 39 (“Financial instruments: Recognition and Measurement”) aims at the same target as the FAS 133. It has come into effect as of January 1, 2002. Its scope is however slightly wider and there are other differences with FAS 133 in particular in terms of transaction costs, definition of financial instruments and liabilities under the scope of the statement, non recognition of a derivatives. Briefly speaking, it imposes the reporting of all derivatives on the balance sheet at fair market

value. It also narrows down the definition of an accounting hedge, imposing very strict conditions.

Just to name some Internet references on the subject: the website of the FSAB: http://www.fasb.org, the one of the IASC: http://www.iasc.org.uk, the one of the ISDA: http://www.isda.org, and the one of the SOA: http://www.soa.org are quite good and provide valuable information.

Remark:

One has to make a clear distinction between tax and accounting. The tax on a given financial asset will merely depends on three factors:

- the nature of the taxable gain/loss
- the timing of the recognition of this gain/loss.
- the nature of the entity: corporate or non corporate.

TAX

Roughly speaking, there are two categories for gains/losses: capital gains/losses or ordinary income. Since capital gain/losses and ordinary income are taxed at the same rate for a corporate, the only difference for a corporate lies in the ability to deduct losses. Losses on Capital gain/losses are limited to the extent of the capital gains. The capital loss can carry back up to three years and carry forward up to five years.

For non-corporate taxpayer, the Tax Payer Relief Act of 1997, applies two different tax rates for capital gains/losses held for a period of more than one

year (: long term capital gains and or losses) and ordinary income, with a lower rate for the first one (in the US, roughly half of it). Capital losses are deductible up to the extent of the capital gains plus ordinary income up to $3,000 and can be carried forward indefinitely.

Positions in futures are generally treated as if they are closed out on the last day of the tax year. As regards accounting, one makes the distinction between a *stand-alone* derivative and a *hedging* derivative.

Hedging transactions are treated as ordinary income or losses. Similarly to accounting rules, the timing of the recognition of the gains or losses is the same as the one of the hedged item(s). However, the qualification of a hedging derivative differs slightly between accounting and tax rules. A tax hedging derivatives is defined as a transaction entered in the normal course of business for either one of the two main reasons:

- reduce the risk of price changes or currency fluctuations of a future or current assets held by the tax payer in order to produce ordinary income.
- reduce the risk of price or interest rate changes or currency fluctuations of a borrowing made by the taxpayer.

For futures contracts that do not qualify as a hedge, any gains or losses on contracts other than on foreign currency contracts, are treated as capital gains or losses, while gains or losses on foreign currency contracts are treated as ordinary income/losses.

Entry category: Futures.

Key words: function of futures, margin, mark-to-market, clearing house, contracts.

Related function of futures, margin, mark-to-market, clearing-house, contracts.

Eric Benhamou[2]

Swaps Strategy, London, FICC,

Goldman Sachs International

[2] The views and opinions expressed herein are the ones of the author and do not necessarily reflect those of Goldman Sachs