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Explain the role of futures contracts and options on futures as instruments for controlling risk. Illustrate their relative merits in the context of investment strategies to control risk.

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Introduction

Main feature of every financial asset is the storage of value. However, this value changes over time being subject to the market laws of equilibrium (supply and demand). With the unexpected changes in value of your assets comes the risk. For instance, today you may have one unit of very precious asset which is demanded by almost everyone and you are from the few happy persons who possess it – the ownership of this asset makes you rich. Unexpectedly, the next day the market is flooded with units of this asset and it rapidly depreciates – you become poorer. You have become a victim of the market risk of this asset. The economists have developed various strategies in order to minimize risk, called hedging strategies. The basic principle is very simple. In order to minimize the risk of your portfolio as investor you will balance your asset with another asset or instrument. Furthermore, the prices of the asset and the instrument will be correlated in such manner that when the asset depreciates in value the instrument will be appreciating and offsetting the depreciation from the main asset. And the opposite when the asset appreciates the instrument will depreciate, keeping the portfolio balanced the value as constant as possible and the risk minimized. The stronger is the correlation between the two prices the less risky is the hedge.

The prices of derivatives instruments such as futures and options provide good correlations with the prices of their underlying assets. Thus, futures and options are the most commonly used financial instruments in hedging strategies and risk minimization. This paper will begin with concise overview of the main characteristics of future contracts and options on futures. Introduction in risk management and how these instruments are used in order to minimize risk. Static and Dynamic risk minimization models. And finally, I will enter the electronic Chicago Board of Trade (eCBOT) with a demo account to compare the effectiveness of two hedging strategies with futures contracts and options on futures. Thus the examples will represent real assets and instrument prices data which will be analyzed and summarized in the conclusion.

Future Contracts – Main Characteristics

Futures contracts are standardized, negotiable, and exchange-traded contracts to buy or sell an underlying asset at a pre-specified price on a pre-specified date in the future. They are often subject to a reverse trading as the investors can offset their positions at low cost before the delivery date of the contract without breaching any contractual obligations.

Trading on exchanges - Future contracts are traded on organized exchanges (both physically located and electronic) such as:

- Chicago Board of Trade (CBOT)
- New York Mercantile Exchange (NYMEX)
- London International Financial Futures Exchange (LIFFE)
- Euronext Paris (MATIF)
- Tokyo International Financial Futures Exchange (TIFFE)

Standardisation – Futures are offered with different expiration dates and fixed contract sizes. The standardization makes the contracts homogeneous and ensures that the contract will be easily traded and even resold on a secondary market.

Clearing house – The clearing house acts as a third party, minimizes the credit risk between the buyer and the seller and ensures the successful performance of the contract. It ensures that the agreement between traders remain anonymous and is independent from the exchange: “The exchange clearing house is a legal entity separate from the exchange itself” (Bailey, 2005, p.383)

Marking to market – Marking to market is a daily based mechanism which is simply the settlement of gains and loses on the contracts every day. This practise minimizes the risk of great loses that can be passed on the clearing house.

Margins – Marking to market keeps account for past loses, but the buffer for future losses is provided by margins. It is a minimum required amount in your account that you must deposit in order to trade. If your funds fall below the margin then you will receive margin call that you have to deposit more funds.

Options – Main Characteristics

Options are financial instruments that give to their owner the right but not the obligation to buy or sell an asset at a pre-specified price until a date in the future or on a date in the future. The pre-specified price is also known as: delivery price, exercise price or strike price. The options that give the right to buy are called call options and those which give the right to sell are called put options. “Although the concept behind these instruments are not new, options have blossomed since the early 1970s, because of a break-through in pricing options, the Black-Scholes formula, and to advances in computing power.” (Jorion, 2003, p.123). Unlike future contracts, where you can be either the buyer or writer of the contract. In options there are four cases as you can buy and write both call and put options. In addition options can be exercised only if they generate profit. In the future contract’s case you have the obligation to buy or sell regardless of the profit or loss. There are two main types of options regarding the exercise timing. European options can be exercised at the maturity date only. American options can be exercised during the period before the maturity date. If the current asset price is such that the option could be exercised at a profit then we say that the option is “in the money”. If the current asset price is such that the option could be exercised at a loss then we say that the option is “out of the money”.

Profit for long position in a call option: $C_t = \text{Max}(S_t - K, 0)$

Profit for long position in put option: $P_t = \text{Max}(K - S_t, 0)$

S_t – price of asset at date t .

K – exercise price.

	In the money	Out of the money
Call Option	$S_t > K$	$S_t < K$
Put Option	$S_t < K$	$S_t > K$

Unlike future contracts, options can only generate positive profits greater or equal to zero. As a result, they are much more valuable assets the price of which is called the option premium. Therefore, the loss from options is limited by the amount of the premium while gains are unlimited.

Risk Minimization Models – Static and Dynamic Hedging

The most common way of market risk minimization is called hedging. In theory hedging is very easy to understand it exploits the following principle: „reduce the risk associated with holding one asset by holding a second asset so that, together, the payoffs cancel out...” (Bailey, 2005, p. 365) or the asset which value has to be hedged is paired with another asset (instrument) which price is affected in opposite direction by the market conditions compared to the main asset's price.

For example, as an investor you own 100 shares of the company X which are now traded on the markets for 100\$ each. This means that the current value of your portfolio is 10 000\$. However, you are concerned that due to the financial crisis market conditions may change and the price next month could decline to 90\$ per share and your wealth to 9 000\$. You want to keep your wealth and hedge that market risk. In order to do that you find a one month X future contracts each consisting of 10 shares of the underlying asset X. Therefore you take a short position with 10 future contracts. After one month as the price of X declines to 93\$ your wealth declines to 9 300\$, but you also have these valuable future contracts which gives you the right to sell at 100\$ per unit. In other words as your asset has depreciated in value your contract has appreciated keeping you at the same position overall.

Expressed mathematically:

Where: - W_t is the value of the portfolio at date t.
- N number of units of asset
- p_t price of asset at date t
- M number of units of instrument
- c_t price of instrument at date t.

Then the total value of our portfolio will be: $W_t = Np_t + Mc_t$

The purpose of hedging is to minimize fluctuation of our portfolio, then the change in W must be equal to zero if the hedge is perfect =>

$\Delta W = \Delta pN + \Delta cM$, if $\Delta W=0$ then: $\Delta pN + \Delta cM = 0 \Rightarrow$

$\Rightarrow M/N = -dp/dc$

The hedge ratio, therefore, can be represented as the coefficient in a regression of the price of the spot instrument on the price of the hedging instrument. This coefficient, however, may be more appropriately represented as time varying rather than static.

The above formula is simplified. In fact, the change in portfolio will never be equal to zero. To construct a proper model for the optimal hedging ratio we have to minimize the portfolio volatility subject to the asset/instrument ratio.

Even though the example and model are simplified they show the basic principles of hedging and the relation between the strength of the hedge and the correlation between the prices of the instrument and the asset.

Hedging of some assets may be easy because of the strong correlation between them and the instrument for example: hedging gold with gold futures.

But in reality perfect hedging is rarely possible because:

1. If we need to hedge the value of some portfolio consisting of many different assets we may hardly find instrument that is perfectly correlated. For example, the FT-SE 100 index might be somehow correlated with our portfolio but this increases the risk of the hedge. Estimation of parameters and forecasting is required, which is based on historical data that might not turn out to be successful in the future.
2. The quantity and period of the instrument available for hedging might be different from what we need. For example, there are only limited dates for which futures contracts are available.

The above example also represents a static hedging strategy. We hedged our assets of company X with futures contract and kept the ratio asset/instrument constant and equal to one until the end of the hedging horizon. The reason why this was possible was because the change in the price of the asset is linear (to a constant proportion) with the change in the price of the instrument. If the strategy used option as a hedging instrument the position had to be re-balanced during the hedging horizon, because the price of the option is not linear with the price of the underlying asset. Dynamic hedging is beyond the limits of this work and until the end in hedging strategies with options I will make the assumption that hedging with options does not require dynamic positions (the price of options is almost linear with the price of underlying asset).

Hedging strategies – Futures or Options on Futures

In this part I will first compare theoretically two hedging strategies. One is using futures and the other options on futures as instruments for controlling risk. After the theoretical conclusion, I will enter the futures and options markets to check the results in absolute real situation and make a practical conclusion.

We have seen so far that both futures and options are effective instruments widely used for minimizing portfolio risk (hedging). However, there are quite significant differences when comes to a particular strategy. These differences are mainly because unlike the options which give the right to buy or sell. Having a future contract obliges you to buy or sell. Another significant difference is due to the greater value in terms of possible choices to exercise or not to exercise – this advantage is captured in the option premium or the price of the option.

Compared in identical strategies seeking to hedge an asset in which the investor has long position the differences between futures and options can be summarized in the following table:

Hedging differences

Asset Scenario	Futures – Sell Short	Option – Buy Put
Price Falls	Price of future rises offsetting the fall in the asset's price. No gain or loss except transaction costs.	Price of option (premium) rises offsetting the fall in asset's price. No gain or loss except transaction costs
Price Rises	Price of future declines offsetting the gain from asset's price increase. No profit or loss except transaction costs.	Price of option falls but it is let to expire without exercising the right. Total gain from asset's price increase - option premium

As seen in the above table, although there is no premium for the future contract it has the function of locking the price of the portfolio not only preventing from loss but keeping the price locked and stopping any possible gain. While with option, an investor can prevent the portfolio from loosing value and in the same time benefit from a possible increase in the asset's price: "With options purchasers enjoy no downside risk, but do enjoy upside potential. This facility does not come for free and is reflected in the cost of options" (Winstone, 1995, p. 2)

Options or Options on Futures – It is very important to note that theoretically two hedging strategies using option or option on futures contract will have in general similar effects on the portfolio. However, options on futures are often used instead of options on the underlying asset due to the higher liquidity of the future contracts and markets. Another advantage is that: “Options on futures allow producers of commodities to hedge quantity risk as well as price risk” (Daigler, 1994, p. 553) for example when the harvest is unknown. Even though options on futures are still options and have the same basic characteristics used in the comparison of different strategies.

Real example 1: Hedging gold with gold futures.

Now I will enter the commodity market as investor, whose job is to design a strategy that will hedge the value of gold assets own by his employer. The company owns 100 troy ounces of gold currently traded at the markets for 1384.3\$ per troy ounce. I am seriously concerned that due to the market conditions the gold’s price is about to fall and I need an asset that can hedge this risk. On the futures market the one month gold futures are currently traded for 1385.2\$ per troy ounce. I decide that this contract is well correlated with the underlying asset and therefore short sell one contract consisting of 100 units of gold. The graph below captures the movement of the future contract 45 trading periods after I entered the market.



Just as I expected the price of gold had suffered rapid decline with the price of the future contract falling from 1385.2\$ to 1379.7\$. After the decline my short position on the futures market led to profit of 550\$.

Now on the gold market I can check that the price of the gold has declined almost perfectly correlated with the one of the contract. From 1384.3\$ to 1378.7\$



Thus on the asset I have loss of 560\$. We can say that the hedge is successful with an overall loss of 10\$ that is due to the spread in the futures market or just costs of trading.

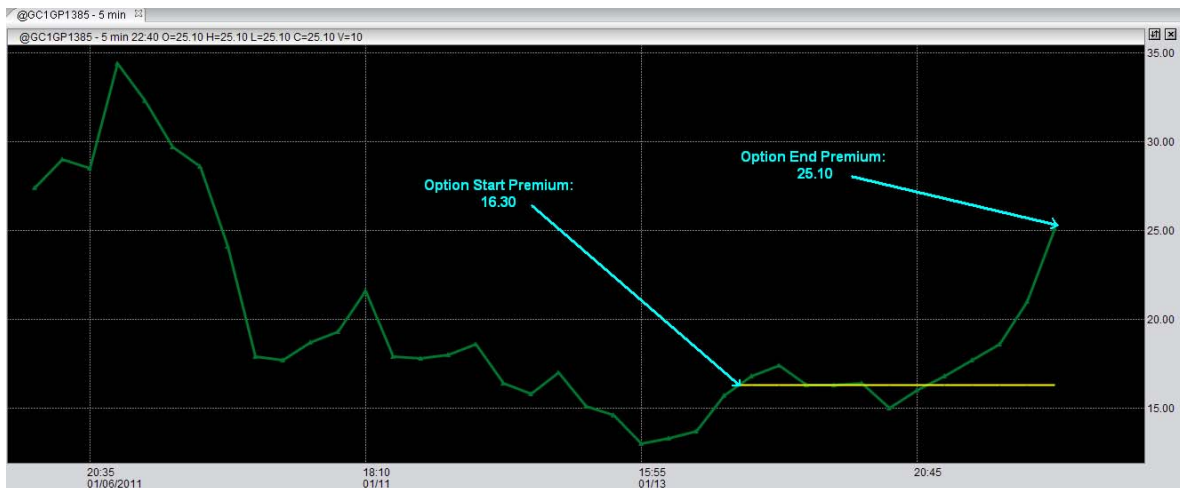
Real example 2: Hedging gold with options on gold futures.

Now again as an investor I enter the derivatives market in order to hedge the value of gold assets, but this time instead of futures I decide to make different strategy using options on gold futures as instrument. As mentioned earlier options on futures are often used by investors instead of options on the underlying asset due to the higher liquidity of future contracts. The asset is currently traded for 1384.1\$ and just like before I have 100 units. For hedging I choose one month 1385\$ put option which is slightly in the money. Take into account that this is the most suitable option currently available on the market, as the next closer option is 1380\$ put which is seriously out of the money. The current premium for that option is 16.3\$. I enter the options market with 10 contracts each of size 10 units.

Through the trading horizon the price of gold fell rapidly from 1384.1\$ to 1374.1\$ leading to a loss in the asset of 1000\$.



In the same time the price (premium) of the 1385 put option has increased from 16.3 to 25.1 leading to a gain from the option of 880\$.



The overall result on the portfolio is 120\$ loss. Which is not a perfect hedge, but in fact is still a good result. The incurred loss of 120\$ after the hedging strategy is 12% of the loss of 1000\$ that would be made without the hedging strategy. In addition, I would like to mention that the price of option was much less volatile and tend to stay very stable and react very slowly during the hedging horizon. After the price of gold felt rapidly, I had to wait much longer period until the price of the option captured the movement and reacted with increase.

In order to make full comparison between strategy 1 and 2 we should take into account the other possible scenarios.

In example 1, if the price of the asset increased instead of decreasing it would be offset by the same increase in future's price and the profit will be 0. The effect of locked price.

In example 2, if the price of the asset increased the price of option will decrease, but here I have the choice not to exercise the option but to let it expire. In this case the result will be the = gain in asset – premium. The total premium was 1630\$.

In order to have profit in overall the price of asset should've increased from 1384.1\$ to 1400.4\$. After 1400.4\$ per unit of the asset we will have profit from not exercising the option. It is obvious that in the current case due to the large option premium the main benefit of options over futures diminishes as such large increase in assets price is unrealistic and will have very small probability to occur.

Conclusion

In conclusion, I will use the results from the real market examples as they proved the theoretical expectations and in addition provided other very important information. Although in theory when the price of the underlying asset increases options on futures have more advantages than futures. These advantages might be with very low probability to occur just like in the examples. Therefore the particular choice between the two instruments depends on the investor's expectations on which scenario is with higher probability to occur. The future contract is easier instrument to use, its price is linear with the one of the underlying asset and simply locks the price of the portfolio it is good tool for investor who expects the price to fall for sure. On the other hand, options on futures are difficult to use instrument, but the effort to design a strategy in options on futures might be advantageous if the investor expects the price to fall, but does not exclude the case of rapid increase.

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