A note on the marking to market of futures contracts

As a finance specialist, it is important to understand the main difference between futures and forwards, namely what is called the "marking to market" of futures contracts. The idea here is the following. **UNLESS** offset before maturity, a long (short) position in a futures contracts on a given asset is, like a forward contract, a binding agreement to deliver (take delivery of) a certain quantity of the asset stipulated in the contract (e.g., a round lot of shares), for a price and at a future date that are both specified in the contract. In other words, although all aspects of the contract are agreed upon when the parties enter into the agreement, asset-delivery obligations come due some time later. Because the underlying asset’s price may fluctuate wildly, there is a huge risk that one or more of the parties will not be able to execute these obligations.

To reduce this risk, participants in the over-the-counter (OTC) market where forwards are traded – e.g., banks in the FX forward market – typically use the counterpart’s reputation to screen out bad risks and use credit line to assess risk exposure. On the other hand, the exchanges where futures are traded have set up two mechanisms:

1) the posting of margins by the parties (typically a few percentage points of the contract value, sometimes up to 20% – margins are set by the exchange for its members and by the latter for their clients and can change during the life of the contract);

2) the marking to market of the contracts, i.e., the requirement that profits and losses on futures positions be paid over every day at the end of trading.

The best way to understand "marking to market", and the resulting potential difference between forward price and futures price, is to go through a numerical example.

Consider the following two transactions in which an investor could potentially engage:

I. on the morning of Thursday, 09-15-05, an investor buys 125,000 Swiss Francs using a four-day forward contract; delivery is set on Wednesday, 09-21-05 (2 banking business days after Monday, which is 4 calendar days from 9-15); the price agreed upon is 0.75$/1SF.
II. on the morning of Thursday, 09-15-05, the investor goes long one September 2005 CME Swiss Franc futures contract; the price agreed upon is 0.75$/1SF. From CME regulations, we know that delivery is on the third Wednesday of the contract month, i.e., on 09-21-05; and that the last day of trading for the Sept. 2005 futures is Monday, 09-19-05 (i.e., two business days immediately preceding that third Wednesday). The broker is Lind-Waldock.

If we forget about discounting, the two contracts entail the same obligations for the buyer (our investor) to take delivery of SF 125,000 on 09-21-05, and the total cost of purchasing those Swiss Francs is 125,000 SF * 0.75 $/1SF = $93,750. However, these cash flows take place at different times for forward and futures, so that if we take discounting into account and the discount rates are stochastic, the prices of both contracts may differ.

I. for the forward purchase, no cash-flow takes place until delivery. On Wednesday, 09-21-05, our investor pays $93,750 (cash-out) and takes delivery of SF125,000 (cash-in).

II. the futures contract will lead to the following cash-flows.

<table>
<thead>
<tr>
<th>time</th>
<th>futures price (a)</th>
<th>margin requirement</th>
<th>cash-flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-15-05</td>
<td>0.75 $/SF</td>
<td>$2,150 (b)</td>
<td>- $2,150 (c)</td>
</tr>
<tr>
<td>(morning)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09-15-05</td>
<td>0.755 $/SF (d)</td>
<td></td>
<td>+ $ 625 (d)</td>
</tr>
<tr>
<td>(close)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09-16-05</td>
<td>0.752 $/SF (e)</td>
<td></td>
<td>- $ 375 (f)</td>
</tr>
<tr>
<td>(close)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09-19-05</td>
<td>0.74 $/SF</td>
<td></td>
<td>- $ 1,500 (g)</td>
</tr>
<tr>
<td>(close)</td>
<td></td>
<td>+ $ 2,150 (h)</td>
<td></td>
</tr>
<tr>
<td>09-21-05</td>
<td>+SF 125,000 (i)</td>
<td></td>
<td>+SF 125,000 (i)</td>
</tr>
<tr>
<td></td>
<td>- $ 92,500 (i)</td>
<td></td>
<td>- $ 93,750 (i)</td>
</tr>
</tbody>
</table>

(a) price of the Sept. 2005 SF futures contract, as determined every day by market forces. The futures price moves broadly in the same direction as, but not one-to-one with, the spot price of the SF. On the last day of trading of the September 2005 futures (Monday, 09-19-05), the September 2005 futures price and the spot price of the SF will be equal, since they both entail
delivery of SF on Wednesday, 09-21-05 (i.e., 2 business banking days later). Put differently, $0.74/SF is not only the price of our September-05 SF futures contract on Monday, 09-19-05, but also the Swiss Franc's spot price on 09-19-05.

(b) this figure is based on the assumptions that trading takes place at the CME on Thursday, 09-15-05; that the minimum margin required by the CME for SF futures contracts is $2,150; and that the margin required from our investor by his broker is also $2,150 (these margin requirements are typical for a SF currency futures; as of April 19, 2006, the requirements were SF2300 for clearing members and 3,105 for non-clearing members on outright positions).

(c) the investor deposits this amount at the clearing house (in practice, on an account with Lind-Waldock); to reduce the investor's opportunity cost of paying in cash, the clearing house (or Lind-Waldock) may allow him/her to deposit part of the $2,150 in the form of U.S. T-Bills.

(d) at the end of the first trading day, the futures contract that the investor entered into is marked to market, i.e., replaced by a new futures contract with the same delivery date but with a delivery price equal to the futures price on the CME at the close of trading. Suppose that the price of the SF futures for 09-21-05 delivery has gone up to 0.755$/SF by the end of Thursday, 09-15-05. This results in a SF125,000 * (0.755-0.75)$/1SF = $625 gain on our investor’s long position of. The investor can withdraw that cash from his/her account at the clearing house.

(e) Lind-Waldock's minimum maintenance requirement is assumed to be $1,600, so there should be no margin call. However, in practice the CME's clearinghouse may not allow most customers to let their deposit fall to that level (see part f).

(f) let us assume that the CME requires the margin posted by our investor to remain $2,150. The contract's marking to market results in a negative "gain" for our investor of SF125,000 * (0.752-0.755)$/1SF = -$375. He/she must deposit that amount in cash at the clearing house.

(g) again, the contract is marked to market, which yields a loss of $1,500. Our investor takes delivery at the prevailing price, $0.74/1SF. This costs him SF125,000 * $0.74/1SF=$92,500.

(h) the investor, since he/she has not defaulted, recovers his/her margin.

(i) delivery takes place on 09-21-05. By 09-21-05, the total cash-flows generated by the futures and the forward contracts are thus equal, but their respective timings differ. Notice that the spot price at the close of 09-19-05 is $0.74/SF. Hence, the holder of the forward contract who bought his/her SF at $0.75/SF has made an implicit loss of SF125,000*(0.74-0.75)$/1SF = $1,250. This is exactly the sum of gains and losses made by the holder of the futures contract.
A note on futures terminology.

As I explained in class, a forward contract specifies a price at which the underlying asset will be delivered at the time stipulated in that forward contract. Technically, this price is called the delivery price.

The forward price for a given forward contract is defined as the delivery price that would make that contract have zero value. The forward price is therefore equal to the delivery price when the contract is created. As time passes, the value of the contract to its holder changes with expectations about spot rates at delivery, yet the delivery price by definition is fixed. Hence, the forward price will change during the life of the contract.

For instance, suppose two contracts on the same stock are signed on the same day, but the first one matures in 77 days whereas the second has a 89-day maturity. Since both are entered into on the same day, say t, the price at date t of the 77-day forward contract on the SF (delivery in t+77) is very likely to be different from that of a 89-day forward contract on the same stock (delivery in t+89).

On the other hand, for arbitrage reasons, the price of an 89-day forward contract signed at time t is equal, at time t+12, to the price of a 77-day contract signed at time t+12.

Because forward contracts are not traded, we need not worry much about this terminology for forwards. In other words, no one will worry on day t+12 about the price of the 89-day contract on the stock: people instead will be thinking, as we have been in class, about the 77-day forward price. Not so with futures.

A futures contract specifies a price at which the underlying asset will be delivered at the time stipulated in that futures contract. Technically, this price is called the delivery price. Again, the futures price for a given futures contract is defined as the delivery price that would make that contract have zero value. The futures price is therefore equal to the delivery price when the contract is created. As time passes, the futures price will change, whereas the delivery price remains the same for the life of the contract. So far, everything seems similar to what we just said for forward contracts.

Remember, however, that futures contracts are traded but that only a few standard delivery dates are accepted, so that (say) a March futures will have a price quoted every day on
the CME (or EuroNext LIFFE, etc.) until the last day of trading. This is why, on page 2 of this handout, I am quoting a futures price every business day from 9-15-05 till 9-19-05. The futures price changes with the cost of carry (the interest rate differential between Swiss and US interest rates) and with the spot price of the underlying asset (the SF against the $ in our example).

This short note should settle questions you may have about forward and futures. If you have any more questions, feel free to discuss them with me during the office hours. Or better yet, for the true enthusiasts, you can read the relevant sections of Hull (not required material!). I think Hull has written one of the clearest and most accessible yet useful books on derivatives.

A note on the relationship between futures and forward prices

If interest rates are deterministic, then, despite the different timing of cash-flows, one can show that in this case forward and futures prices should be equal.\(^1\) If they are not, then there is room for arbitrage.

If interest rates are stochastic, however, there is no reason why forward and futures prices should be equal. In fact, the opposite is true. The exact relation depends on whether interest rates movements and futures price changes are positively or negatively correlated.

In theory:

1. If the correlation between futures prices and (domestic) interest rates is positive, then futures prices should be slightly higher than forward prices. This is because, whenever the futures price goes up, the holder of a long futures position makes an immediate gain which he/she can invest at a higher-than-average rate of interest, and, whenever the price of the futures goes down, he/she can finance the resulting loss at a lower-than-expected rate of interest (since interest rates have gone down at the same time as the futures price).

2. The contrary is true if the correlation is negative. In this case, economic intuition tells us that futures prices should be lower than forward prices.

In practice, however, the difference between futures and forward prices is very small and, in the presence of transactions costs, is typically too small to yield arbitrage opportunities.

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\(^1\) For a formal proof, read the article by Cox, Ingersoll and Ross in the Journal of Financial Economics, 1981.