Andreas Krause

Forwards and futures

- Forwards are the most basic financial derivatives and have been used since the 17^{th} century, they have been common to use for agricultural products throughout the 20^{th} century in US.
- They have seen much more widespread use since the 1970s for interest rates and currencies after the breakdown of the Brtton Woods agreement on fixed exchange rate and the volatility of exchange rates and interest rates that followed.
- Since the 1980s they have also been used on stock indices and occasionally individual stocks.

Definitions

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- A forward is a contract that is based on another asset, such as a security, currency, commodity. It is a contract to purchase (or sell) this so-called underlying asset. This purchase (or sale) will be completed in the future. Purchases (sales) that are completed immediately are called spot transactions.
  - The time period until the purchase is completed is also called the time to maturity.
  - The price at which the purchase (sale) is to be conducted, will already be agreed at the time the forward is agreed.
  - This price at which the asset is to be purchased (sold) is called the strike price.
- The purchaser agrees to buy the asset at these conditions and the setter agrees to sell it to him. Thus the contract is binding on both parties. This is different to options, where the contract is binding only on the seller of the option.
- A futures contract is the same as a forward contract, but it has standardised maturities and strike prices that allow these contracts to be traded on an organised exchange.
  - Typically futures have a short time to maturity, often within 3 moths, and rarely over 1 year.
  - Forwards are agreed bilaterally between the two parties, only of which is usually a bank, and can be bespoke in all aspects, the strike price but also the time to maturity, which can be substantial, often many years.
- In futures both parties have to provide collateral as this is a commitment to engage in a transaction. This collateral is called a margin.

→ Thus forwards and futures are in essence the same and we will here neglect the impact the margins will have on any decisions.

Definitions

- A Forward is a contract in which the buyer agrees to purchase the underlying asset at a future date

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Forward value

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→ We now seek to determine the value of a forward (or a future) and we focus on the value of a future from the perspective of the buyer.

- We consider the value of the future at its maturity, that is at the time the purchase or sale is completed. At that time we can determine that the value will depend on the value of the underlying asset.
- The asset is bought at the strike price, hence the profits of the buyer is the difference between these two values.
- From these profits we have to deduct the price the buyer paid to obtain the forward.

- *Formula*

- Rather than using a forward, the buyer could purchase the asset directly. After the transaction the buyer holds the asset and obtains its value at maturity of the forward.
- They also obtain any payments the asset makes during these T time periods until maturity of the forward. These returns might be dividends for stocks, interest paid on bonds, and similar.
- From this the purchase price, the current price of the asset, needs to be conducted. As with a forward we only pay the purchase price at maturity, we have additional financing costs for buying the asset already now.

- *Formula*
- At maturity of the forward, both strategies yield the same outcome, namely the purchase holds the underlying asset. Thus the profits these two strategies yield must be the same. If this were not the case, then either forwards would not be demanded or everyone would demand forwards and not purchase the asset directly. It would thus enable arbitrage by engaging in one strategy and offsetting it with the other (short sale), giving a profit as that would be the difference between the two strategies.
- [⇒] *Formula*

- The value of the futures is then consisting of the profits to be made from purchasing the asset through the forward at the strike price compared to purchasing it outright now.
- To this we add the financing costs of the direct purchase as a benefit for delaying the purchase, but also take into account the benefits the asset provides and which do not accrue to the purchaser if delaying the purchase through a forward. This difference is knows as 'cost of carry' or the 'basis'.

- We can easily see that the value of a forward can be positive or negative. If the strike price of the asset is high compared to the current price or the yield on the asset is high (r_S), the forward value can be negative. The value of a forward to the seller of the asset (and hence the seller of the forward) would be the same, just with the opposite sign.

→ Forwards are often quoted using a the forward or futures rate. We will determine this value now.

Forward value

- At maturity of the forward, the profits are the value of the underlying asset
- $\Pi_T = S_T$

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Forward value

- At maturity of the forward, the profits are the value of the underlying asset, less the strike price
- $\Pi_T = S_T - K$

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- If buying the underlying asset directly, the profits are the value of the underlying asset
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- $\hat{\Pi}_T = S_T + r_S T S_t$

Forward value

→ We now seek to determine the value of a forward (or a future) and we focus on the value of a future from the perspective of the buyer.

- We consider the value of the future at its maturity, that is at the time the purchase or sale is completed. At that time we can determine that the value will depend on the value of the underlying asset.
- The asset is bought at the strike price, hence the profits of the buyer is the difference between these two values.
- From these profits we have to deduct the price the buyer paid to obtain the forward.

- *Formula*

- Rather than using a forward, the buyer could purchase the asset directly. After the transaction the buyer holds the asset and obtains its value at maturity of the forward.
- They also obtain any payments the asset makes during these T time periods until maturity of the forward. These returns might be dividends for stocks, interest paid on bonds, and similar.
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- The value of the futures is then consisting of the profits to be made from purchasing the asset through the forward at the strike price compared to purchasing it outright now.
- To this we add the financing costs of the direct purchase as a benefit for delaying the purchase, but also take into account the benefits the asset provides and which do not accrue to the purchaser if delaying the purchase through a forward. This difference is knows as 'cost of carry' or the 'basis'.

- We can easily see that the value of a forward can be positive or negative. If the strike price of the asset is high compared to the current price or the yield on the asset is high (r_S), the forward value can be negative. The value of a forward to the seller of the asset (and hence the seller of the forward) would be the same, just with the opposite sign.

→ Forwards are often quoted using a the forward or futures rate. We will determine this value now.

Forward value

- At maturity of the forward, the profits are the value of the underlying asset, less the strike price, and the price paid for the forward
- $\Pi_T = S_T - K - F_t$
- If buying the underlying asset directly, the profits are the value of the underlying asset, plus any returns on that asset, less the costs of financing the asset
- $\hat{\Pi}_T = S_T + r_S T S_t - (1 + r_L T) S_t$

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- The value of a future consists of the profits to be made

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Forward rate

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- When a forward is agreed, the strike price agreed is often set such that the value of the forward is zero and no payments are necessary until maturity.
- [⇒] We solve the value of a forward for the strike price and obtain the *formula*.
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  - If we are using futures, the strike prices are set by the rules of the exchange on which they are traded.
  - For this reason we cannot set the strike price such that no premium is payable when entering a futures contract.

→ Once a forward has agreed, its value with become positive or negative; this is because the current value of the underlying asset will change (S_t), but also the cost of carry (basis) changes as the time to maturity becomes shorter.

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- [⇒] We solve the value of a forward for the strike price and obtain the *formula*.
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Forward rate

- Forwards are commonly set such that no initial premium is to be paid: $F_0 = 0$

$\Rightarrow K = S_0 + (r_L - r_S)\, T S_0$

- This is known as the forward rate
- For futures the strike prices are given and they will have an initial premium to pay

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Types of forwards

	Financing rate r_L	**Yield on underlying asset** r_S

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Stock index	risk-free rate	dividend yield

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Currency	interest rate domestic currency	interest rate foreign currency

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Currency	interest rate domestic currency	interest rate foreign currency
Interest rate	risk-free rate	bond yield

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Commodities	risk-free rate	negative of storage costs

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Properties of forwards and futures

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- The value of a forward is based on the difference between the current price and the strike price, thus the profits or losses that would be made when purchasing the underlying asset using the forward or future.
  - These profits or losses are adjusted by net financing costs if purchasing the underlying asset directly now, the so-called cost of carry.
- If the yield on the underlying asset is higher than the financing costs, this cost of carry is negative and the forward rate will be below the current value of the underlying asset.
- We have also seen that forwards and futures can have either a positive or negative value.

→ Forwards and futures are used for speculators as they require no or a very small initial investment, but as the profits (or losses) depend on the value of the underlying asset, they fully participate in the movements of the underlying asset. This give the potential for substantial profits with very small initial investment, but also the potential for very large losses. As profits and losses often are a multiple of the forward or future value, the investment is often referred to as 'levered'.

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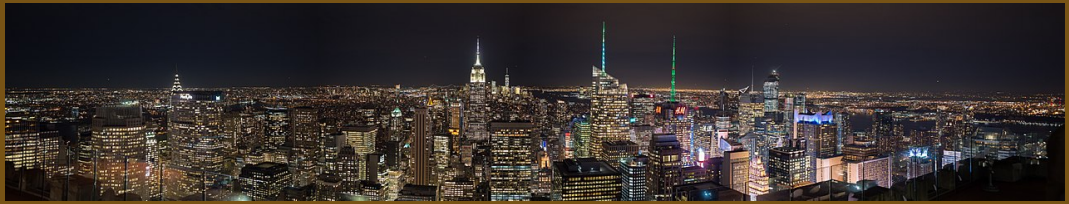

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