

Lesson Notes

MODULE 2 | LESSON 1

TRADING VOLATILITY: VARIANCE SWAPS

Reading Time	30 minutes
Prior Knowledge	Mark to market, Derivatives, Variance and Volatility , The Greeks, Black-Scholes equation
Keywords	Mark-to-market, Initial Margin, Margin call, Dealer bank, OTC, Forward contract

In the last lesson, we discussed various quantitative techniques for measuring and predicting systemic risk. In this module, we dig into the concepts of volatility and variance, which are often conceived as synonymous with risk. In this first lesson, we discuss variance not just as a property of asset prices but as something that can itself be traded in the over-the-counter market.

1. Trading Risk

Throughout the Portfolio Management course, we often used volatility or variance as a somewhat abstract proxy for the risk of a security or portfolio, though we also discussed drawdown, which is a more intuitive measure of risk: Volatility of returns is not by itself a bad thing, if all the price changes that drive the volatility are positive (assuming we are discussing a long position in the underlying). Of course, it's true that volatility tends to increase with price decreases, and price decreases are often much steeper than increases. However, if you are a portfolio manager only concerned with a price decrease in a given stock or stock index or some other asset, you might prefer to look for a put option that suits your needs. Similarly, if you are looking for relatively cheap exposure to the price increase of an underlying security, you might first look into the pricing for various call options with that underlying security. However, if you have a strong view about the direction of volatility itself, without any confidence or concern about the direction of the underlying price level, you might consider a variance swap. We will talk more in the next lesson about the very intertwined relationship between variance swaps and options, but for now, consider them completely distinct and in isolation.

In this lesson, we learn that volatility and variance can be isolated and traded as an asset class of its own. In Financial Markets, we discussed how credit default swaps (CDSs) can be used to trade the credit risk of a bond. In this lesson, we learn about a similar product, called the variance swap, that allows for the direct trading of the variance of an asset's or an index's returns. It's not a put or a call, which also fluctuates in value depending on the implied volatility. Those options are different in that 1) they are options, not swaps; and 2) their money-ness, whether they are "in the money" or "out of the money" depends on the price level itself: A long call is worth more if the underlying price is above the strike, like a long put is worth more if the underlying price is below the strike. A long variance swap increases in value if the variance of the underlying increases, whether or not the underlying price has significantly changed.

2. Exchange-Traded Derivatives

Futures and certain options are traded on an exchange, as well as publicly traded stocks. This means that the prices are transparent to all market participants. It also means that orders to buy and sell the same security are matched by a pricing engine, which eliminates the need for a middleperson. The exchange is thus an ideal transaction venue for fungible assets such as stocks, futures, and standardized options. We discussed fungible assets in Financial Markets: Since there is no meaningful difference between two shares of a share of FirstRand stock, you are willing to pay the same price regardless of the seller; the exchange matching engine facilitates this.

Back in Financial Markets, we discussed how houses are not considered fungible because of all the various characteristics that distinguish one house from the next. In other words, they are not standardized. Futures have contract specifications so that they are standardized: A certain futures contract might be a contract to buy or sell a pre-specified amount of some underlying product (cattle or gold, for example) at a pre-specified and standardized date and according to a multitude of other pre-specified and standardized terms. All this standardization ensures that the futures contracts are equivalent or fungible. Many puts and calls can be standardized in similar ways so that they expire on the same date and have the same strike.

3. Over-the-Counter Derivatives

In contrast to the fungible contracts with standardized terms and features, there are times when portfolio managers require more tailored derivative products. This could be as simple as an option on FirstRand stock but one that expires on a date different from the standardized options that trade on an exchange: for example, a call or put with a very short or a very long maturity, which does not trade on the exchange. Instead of a currency future with a notional value of 125,000 euros, a corporate treasurer may need to hedge a notional value of 400,000 euros—which cannot be accomplished with a whole number multiple of futures contracts—and perhaps also with a settlement date that does not line up with the futures maturity dates. Such bespoke contracts as these would be considered relatively vanilla in comparison to some more exotic derivatives, but nevertheless, an exchange would be no help to this portfolio manager or treasurer. In these situations, the portfolio manager or treasurer would likely have to enter into a bilateral contract with an investment bank acting as a forward dealer.

Such contracts are called OTC or “over the counter.” So if you are a hedge fund looking to put on an exotic derivatives position, such as the variance swap we will be discussing in this lesson, you would most likely go to a dealer bank that deals in such OTC products. The dealer bank makes a market in these more bespoke products, where the customer wants to tailor the contract in some way. In Financial Markets, we discussed one such OTC product, the credit default swap or CDS. We also discussed the fate of some of the major dealer banks in the Great Financial Crisis, such as Lehman Brothers.

4. OTC Risk Management

In general, an OTC trade is entered into under an umbrella agreement known as the ISDA (**International Swaps and Derivatives Association**) Master Agreement, which is often accompanied by a CSA (Credit Support Annex). These are boilerplate agreements that the industry has agreed to use, but they still allow for certain flexibility with respect to certain terms. Having an ISDA agreement (often just called an ISDA, pronounced “*IZ-duh*”) eliminates the need to negotiate and renegotiate all the contract terms anew for each trade.

Another benefit of the ISDA is that it allows for counterparty risk management in the form of margin or collateral. Margin can take two forms, initial margin and variation margin.

- Initial margin is posted upfront, at the inception of the trade. A large investment bank is likely to require most of its counterparties to post some amount of collateral as initial margin in case the trade “goes against” the customer. You can imagine that if the OTC trade has a 12-month maturity, there is plenty of time for the trade to move against the customer. The position could even start losing money on the very first day of the trade. If that happened, the customer might default (similar to a defaulting mortgagee), but at least the dealer bank will have the initial margin to make up for some of the loss (similar to the down payment).

The bank’s credit risk team is generally responsible for assessing the creditworthiness of the counterparty client as well as the riskiness of the trade under the prevailing market conditions. These factors determine the amount of the initial margin that the investment requires from the counterparty in order to enter the trade. It is possible that the bank’s credit risk management team considers the client to be of sufficient creditworthiness that no initial margin is required, for example, if the counterparty is another large, well-run bank or corporation.

- Variation margin is exchanged on a regular, usually daily, basis for the life of the trade. We talked about “mark-to-market” accounting in the last module: Positions are “marked,” meaning their prices are updated, so that the most current value of the portfolio can be calculated. The same concept is applied to margining for variation margin purposes. If the trade loses value from the perspective of the client (which means the trade is profitable from the bank’s perspective), the client needs to post this loss amount as collateral to the bank. Conversely, if the trade is profitable for the client, the bank is usually expected to pay out the increase in value to the client.

5. Mark-to-Market Margining

In the readings for this lesson, we will discuss the mark-to-market for the variance swap. As an example for now, let’s say that you have entered a forward contract to buy 10,050 ounces of gold denominated in South African Rand (ZAR) in three days. The seven-day forward price is 30,000 ZAR per ounce of gold.

- Day 0: The dealer bank requires 6,030,000 ZAR (2% of the trade’s notional value) as initial margin. No other money is exchanged on day 0.
- Day 1: The forward price of gold has increased to ZAR 30,500, but you have already contracted to buy it at only 30,000 ZAR, meaning your position has increased by 500 ZAR per ounce of gold, or 5,025,000 ZAR. Assuming your ISDA agreement allows for it, the dealer bank must pay you this amount as variation margin.
- Day 2: The forward price of gold has decreased to 30,400 ZAR, meaning your position lost ZAR 100 per ounce of gold. You will need to post 1,005,000 ZAR back to the bank.
- Day 3: This is the final day of the trade. The current price of gold is actually only 29,900 ZAR, but you are already in a contract to buy 10,050 ounces for 30,000 ZAR per ounce. You pay the 301,500,000 ZAR and receive your 10,050 ounces. The dealer bank also returns your 6,030,000 ZAR initial margin as the bank has no more credit risk to you in relation to this trade.

This is mark-to-market margining, and it greatly reduces the credit risk for OTC positions in the financial system: Instead of waiting for a whole year or more of potential losses to accumulate for either party, daily marking to market means a more frequent exchange of generally smaller amounts of money, which helps reduce counterparty credit risk.

6. Conclusion

In this lesson, we discussed some of the important differences between exchange-trade and OTC derivatives. We also discussed variance swaps and some of the important differences between these and volatility swaps.

References

- Hilpisch, Yves. "Derivatives, Volatility and Variance." *GitHub*, https://github.com/yhilpisch/lvvd/blob/master/code/01_derivatives_volatility_variance.ipynb.
- Hilpisch, Yves. "Realized Variance and Variance Swaps." *GitHub*, https://github.com/yhilpisch/lvvd/blob/master/code/09_variance_swaps.ipynb.

