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Looking into the futures markets: What are they really for?

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First things first – contrary to popular opinion, the main reason farmers and grain traders use futures markets is not to hedge spot price and basis risks, but to ensure the profitability of the storage business. The scientific literature mainly discusses the minimum variance hedge ratio, which aims at minimizing spot price and basis risks. In practice, however, it is of little use to farmers and grain traders and has the potential to yield negative economic consequences. Minimum variance hedging (MVH) leads to over-hedging on inverse markets and under-hedging on carry markets. In both cases, the costs of storage cannot be (adequately) covered. It is therefore not surprising that farmers and grain traders do not actually use MVH. On a carry market, a good strategy is to trade the basis. The opposite is true for inverse markets where hedging on futures markets does not make sense. Here, it is better to follow a rather speculative strategy that takes account of price trends. In a nutshell: buy on a weak basis and sell on a strong basis (carry market), or speculate (inverse market).

For decades, agricultural futures markets were used almost exclusively by grain traders, while farmers tended to overlook their advantages. However, in recent years this has begun to change. For example, more than a quarter of large US farms and as much as five percent of smaller farms now operate directly on futures markets (Prager et al., 2020). New futures contracts such as the Black Sea Wheat futures launched by the Chicago Mercantile Exchange (CME) group testify to the increasing appeal of futures markets over the last years.[1]

However, despite the (growing) importance of futures transactions for grain traders and farmers, the literature has yet to clearly indicate how best to use them.[2]

A common view (e.g., Brorsen, 1998; Brinker et al., 2009; Franken et al., 2020) is that farmers and grain traders should primarily use futures markets to hedge their overall price risk, i.e. their spot price and basis risks.[3] In order to hedge the risk on the spot market, they should take a short position on the futures market. In fact, recommendations even state that the futures market should be used to minimize both the spot price risk and the basis risk. This is where scholars advocate the use of the minimum variance hedge ratio (Johnson, 1960; Stein, 1961).

Given the potential economic impact this strategy can have, it is surprising how commonly it is called for and its (alleged) practical utility praised in the scientific literature and in textbooks (Hull, 2004). Not only is the strategy based on questionable assumptions, but it simply ignores the fact that farmers and grain traders first and foremost seek to be profitable. In particular, the trade-off must be considered between generating profit and minimizing risk on futures markets (Prehn, 2020).[4]

However, surprisingly, criticism on that recommendations have obviously fallen on deaf ears. Leading futures market experts, for example, have for decades been decrying the "pure" price hedging function of futures markets (Hieronymus, 1977) and strategies to minimize risk using MVH (Gray, 1982).

[1] Although demand for Black Sea Wheat futures is (still) relatively low.
[2] The statements made in this policy brief refer exclusively to hedgers who take a short position on the futures market. They do not apply to other market participants such as index funds (Glauben et al., 2013).
[3] For the sake of simplicity, we have limited ourselves to basis risk in this policy brief. In practice, of course, other risks, such as quality risk, location risk or exchange rate risk, also play an important role.
[4] In principle, the statements made in this policy brief can also be applied to hedging spot price and basis risk before harvest. The only difference is that before harvest, it is not the storage margin that is important, but the production margin.

MVH has its weaknesses

Minimum variance hedging (Johnson, 1960; Stein, 1961) rests on the theoretical foundations of Markowitz's (1952) portfolio theory, which seeks to minimize the risk of return through the efficient diversification of investments. Based on this, MVH aims at minimizing the overall price risk of forward deals. Unlike the portfolio theory, however, this does not involve two capital investments (e.g. shares), but a long (buying) position on the spot market is contrasted with a short (selling) position on the futures market.

However – and this is important – two types of risk come into play when hedging the overall price risk on the futures market: the spot price risk and the basis risk, which essentially includes the storage risk (or, more generally, the transaction risk over time). While the spot price risk is considered to be purely random (stochastic)[5], the basis, i.e. the difference between the spot price and the futures price, generally follows a more or less steady upward or downward trend. On an inverse market (demand driven market), for example, the basis has a tendency to fall (weaken), since the spot price is always higher than the futures price due to high demand and both prices converge towards the end of the contract.[6] On a carry market (supply driven market), the opposite is true. Here, the basis tends to increase (it becomes stronger) because the spot price is always lower than the futures price due to excess supply and both prices converge towards the end of the contract.

The main problem with MVH is that it leads either to over-hedging on inverse markets or to under-hedging on carry markets. This applies regardless of whether the agent is risk-averse, risk-neutral or risk-affine. As a result, farmers and grain traders must face loss of profits because they are particularly unable to cover their storage costs. MVH does not take into account the "trade-off" that must be made between the need to cover storage costs and minimizing the overall price risk, which in the medium to long term can have negative economic consequences.

This can be illustrated as follows, first for an inverse market (demand driven market) and then for a carry market (supply driven market). Inverse markets are particularly characteristic of high-price phases in which the physical commodity is needed in the short term. Accordingly, the spot price will always be higher than the corresponding futures price (Figure 1), with the spot price often showing an upward trend.[7] The "mark-up" serves to initially make storage economically unattractive and thus ensure sufficient supply to the market. Wheat and soybean markets in particular are frequently characterized by inverse markets.

On carry markets, on the other hand, there tends to be an "oversupply" with a greater need for storage, as is often the case for feed grain markets. Futures prices are always higher than spot prices (Figure 2) and, in contrast to inverse markets, also reflect storage costs. The greater the storage requirement (the higher the "oversupply"), the higher the futures price in relation to the spot price, with the spot price in particular more frequently showing a downward trend.

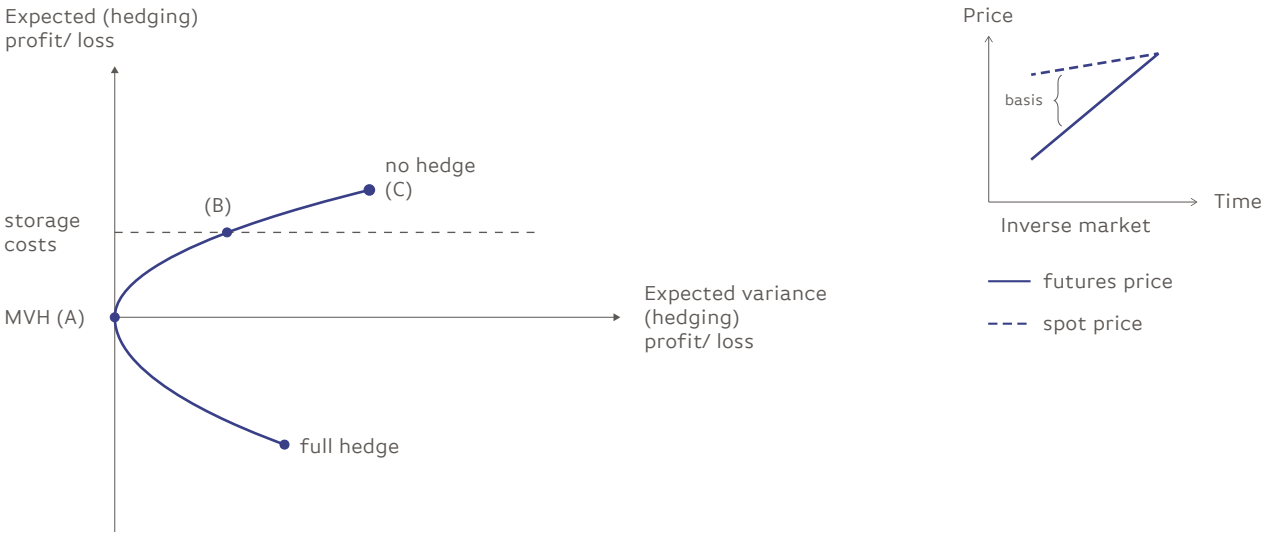
MVH leads to over-hedging on inverse markets

The following situation then arises on an inverse market (Figure 1). Similar to the portfolio theory mentioned above, the corresponding hedging gain/loss (vertical axis) and the associated variance (horizontal axis) can be plotted for the MVH ratio for any spot market-futures market combination. The highest overall price risk (spot price risk and basis risk) comes from not hedging at all. However this would also yield the highest profit. Full hedging, on the other hand, would minimize the spot price risk, but realize a hedging loss, as the basis risk would still apply. This is especially true given that, on inverse markets, the basis, i.e. the likelihood of generating a profit through storage, decreases over time (the basis becomes weaker).

The minimum variance hedge ratio here indicates the percentage of the physical commodity that must be hedged on the futures market to minimize the spot price and basis risk.[8] The figure shows that, according to MVH, the minimum risk hedge is at point A, where neither a hedging gain nor a hedging loss will be realized. However, in this case farmers and grain traders would also have to forego any revenue from storage activities in favor of price hedging. This is unrealistic from an economic point of view, as revenue from storage is needed to cover the costs of storage. Accordingly, even risk-averse farmers and grain traders should take a more speculative position, namely at the intersection of the storage costs with the portfolio curve (point B), so that storage costs can be covered. Accordingly, MVH leads to over-hedging. More risk-affine farmers are likely to take an even more speculative position (up to point C), although there is for sure no guarantee that a speculative gain will be realized.

[5] In the literature, a "random walk" is usually assumed, i.e. all available information is already included in the market price.
[6] Convergence between spot price and futures price at the delivery point is necessary because otherwise arbitrageurs could make a risk-free profit. They could buy the futures contract before it expires, have it delivered to them, and then sell the corresponding commodity back on the spot market for a profit.
[7] Like the MVH approach, we also assume that commodity futures markets do not always follow the efficient markets hypothesis. For a detailed discussion of how realistic the latter hypothesis is, see Bigman et al. (1983).
[8] Formally, the minimum variance hedge ratio can be calculated as follows: $\rho_{KF} \times (\sigma_K / \sigma_F)$, where ρ_{KF} corresponds to the correlation coefficient for the spot price and the futures price, and σ_K and σ_F to the standard deviation of the spot price and the futures price. For example, if the calculated MVH ratio is 0.6, then according to MVH, 60 percent of the physical commodity would have to be hedged on the futures market to minimize the overall risk, i.e. the spot price risk and the basis risk.

Figure 1: MVH on an inverted market
Source: author's own representation based on Markowitz (1952).



MVH leads to under-hedging on carry markets

The reverse is true for a carry market (Figure 2). In contrast to an inverse market, a full hedge on a carry market does not lead to a hedging loss, but to a hedging gain. This is because the basis, i.e. the likelihood of making a profit from storage, has a tendency to grow on carry markets (the basis becomes stronger).

On the other hand, it is generally recommended not to take a purely speculative position (no hedging) on a carry market (even for risk-affine farmers), since spot prices on carry markets tend to fall over the course of the contract or remain at a more or less constant level. Otherwise there is a risk that a loss will be realized.

As with the inverse market, hedging according to the MVH rule (point A) would also be suboptimal on a carry market. Farmers and grain traders should rather hedge a larger portion of the commodity (until the storage costs intersect with the portfolio curve (point B)), otherwise they will not be able to cover the costs of storage. Hedging according to MVH would lead to under-hedging on a carry market.

Buy on a weak basis and sell on a strong basis or speculate

The discussions above demonstrate once more that the idea of "pure" price risk minimization, which is often provided in the literature (e.g. Brorsen, 1998; Brinker et al., 2009) and formalized by the rule of minimum variance hedging, simply neglects key elements necessary for implementing appropriate hedging strategies on futures markets. On inverse markets, which are characterized by excess demand, MVH leads to over-hedging so that storage costs cannot be covered. On carry markets, dominated by high supply, MVH calls for too little hedging of the physical commodity on the futures market (under-hedging).

So (how) should farmers and grain traders hedge their transactions on futures markets? How can they keep the spot price risk as low as possible, while also generating enough profit to cover their costs of storage? The following general basic recommendations can be made for risk-neutral or risk-affine agents.

First, the main purpose of futures markets should not be to minimize spot price and basis risks but to enable farmers to make storage profitable.

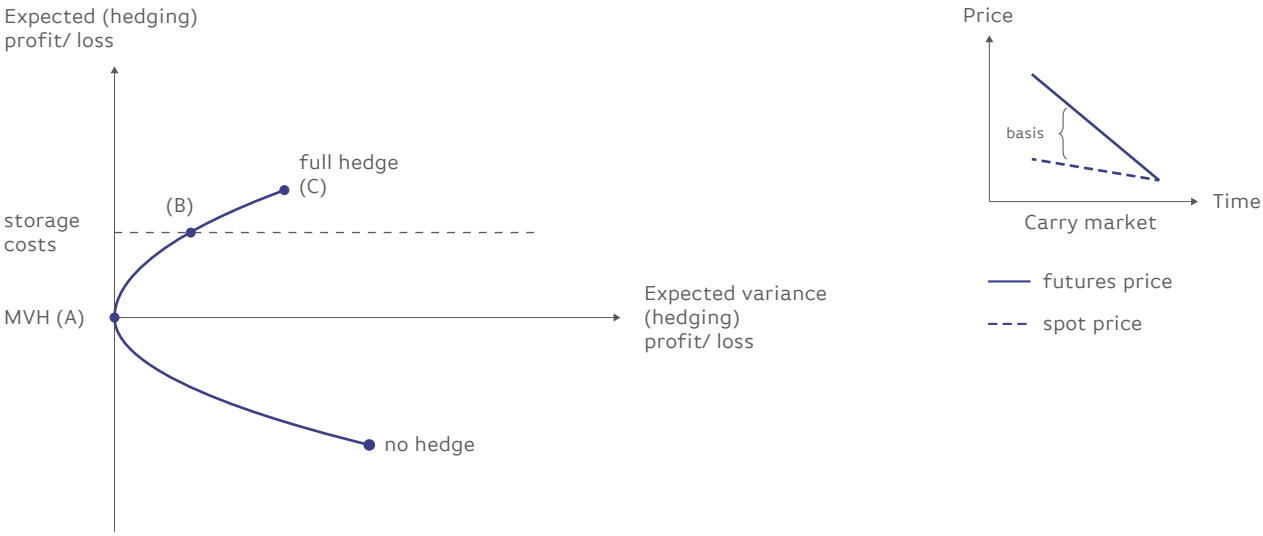
Second, whether to hedge at all and how to hedge depends crucially on the type of market, i.e. whether it is an inverse market or a carry market.

Third, basis trading could be a preferred strategy on a carry market. If it is very likely that a profit will be made by trading the basis (storing the commodity), farmers should hedge 100 percent of the physical commodity on the futures market[9] (point C in Figure 2) until a sufficiently strong basis, i.e. an acceptable spot price, is reached. At this point, the commodity can be offered. The profit generated as a result of storage is then equal to the difference between the buying and selling basis, corrected for the storage costs. To put it simply: buy when the basis is weak and sell when the basis is strong.[10]

Fourth, when it comes to inverse markets, finding a appropriate strategy can be more complex. Here, farmers are essentially advised against hedging on the futures market. Instead, they should rather speculate (from point B to point C in Figure 1).[11] When spot prices begin to fall, they should sell as soon as

[10] Of course, spreads would also have to be taken into account when trading the basis, which allow the basis profit to be leveraged even further. More information on spread trading can be found in Hieronymus (1977).
[11] For grain traders, inverse markets provide an ideal environment to sell forward, i.e. to sell the physical commodity forward for a strong basis and then buy the corresponding commodity for a weaker basis. [9] By taking a short position (i.e. selling a futures contract) on the relevant futures market.

Figure 2: MVH on a carry market
Source: author's own representation based on Markowitz (1952).



possible, as storage would no longer be economical. However, if spot prices start to rise, then the commodity should be stored until this trend ends or reverses. Farmers can use freely available chart analyses of price trends as a guide (e.g. www.kaack-terminhandel.de).

Many of these findings or similar are already being implemented e.g. in the USA (Usset, 2015). Furthermore, initial preliminary results of an ongoing empirical study by Thiermann and Prehn (2020) for the state of Lower Saxony (Germany) show that the strategies outlined above are more promising than many ad hoc-oriented recommendations made in the German trade press.[12]

However, these findings have yet to be adequately reflected in the mainstream scientific literature. In particular, recent scientific papers tend to overly favor MVH while only few researchers (e.g., Hieronymus, 1977; Prehn, 2020), for example, highlight the advantages of basis trading.

Accordingly, both sides would benefit immensely from closer collaboration between research and practice in agriculture. At the same time, universities, (technical) colleges and vocational training institutes should increasingly include courses related to futures transactions in their training programs.

[12] For example, the (preliminary) empirical results of a study by Thiermann and Prehn (2020) indicate that farmers can earn on average around nine euros/ton more from wheat storage when implementing the above-listed strategies on inverse markets or carry markets than when implementing the current recommendations of the trade press.

Further Information

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