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Why grain merchants will never be so naïve to use minimum variance hedging in daily business: A critical discussion

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Why grain merchants will never be so naïve to use minimum variance hedging in daily business: A critical discussion

Minimum variance hedging is probably one of the most popular concepts in the literature on agricultural futures markets. It has been applied many times in the literature, and all studies confirmed that minimum variance hedging has the potential to improve the effectiveness of hedging. However, despite this advantage, no grain merchant has ever used minimum variance hedging in daily business. In this paper we show that grain merchants have a good reason for this. Minimum variance hedging prevents them from trading the basis. If grain merchants do not trade the basis, they will not generate the profits that are necessary to cover the costs of grain storage and will go bankrupt sooner or later. In theory, risk avoidance may be a desirable goal, but in reality, it is not affordable. In fact, the only long-term sustainable strategy is basis trading.

Key words: Hedging, minimum variance hedging, basis trading, storage costs, price paid for storage.

Introduction

Minimum variance hedging (McKinnon, 1967) is probably one of the most popular concepts in the literature on agricultural futures markets. It owes its popularity to the fact that minimum variance hedging is easy to implement and interpret. The standard procedure for calculating the minimum variance hedge ratio is to regress the cash price of a commodity on its futures price (Heifner, 1972). The corresponding slope parameter then measures the minimum variance hedge ratio (i.e., the percentage of the cash commodity that must be hedged on the futures market to minimize the price risk of the cash commodity).

The minimum variance hedge ratio has been applied several times in the literature.[1] For instance, Bond et al. (1985) applied it to Australian wheat exports and Brorsen et al. (1998) to hard red winter wheat hedging in the United States. All studies confirmed that a minimum variance hedge has the potential to improve the effectiveness of hedging (i.e., the percentage of the cash price risk that can be hedged on a futures market).

Despite this advantage, however, grain merchants are more than reluctant when it comes to using minimum variance hedging in daily business. In fact, to date no grain merchant has ever used a minimum variance hedge in his daily operations. Grain merchants still adhere to the same old hedging approach that they have always adhered to. They hedge to trade the basis (i.e., the price relationship between the cash price and the futures price) (Peck, 1978).[2]

[1] For a literature review see Garcia and Leuthold (2004).

[2] In fact, not every grain merchant actively trades the basis. There are also grain merchants who use only a naïve hedge (Working, 1962). However, even naïve hedgers benefit from a seasonal strengthening of the basis.

The basic idea of basis trading is simple (cf. Working, 1953a, b).[3] Whenever the basis is weak (i.e., the cash price is significantly lower priced in proportion to the futures price), grain merchants have a strong incentive to buy grain on the cash market and sell a futures contract on the futures market to lock in the weaker basis. Later, when the basis has strengthened, the grain merchants resell the grain on the cash market and offset their futures position by buying a futures contract. The latter locks out the now stronger basis. The gross profit margin is then equal to the difference between the weaker basis and the stronger basis (Lorton and White, 2010).

What the grain merchants are actually doing is combining two market transactions, one on the cash market and one on the futures market, to speculate on changes in the basis. The grain merchants pursue a strategy of buying grain for a weak basis and selling it back for a stronger basis. According to Hieronymus (1977), grain merchants can be regarded as a kind of speculator: one who does not speculate on price changes but on changes in price spreads (i.e., differences between prices).

Obviously, basis trading and minimum variance hedging are two completely different concepts—the former is based on profit generation and the latter on risk avoidance. In this paper, we will critically discuss why grain merchants will never use minimum variance hedging in daily business, but will stick to basis trading. The reason for this is related to the basis and what the basis stands for. The basis not only measures the difference between the cash price and the futures price, but is also strongly related to storage costs. In fact, the basis measures the price that the market is currently willing to pay for the storage of grain until the end of the futures contract. If grain merchants do not trade the basis, they will not make the profits that are necessary to cover the aforementioned storage costs and will go bankrupt. In theory, risk avoidance may be a desirable goal, but in reality, it is not affordable.

This paper contributes in particular to the work of Williams (1986, 2001), who has already disproved the portfolio theory of hedging (Johnson, 1960; Stein, 1961; McKinnon, 1967)—the theoretical basis of minimum variance hedging. We are proving here that minimum variance hedging is not economically viable either. No grain merchant will ever be so naïve to use minimum variance hedging in daily business. It would be a guarantee for bankruptcy.

In the next section, we will provide more details on why grain merchants will never use minimum variance hedging in their daily operations. We will illustrate our case with a simple example. The final section will conclude.

Importance of storage costs

We begin our discussion about the reasons why grain merchants do not use minimum variance hedging in their daily operations, but instead use basis trading, with figure 1. Figure

[3] For the readers who are not familiar with the concept of basis trading, we warmly recommend the collected edition of Ann E. Peck (1978). The collection is freely available under following link: https://legacy.farmdoc.illinois.edu/irwin/links_archive_book_ViewsFromtheTrade.asp

1 shows a carry market—the standard term structure for storable agricultural commodities.[4] A carry market implies that the cash price relatively outperforms the futures price over the course of the futures contract. In addition, the futures price and the cash price at the delivery location of the futures contract must converge at contract maturity, otherwise arbitrageurs could make a risk-free profit (Hieronymus, 1977).

For the sake of simplicity, we have assumed a par-delivery, i.e., that the delivery location of the futures contract is in the region of the cash market. We have also assumed that the futures price will fall from 100 to 90 and the cash price from 95 to 90 (see figure 1).[5]

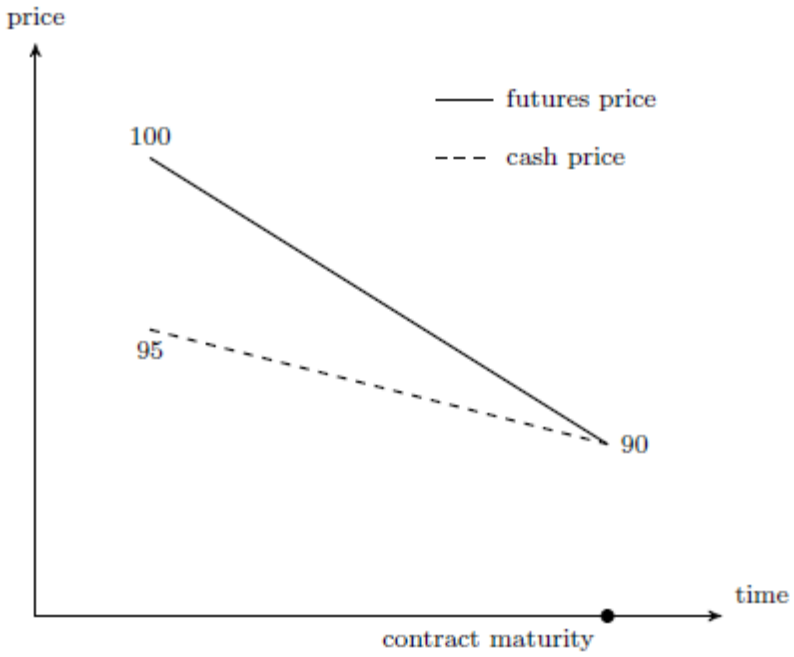

Figure 1. Example carry market

In the following, we will use figure 1 to compare a basis trade with a minimum variance hedge, see table 1.

[4] Inverse markets are very rare, especially for grain markets. If at all, then grain markets are inverse only at the end of the crop year (Working, 1949). At this point, however, grain merchants no longer store grain, but sell it to make room for the new crop.
[5] Our findings would also apply for a carry market with rising futures and cash prices.

Table 1. Comparison basis trade vs. minimum variance hedge (hedge ratio = 0.5)

	Cash market		Futures market			
	Buy	Sell	Long	Short	Basis trade	Minimum variance hedge
Buy basis	95			100 (50)	-5	+45
Sell basis		90	90 (45)		0	+45
					+5	0

Notes: Futures price times minimum variance hedge ratio in brackets.

Table 1 illustrates the standard example of a basis trade (Lorton and White, 2010). On one side we have the cash market and on the other the futures market. Whenever a grain merchant buys grain on the cash market, he sells (shorts) a futures contract to offset the price risk. The latter establishes the so-called buy basis, the basis for which the grain merchant buys the grain. In this example, at a cash price of 95 and a futures price of 100, the grain merchant would buy the grain for a basis of -5 (see figure 1).

Later, when the grain merchant resells the grain, he offsets his futures position by buying a long futures, which in turn establishes the so-called sell basis. In this example, again, the grain merchant would resell the grain at contract maturity for a basis of 0, with the gross profit margin equal to the difference between the buy basis and the sell basis, +5 in this example.

The main difference between the basis trade and the minimum variance hedge is that by the basis trade 100% of the cash commodity is always hedged on the futures market, while by the minimum variance hedge the minimum variance hedge ratio specifies the percentage that is to be hedged on the futures market. In this example, the minimum variance hedge ratio would be 0.5; when the futures price decreases by 1 unit, the cash price decreases by 0.5 unit (see figure 1). Obviously, if only fifty percent of the cash commodity is hedged on the futures market, this has an effect on the value of the buy basis and that of the sell basis. In this example, both bases change to +45. In addition, the basis changes affect the gross profit margin, which changes to 0. The latter is also the value we would have expected if the total cash price risk could be offset, as in this example.

However, the last point does not yet explain why grain merchants do not use minimum variance hedging in their daily operations. It only confirms once more that risk minimization is not free of charge, which is a known fact. To understand why grain merchants will never use minimum variance hedging in daily business, it is necessary to go a step further and ask what the basis is and what the basis stands for.

In fact, the first question has already been answered above. The basis defines the difference between the cash price and the futures price. However, this is only a technical definition, not an economic definition. The economic definition is revealed by looking more closely at the futures price and its definition. The futures price is defined as:

$$F_{t,T} = C_t + St_{t,T},$$

where $F_{t,T}$ defines the current futures price at time t with maturity T. C_t is the current cash price at time t. And $St_{t,T}$ is the price that the market is currently willing to pay for the storage of grain until the end of the futures contract T.

At this point, it is important to stress that we are not focusing on storage costs, but on the price paid for storage. While the former refers to the amount of money a grain merchant has to spend on grain storage, the latter is the equilibrium price on the storage market. Only in the case of the marginal grain merchant do the individual storage costs correspond to the equilibrium price on the storage market, otherwise the two values differ from each other.

Obviously, the equality of the futures price definition must always be guaranteed, otherwise grain merchants would have a strong incentive to trade on the inequality. For example, if the futures price exceeds the cash price plus the price paid for storage, then even grain merchants with higher storage costs than the marginal grain merchant would buy and store grain on the cash market. The latter would increase not only the cash price but also the equilibrium price on the storage market. On the other hand, the additional hedging pressure (i.e., short hedging) would reduce the futures price. A new market equilibrium would only be achieved when the futures price would again correspond to the cash price plus the price paid for storage. Otherwise at least some grain merchants would still have an incentive to trade on the inequality.

The important point to note is that the basis is the inverse of the price paid for storage. This can be seen by rearranging the definition of the futures price, $-St_{t,T} = C_t - F_{t,T}$, and reconsidering the definition of the basis, $B_t = C_t - F_{t,T}$. After equalizing the two equations one gets $B_t \equiv -St_{t,T}$. Obviously, this identity confirms the earlier statement that the basis corresponds to the inverse of the price paid for storage.

That this identity is crucial to understanding why grain merchants have no other chance than to trade the basis becomes clear when one reconsiders the marginal grain merchant. As already mentioned, in a balanced market, the storage costs of the marginal grain merchant must be equal to the price paid for storage. Furthermore, because the price paid for storage is the inverse of the basis and the basis is -5, in this example the storage costs of the marginal grain merchant are +5. Accordingly, in order to reach the break-even point, the marginal grain merchant must at least make profits of +5, otherwise he would go bankrupt sooner or later.

Obviously, if the marginal grain merchant trades the basis, he can generate the profits that are necessary to cover the storage costs (see table 1). The basis trade would bring him a profit of +5, while his storage costs would be +5. The marginal grain merchant would make a zero-

profit, exactly the value we would have expected for a marginal grain merchant in a perfectly competitive market.

On the other hand, the minimum variance hedge would not be economically viable. As shown in table 1, the minimum variance hedge would only generate profits of 0, which are nowhere near enough to cover the storage costs of +5. In fact, the marginal grain merchant would make a loss of -5. Moreover, if he does not change his hedging strategy, he will go bankrupt sooner or later.

The last point is important because it answers our original question why grain merchants will never use minimum variance hedging in daily business. They will never do so because a minimum variance hedge is a guarantee for bankruptcy. If grain merchants rely on minimum variance hedging, they will not make the profits that are necessary to cover the costs of grain storage. Sooner or later the missing profits will lead to bankruptcy. The latter does not only apply for the marginal grain merchant, but also to all other grain merchants with positive storage costs.[6] In fact, the results of this paper also apply for cross hedging (see appendix A).

It can also be analytically proven that on a carry market, basis trading is always superior to minimum variance hedging. For this purpose, the gross profit margin of a minimum variance hedge must be compared with that of a basis trade. If minimum variance hedging is superior, its gross profit margin should be greater than that of a basis trade. The corresponding equation is:

$$\Delta C - MVHR * \Delta F > \Delta C - \Delta F,$$

where ΔC (ΔF) corresponds to the difference between the cash price (futures price) at the begin of the hedge and the end of the hedge, and MVHR is the abbreviation for the minimum variance hedge ratio. Note that the equation does not presuppose a convergence of the cash price and the futures price at contract maturity.

After rearranging the former equation, one obtains:

$$(- MVHR + 1) * \Delta F > 0,$$

As can easily be seen, minimum variance hedging is only superior (> 0) if the futures price falls ($\Delta F < 0$) and the $MVHR > 1$ or the futures price rises ($\Delta F > 0$) and the $MVHR < 1$. The last two situations, however, correspond to an inverse market (i.e., a market where the cash price is higher priced than the futures price) and not a carry market (see figure 2). Ergo, we can conclude that on a carry market, basis trading is always the superior marketing strategy.

The last point is important because it invalidates the argument that, in reality, cash and futures prices do not usually converge perfectly at contract maturity, and that the corresponding basis risk would in turn justify a minimum variance hedge. The previous proof, however, has clearly shown that regardless of whether the cash price at contract maturity is higher or lower than the futures price, a basis trade is always the better choice. Only on an inverse market would a minimum variance hedging be the better choice. On an

[6] The results of this paper also apply to exporters (i.e., long hedgers) and processors (i.e., crush margin hedgers) in a slightly different form.

inverse market, however, grain merchants do not go long the basis (i.e. they buy and store grain), but short the basis (i.e. they sell grain forward) (Lorton and White, 2010).

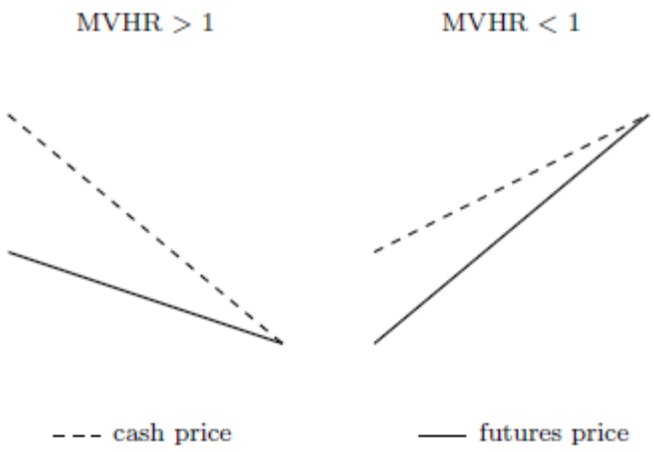

Figure 2. Inverse markets

Our work contributes in particular to the work of Working (1953a; b), who has already described the foundations of basis trading. Our contribution is that we have explained why grain merchants have no other choice but to trade the basis. Without basis trading, grain merchants would not make the profits that are necessary to cover the costs of grain storage. In fact, basis trading is the only grain marketing strategy that is sustainable in the long run.

Conclusions

In this paper, we dealt with the question of why grain merchants have never used minimum variance hedging in daily business. This is a very interesting question, as many articles have emphasized the advantageousness of minimum variance hedging, in particular the improved hedging effectiveness.

However, risk minimization is not the only relevant variable in grain merchandising. Above all, it is important that a grain merchant can cover his storage costs. However, this is precisely where the problem of minimum variance hedging lies. Minimum variance hedging makes it possible to minimize the price risk, but prevents grain merchants from trading the basis. However, as we have shown, the profits from basis trading are crucial to cover the costs of grain storage. If a grain merchant does not trade the basis and does not make the profits to cover his storage costs, he will go bankrupt sooner or later. From a theoretical point of view, risk minimization may be a desirable goal, but it is not affordable in reality—at least not in grain merchandising. The only long-term sustainable strategy is basis trading—the strategy that grain merchants have been following for 170 years (Peck, 1978).

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Appendix

The objective of this appendix is to demonstrate that the results of this paper also apply for cross hedging. As an example, we have opted for a cross hedge of barley at a corn futures market, see figure A1.

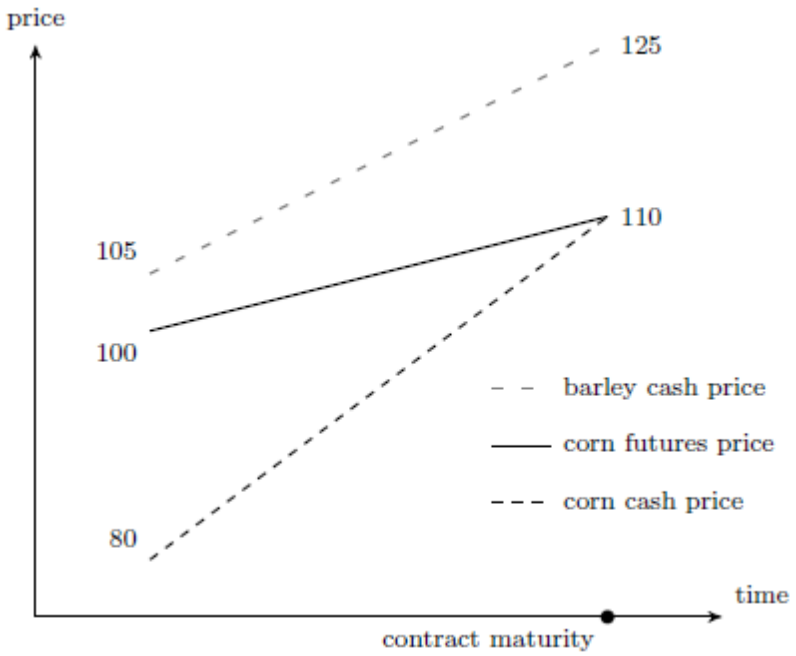

Figure A1. Example barley cross hedge at a corn futures market

As before, we are dealing with a carry market. The only difference is that we are now dealing with a carry market with rising futures and cash prices. The most important point is that the premium for barley decreases by 10 cents/bu. over the course of the contract; while the cash price for corn rises by 30 cents/bu. (from 80 to 110), the barley cash price rises only by 20 cents/bu. (from 105 to 125).

As expected, the minimum variance hedge ratio (in this case 2) again offsets the total cash price risk, see the calculations in table A1. In this case, too, the profits from the minimum variance hedge (i.e., the cross hedge) would not have been sufficient to cover the costs of grain storage. Sooner or later, the grain merchant would also have gone bankrupt with cross hedging.

Table A1. Comparison basis trade vs. cross hedge

	Cash market		Futures market			
	Buy	Sell	Long	Short	Basis trade	Cross hedge
Buy basis	105			100 (200)	+5	-95
Sell basis		125	110 (220)		+15	-95
					+10	0

Notes: Futures price times minimum variance hedge ratio in brackets.

More interesting, however, are the results for the basis trade, see table A1. The basis trade delivers only a gross profit margin of +10 cents/bu. Had the corn and barley price been parallel, the basis trade would have yielded a gross profit margin of +20 cents/bu. The difference is clearly due to the falling premium for barley.

One could now think about hedging the premium risk.[7] However, this would not correspond to what the market is trying to say to its market participants. To understand what the market is trying to say, look at figure A2.

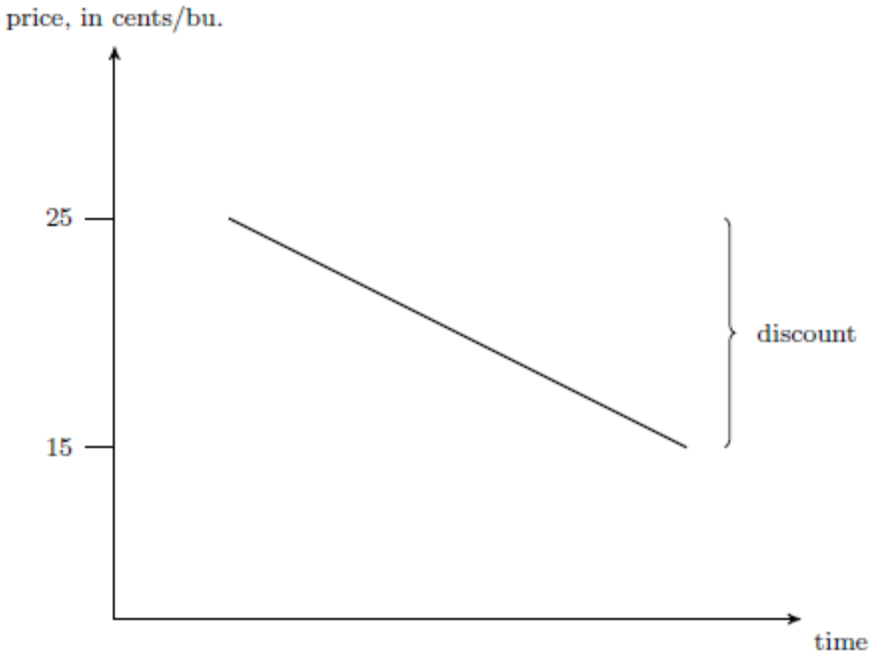

Figure A2. An inverse premium market

[7] A premium hedge could be imaged as a kind of hybrid: A combination of a basis trade with a minimum variance hedge for the premium risk (i.e., barley premium regressed on corn futures).

Figure A2 shows the temporal development of the barley premium. Obviously, the barley premium follows the structure of an inverse market. The premium is higher first, then lower, which means that the market discounts any subsequent sales of barley. What the market is trying to say with the inverse premium is that the market currently needs barley more urgently than corn; the grain merchants should sell barley first and then corn later.

The last example also explains why a barley futures contract is not required. The storage costs of barley can already be effectively hedged at the corn futures market, while the size of the barley premium defines which feed grain needs to be sold first, corn or barley.