The Hedging Pressure Hypothesis and the Risk Premium in the Soybean Reverse Crush Spread

Ziran Li, Ph.D.
School of Public Finance and Taxation, Southwestern University of Finance and Economics, Chengdu Sichuan, China

Dermot J. Hayes, Ph.D.
Department of Economics and Finance, Iowa State University

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This article develops a theory of multiproduct hedging which serves to formalize Keynes's hedging pressure hypothesis that the need to attract speculative capital to match hedgers' trades creates a difference between the futures and expected maturity price. The authors test the theory empirically in the context of the soybean complex which has speculators and hedgers in soybeans, soybean meal and soybean oil. The focus is on the crush spread because it is unlikely that hedgers will want to make simultaneous trades on the opposite side of soybean crushers in all three markets. The findings reveal that there is a significantly positive return to speculators for providing this liquidity.

Introduction

Keynes (1930) postulated that hedgers in futures markets ought to compensate speculators for bearing the risk of price movements. This compensation, also referred as risk premium, if it exists, suggests that the futures contract price deviates from the expected maturity price. There is little consensus in the literature regarding the existence of hedging pressure, in part because it is impossible to know the expected maturity price.

Soybean processors buy soybeans, crush them, and sell the resulting soybean meal and oil. The soybean "crush" thus represents the price difference between the appropriately weighted value of the soybean meal and oil futures, and the purchase of soybean futures, in other words it is a forward-looking measure of their expected margin. They can hedge this margin by buying soybean futures and selling oil and meal futures. Soybean processors commonly use this soybean crush spread as a hedge. Speculators can take "reverse crush" positions, long oil and meal and short soybeans, in order to take advantage of a potential risk premium paid by the crusher. There is no prior research examining whether the soybean crush spreads exhibit properties consistent with the hedging pressure hypothesis. This would happen if the speculators, who routinely take the reverse crush make consistent positive profits, i.e., earn a risk premium. The purpose of this paper is to determine if these profits exist.

Why the Paper's Research Agenda is Important

The price risk insurance role of futures markets remains a controversial debate. The authors contend that the crush spread is an ideal "laboratory" to test the hedging pressure hypothesis for five distinct reasons.

This digest article was contributed by Ana-Maria Fuertes, Ph.D., Professor in Finance and Econometrics at Bayes Business School, City, University of London (U.K.) and Associate Editor of the GCARD.

First, the spread itself is small relative to the underlying soybean price. A one- or two-cent risk premium might be detectable in the spread even if undetectable in the flat price of soybeans. Second, when crushers place their hedges in the relevant futures they buy soybeans, pushing their input prices up, and sell oil and meal, thereby putting downward pressure on their output prices. In both cases, their activity works to reduce the crush spread (increase the reverse crush) as measured in the futures markets. Third, crushers have information about the equilibrium size of the spread, which may come from measuring the historic spread for each month or by measuring the average fixed costs that the spread is covering. The appropriate size of the spread is not relevant to those who hedge or speculate in only one of the markets. Therefore, crushers can respond quickly to market conditions that provide them with a favorable spread. Conditions that are favorable to one crusher might lead other crushers to place similar spreads. Fourth, commodities such as corn and soybeans have natural longs and shorts. With natural hedgers on both sides of the market, it is hard to separate hedging pressure from other market forces. Any other market participant is very unlikely to *simultaneously* take the opposite side of the soybean crush for hedging purposes. On days when crushers place large hedges, having natural hedgers in all three underlying futures markets to offset the crush hedge is unlikely. Instead, speculative capital may be needed to provide liquidity in one or more markets; and incentives to attract speculative capital are what may allow us to detect the risk premium.

Theoretical Framework

Each of the three underlying futures markets studied does have natural hedgers on the opposite side of the crusher, which motivates the authors to develop a general theory of how producer-hedgers, processor-hedgers, and speculators in all three markets interact. The authors setup a model under just two types of players – a soybean producer (farmer) and a speculator. They initially leave out the commodity processor because this may take the opposite side from the producer. The speculator serves to clear the futures market by taking the opposite of the producer's desired short position. Net they set up a model in a more realistic scenario with producers, processors and speculators.

The theoretical framework suggests that without the offsetting positions from producer-hedgers, crushers will pay a risk premium to hedge the crush spread. Since there is no natural hedger for the reverse crush, they authors hypothesize that passively taking the reverse crush will yield significant positive returns.

Empirical Analysis

They authors test the aforementioned hypothesis by calculating sample moments of the returns of the soybean reverse crush spread. The main data are futures prices for soybean, soybean meal and soybean oil from *Barchart*. The key control variable is the carryover, which measures the available crop on December 1st from the United States Department of Agriculture to account for both the ending stocks from the previous marketing year as well as the new crop.

To execute a soybean crush hedge, the crusher sells 9 contracts of soybean oil, 11 contracts of soybean meal, and buys 10 contracts of soybeans. This "9-11-10" spread closely replicates the proportions governed by the soybean crushing technology (less 10,000 lbs out of 550,000 lbs of soybean oil, which is left unhedged). Thus, we calculate the reverse crush spread (*rcs*) in month $j < J$ maturing in month J as:

$$rcs_{j,J} \equiv \log\left(2.2 * meal_{j,J} + 10.8 * oil_{j,J}\right) - \log\left(soybean_{j,J}\right) \text{ with } J = 1, 3, 5, 7, 9, 11 \quad (1)$$

The excess return of the soybean futures reverse crush spread is obtained as $\Delta rcs_{j,J} \equiv rcs_{J-1,J} - rcs_{j,J}$ with the reverse crush trade closed one month prior to the maturity month to avoid liquidity and calendar date problems in months when contracts expire.

Table 1 provides details on the average return of the reverse crush spread by contract maturity from 1962 to 2019. There is evidence of a risk premium—the November soybean futures crush spread price with more than three months to maturity overestimated the realized crush margin by approximately 1.5%. The crush spread per bushel of soybeans purchased is typically 20% of the price of one bushel, which, for $10 per bushel soybeans, corresponds to $2 per bushel used. A 1.5% reverse crush margin means that the crusher is paying about $0.03 per bushel crushed and appropriately hedged.

Table 1
Reverse Crush Spread Return by Contract Maturity and by Month to Maturity, 1962–2019

	Holding Period (month)									
Maturity Month	1	2	3	4	5	6	7	8	9	10
Jan	0.004	0.008	0.014	0.015	0.017	0.018	0.018	0.021	0.023	0.021
Mar	0.000	0.000	0.003	0.005	0.010	0.010	0.011	0.013	0.013	0.016
May	0.001	-0.001	0	0.001	0.002	0.004	0.007	0.007	0.007	0.010
July	0.000	0.002	0.004	0.001	0.001	0.003	0.003	0.005	0.009	0.005
Sep	0.005	0.008	0.005	0.007	0.010	0.010	0.011	0.012	0.009	0.005
Nov	0.008	0.010	0.013	0.014	0.013	0.015	0.018	0.018	0.017	0.012

Note: The reverse crush spread is closed one month prior to the maturity month, thus we construct the January reverse crush spread using January contracts closed in December of the preceding year. The November reverse crush spread consists of the November soybean contract and December contracts of soybean meal and oil. The November reverse crush is closed in October.

The sample averages for different maturity and duration combinations are overwhelmingly positive. If the futures forecasts are truly unbiased with equal probability of over- and under-predicting the realized spot prices in a given month, then the Bernoulli probability of observing 59 positive forecast errors out of 60 is very small at $\frac{1.73}{10^{18}}$.

Table 2 summarizes the reverse crush spread by contract maturity of the returns with less than 12 months to maturity. The skew is positive for contracts maturing in January, March, May and November. Chen's (1995) upper-tailed test for the mean of positively skewed distributions indicates these sample averages are significant at the 1% level.

Table 2
Summary Statistics of Reverse Crush Spread Return

	Maturity Month					
	Jan	Mar	May	Jul	Sep	Nov
Mean	0.0157***	0.0080***	0.0038***	0.0033	0.0083	0.0137***
(p-value)	<0.0001	<0.0001	0.0003	\	\	<0.0001
Median	0.0102	0.0019	-0.0001	0.0019	0.0084	0.0099
Std. Dev	0.0354	0.0363	0.0279	0.0272	0.0244	0.0254
Min	-0.0692	-0.0551	-0.0738	-0.1197	-0.0608	-0.0493
Max	0.1443	0.1991	0.1489	0.0838	0.0795	0.0876
Skewness	0.8774***	2.5297***	1.6973***	0.0510	0.1626	0.4894***
(p-value)	<0.0001	<0.0001	<0.0001	0.6221	0.1210	<0.0001
Excess Kurtosis	4.1284***	12.7040***	9.3400***	4.2315***	3.2514	3.0825
(p-value)	0.0002	<0.0001	<0.0001	0.0001	0.2159	0.5939

Note: The table reports statistics for the reverse crush spread of different maturities with less than 12 months to maturity. The sample period is 1962 to 2019. p-values are reported for the mean, skewness, and excess kurtosis are reported. Asterisks denote significance levels as follows: *10%; ** 5%; and ***1% significance.

Conclusions

In this paper, the authors start by arguing that the crush spread represents an ideal laboratory to test Keynes's hedging pressure hypothesis. They develop a general equilibrium model that includes speculators, producer hedgers, commodity processor-hedgers, and hedgers who take the opposite side of the processor in the output market. Testing hypothesis that arise from the model, they provide evidence of hedging pressure in the soybean reverse crush spread. The size of the spread is modest – about $0.03 per bushel hedged – relative to whole soybean prices. This modestly sized risk premium, coupled with a lack of information on what the true expected maturity price is in other futures markets, may explain why support for Keynes's hedging pressure hypothesis has proven so elusive. The results suggest that in markets where net hedging is long, the futures prices will be biased upwards. The opposite is true in markets where net hedging is short. The implications for traders in the soybean pits is that there is likely a small negative bias in new crop soybean futures and a small positive bias in meal and oil futures.

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Author Biographies

ZIRAN LI, Ph.D.
School of Public Finance and Taxation, Southwestern University of Finance and Economics, Chengdu Sichuan, China

Dr. Ziran Li is an Associate Professor at the School of Public Finance and Taxation at Southwestern University of Finance and Economics in Chengdu Sichuan, China. He received both a Bachelor of Applied Science in Economics and Math and a Ph.D. in Agricultural Econimics and Behavioral Economics from Iowa State University. His research papers have been published in journals including *Agricultural Finance Review*, *American Journal of Agricultural Economics*, *Agricultural Policy Review*, and the *Journal of Futures Markets.*

DERMOT J. HAYES, Ph.D.
Department of Economics and Finance, Iowa State University

Dr. Dermot Hayes is the Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences in the Department of Economics and Professor and Pioneer Hi-Bred International Chair in Agribusiness in the Ivy School of Business at Iowa State University. His areas of expertise include U.S. farm policy and international agricultural trade, agribusiness, crop insurance, financial derivatives and the potential impact of China on commodity markets.

In 2006, Dermot received a "Publication of Enduring Quality" award from the Agricultural and Applied Economics Association. AAEA named him a Fellow in 2007, its highest recognition for distinction in the discipline. Since 1995 he has been a consulting trade economist for the National Pork Producers Association.