The Reverse Soybean Crush Spread: Evidence of the Hedging Pressure Hypothesis

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1. Introduction

The soybean futures crush spread, consisting of simultaneous long soybean, short soybean meal and short soybean oil futures contracts, is a commonly traded hedge spread by soybean processors. The hedging pressure hypothesis (Keynes, 1930) postulates that hedgers in futures markets ought to compensate risk-averse speculators for bearing the risk. If it exists, this compensation, also referred as risk premium, suggests that the futures contract deviates from the expected maturity price. There is little consensus in the literature regarding the existence of hedging pressure (Gorton, Hayashi and Rouwenhorst, 2012).

To the best of our knowledge, there has been no published paper examining whether the soybean crush spread exhibits properties consistent with the hedging pressure hypothesis. Commodities such as corn and soybeans have natural longs and shorts and this makes it hard to identify hedging pressure. With natural hedgers on both sides of the market, it is hard to separate hedging pressure from other market forces. There is no market participant would wish to take the opposite side of the soybean crush for hedging purposes and this makes it ideal for studying the hedging pressure hypothesis.

In this article, we analyze the monthly return of the reverse crush spread, an effective sale of soybean futures contracts and offsetting purchase of soybean meal and oil futures contracts, by contract maturity from 1962 to 2016. We take into account the non-continuous nature of futures contracts, and explore the cross-sectional variations among the trade across different maturities. The existence of hedging pressure in the soybean complex is consistent with the positive and predictable return on this reverse crush.

2. Previous Work

The previous literature on the soybean crush spread can be categorized into two areas. Crushers, use the futures markets to stabilize their gross profit margin (Chicago Board of Trade, 1978). Crushers will be more inclined to hedge when the variation in their profit margin increases, this is positively correlated with their profit margin (Boyd, Brorsen and Grant, 1987). Lence, Hayes, and Meyers (1992) find a similar positive relationship between margin risk and profit margin. Because the soybean processor does not wish to lock in a negative crush spread, the processor will selectively hedge depending on the magnitude of the crush (Working, 1962). Lence, Hayes and Meyers (1992, 1995) find evidence that soybean processors increase production when the futures prices for meal and oil increase relative to cash soybean prices. Kenyon and Shapiro (1976) also demonstrate that processors attempt to lock in above normal crush margins in the futures markets.

On the speculative side, the behavior described above suggests a trading rule based on mean reversion the spread. The speculative rule is to be long the crush spread when it is relatively large, and to short it when it is low. Rechner and Poitras (1993) define whether a spread is large or small compared to the previous day's close. Simon (1999) and Mitchell (2007) use the recent 5-day moving average as the threshold, above which a long crush spread will be initiated, and vice versa. Johnson, Zulauf, Irwin and Gerlow (1991) examine the recent 36, 60 and 120-month moving averages as the thresholds for initiating either a long or short. These studies find that the soybean crush spread exhibits mean-reversion at various frequencies.

It is worth noting that these empirical studies have used continuous futures prices constructed from the nearest to maturity futures contracts. But crushers may choose to utilize crush spreads with deferred maturity where price uncertainty plays a more important role.

3. Reverse Crush Spread

The hedging pressure hypothesis, as it applies to the soybean complex, suggests that soybean processors who routinely place a crush spread trade will compensate risk-averse speculators who take the opposite position. We calculate the reverse crush spread (*rcs*) in month *t* maturing in month *T* as:

$$(1) \qquad rcs_{t,T} \equiv \log\left(2.2 * meal_{t,T} + 11 * oil_{t,T}\right) - \log\left(soybean_{t,T}\right),$$

where $T = 1, 3, 5, 7, 9, 11$.

And the return for a reverse crush spread initiated in *t* is thus defined as:

$$(2) \qquad \Delta rcs_{t,T} \equiv rcs_{T-1,T} - rcs_{t,T}.$$

Equation (1) represents the gross processing margin for a soybean crusher stemming from the crushing production technology and different units used in the futures contracts (CME, 2015). Note that all futures contracts of the soybean complex used to construct $rcs_{t,T}$ have the same maturity date, except for the November reverse crush spread, in which the December futures contracts for soybean meal and oil are used. Equation (2) calculates the return of the reverse crush spread on a daily basis. We close the reverse trade one month prior to the maturity month to avoid the liquidity and calendar date problems in months when contracts expire.

To execute a soybean crush spread hedge in the futures markets, the soybean processor buys 9 contracts of soybean oil, 11 contracts of soybean meal and sells 10 contracts of soybean. This "9-11-10" spread closely replicates the proportions described in equation (1), except for

10,000lbs out of 550,000lbs of soybean oil which is left unhedged. Thus, from a market participant perspective, the reverse crush spread is written as:

(3) $rcs_{t,T} \equiv \log\left(2.2 * meal_{t,T} + 10.8 * oil_{t,T}\right) - \log\left(soybean_{t,T}\right)$.

In the following analysis, we report results based on the equation (3) which has more practical implications.

3.1 Pre- vs. Post-harvest Reverse Crush Spread

Figure 1 illustrates that over the last 55 years, the average return of the reverse crush spread is positive, and it is increasing in months to maturity. This is consistent with the fact that the uncertainty associated with the crusher's gross processing margin increases with time to maturity, and is consistent with a scenario where crushers routinely place a crush spread.

Table 1 shows the return of the reverse crush spread by contract maturity. We define May, July and September spreads as pre-harvest spreads. Spreads maturing between November and March of the following year are defined as post-harvest spreads. The results show that post-harvest reverse crush spreads provide a significantly higher average return than the pre-harvest spreads. This is consistent with crushers placing large volumes of crush spreads in the post-harvest period when soybean prices are expected to be at their seasonal lows.

3.2 DCOT Hedging pressure measures vs. Post-harvest Crush Spread

An alternative approach to explore hedging pressure is via the actual positions of hedgers, this is published in the weekly CFTC's disaggregated commitment of traders (DCOT) reports. Soybean processors who hedge the crush spread take long positions in soybeans and short positions in

soybean meal and soybean oil. However, DCOT provides no information about the proportions of the crushers' positions held in each contract.

If the crusher's hedge supply risk of the new soybean crop using a post-harvest crush spread, we should be able to predict the return on the reverse spread using the hedgers' long position in the soybeans. To test this hypothesis, we use the net long position of hedgers in the new soybean futures contracts as a measure of the hedging pressure $hp_t \equiv$

$$(HL_t - HS_t) \Big/ (HL_t + HS_t),$$

where HL_t and HS_t represent the open long and short positions respectively held by producers/commercial hedgers, as classified by CFTC in week *t*.

To match the frequency of the return variables as shown in equation (3), we take the average of the hp_t reported in the same month. We also construct similar hedging pressure measures for soybean meal and soybean oil, which share a similar formulation as equation (4) except that the net short positions of hedgers are used in the numerator since crushers are sellers of these two products.

Table 2 summarize the correlations among the hedging volume for soybean, soybean meal and oil, and the return of the November reverse crush spread initiated before July. The reverse crush spread return is much more correlated with the hedging volume for soybeans than for soybean meal and oil.

Figure 3 provides a scatter plot between hedging volume and the reverse crush spread. The spread increases nonlinearly in hedging volume. The red dotted line is the fitted values from a quadratic regression of the November crush spread return on the hedging pressure in soybean. The regression explains the variations in the crush spread return well with R^2=0.37.

Reference

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Tables and Figures

Table 1. reverse crush spread return by contract maturity and by month to maturity, 1962-2015.

	Holding period (month)							
Maturity Month	1	2	3	4	5	6	7	8
Jan	0.4%	1.0%	1.5%	1.7%	1.9%	2.1%	2.0%	2.1%
	(1.9%)	(2.8%)	(3.4%)	(3.5%)	(3.6%)	(3.7%)	(3.7%)	(3.8%)
Mar	0.0%	0.0%	0.2%	0.6%	1.0%	1.1%	1.3%	1.5%
	(1.7%)	(2.5%)	(3.2%)	(3.5%)	(3.9%)	(4.0%)	(4.0%)	(4.1%)
May	0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.3%	0.6%	0.6%
	(1.1%)	(1.7%)	(2.2%)	(2.4%)	(2.7%)	(3.0%)	(3.3%)	(3.4%)
July	-0.1%	0.1%	0.2%	0.0%	0.0%	0.1%	0.1%	0.3%
	(1.3%)	(1.9%)	(2.1%)	(2.7%)	(2.8%)	(2.8%)	(2.8%)	(3.0%)
Sep	0.6%	0.8%	0.5%	0.7%	0.8%	0.8%	1.0%	1.0%
	(1.7%)	(1.9%)	(2.1%)	(2.1%)	(2.4%)	(2.4%)	(2.5%)	(3.0%)
Nov	0.8%	1.1%	1.4%	1.5%	1.3%	1.5%	1.6%	1.6%
	(2.9%)	(2.8%)	(2.6%)	(2.6%)	(2.6%)	(2.5%)	(2.3%)	(2.0%)

Note that the reverse crush spread is closed one month prior to the maturity month. So the January reverse crush spread is constructed using January contracts and is 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.

Table 2. Correlation coefficients among return of the November reverse crush spread and hedging volume of soybeans, soybean meal and soybean oil, 2007-2015.

	Return	Hedging pressure_bean	Hedging pressure_meal	Hedging pressure_oil
Return	1.00	0.47	0.07	-0.15
Hedging pressure_bean	0.47	1.00	-0.18	0.11
Hedging pressure_meal	0.07	-0.18	1.00	-0.16
Hedging pressure_oil	-0.15	0.11	-0.16	1.00

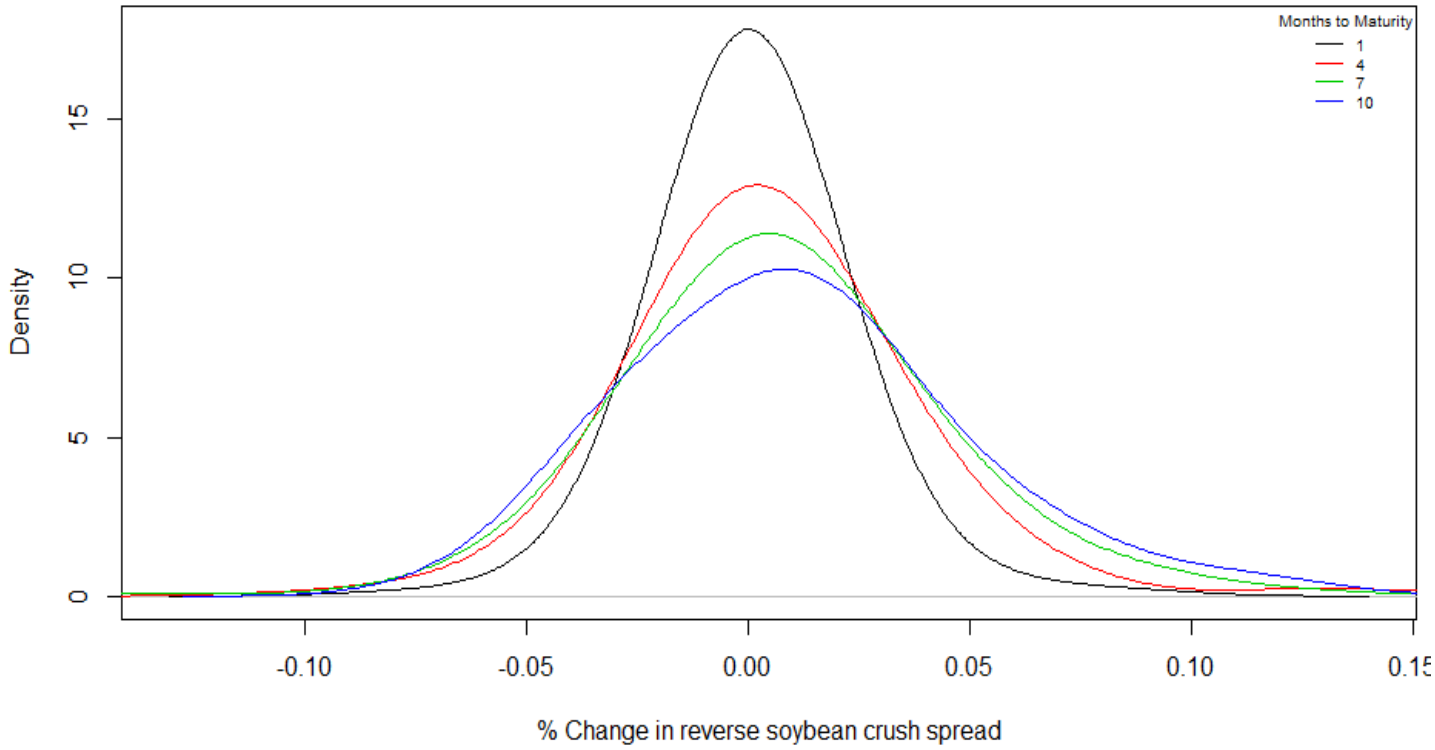

Figure 1. Density plots of returns of holding the reverse crush spread to maturity, 1962- 2015.

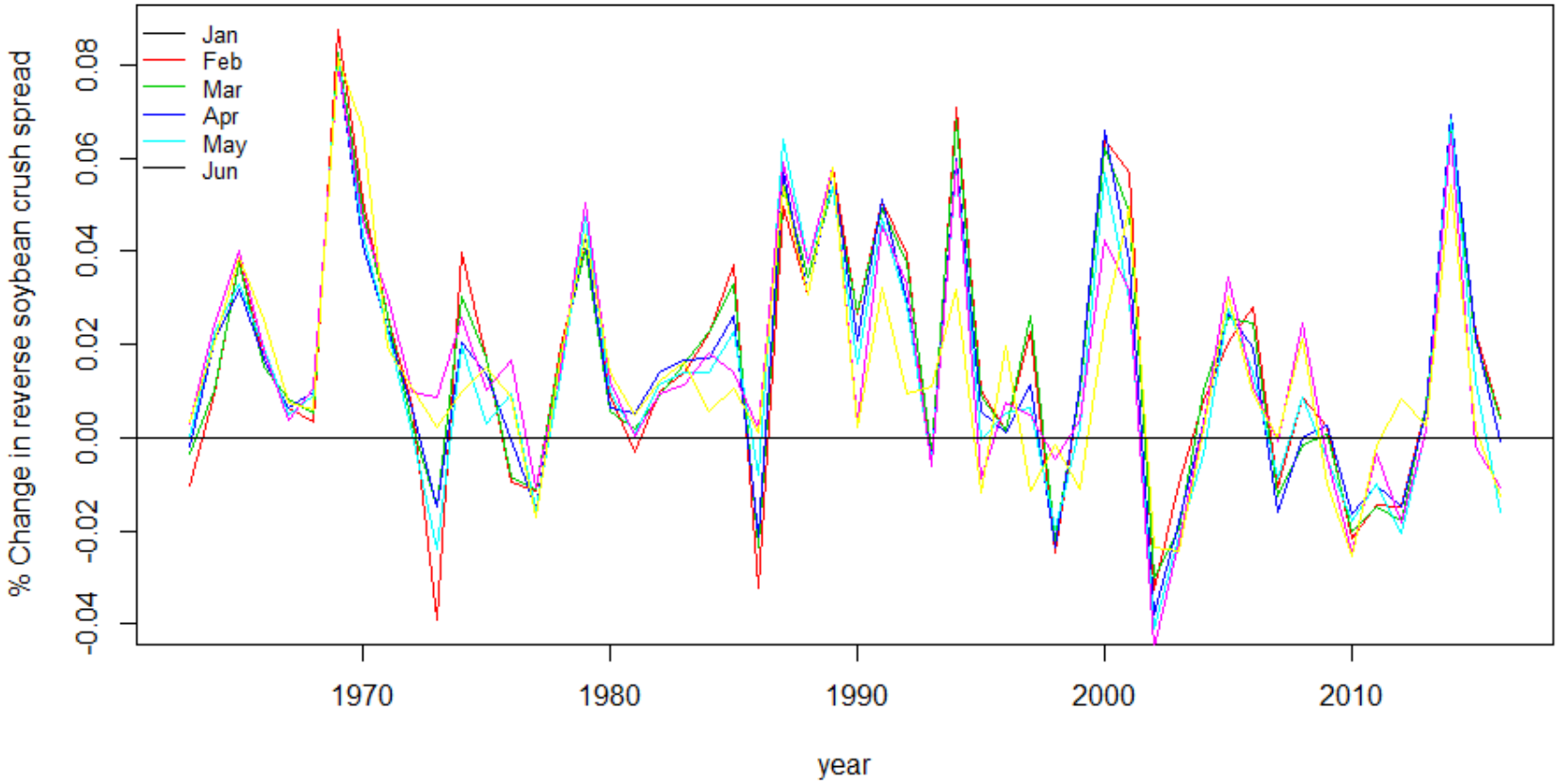

Figure 2. Returns of the post-harvest reverse crush spread to maturity, 1962- 2015.

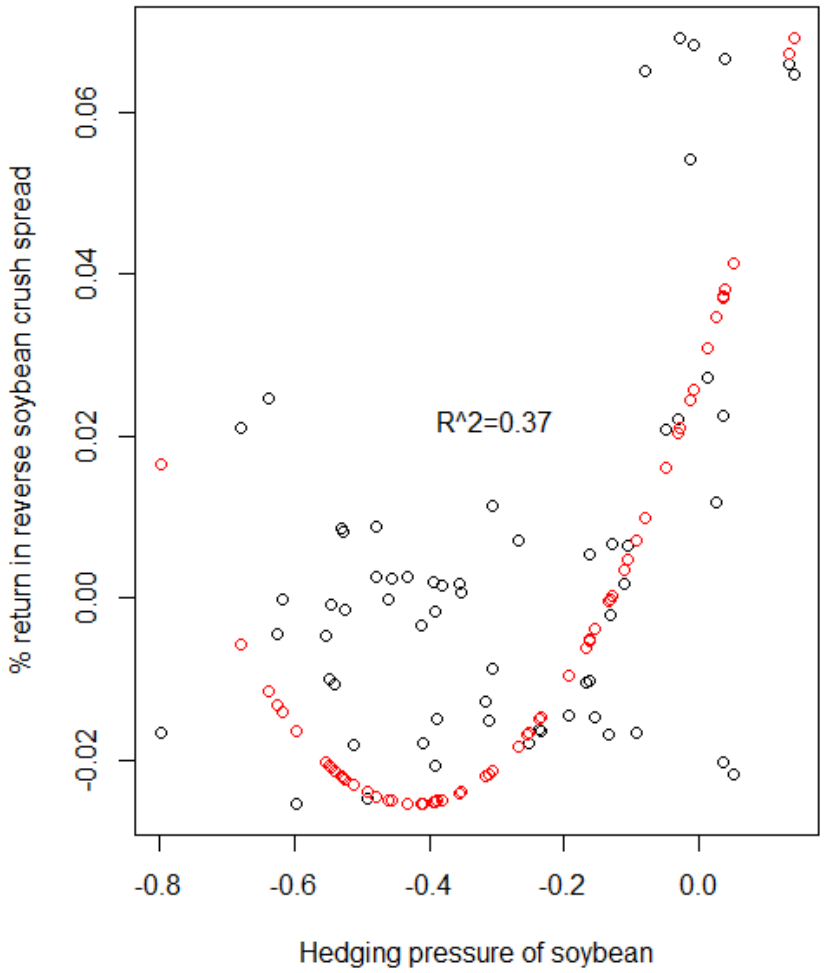

Figure 3. Returns of the post-harvest reverse crush spread vs. the hedging pressure of soybean, 2006- 2015