# SPATIAL ARBITRAGE IN THE WESTERN CANADIAN CANOLA MARKET

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THRESHOLD COINTEGRATION IS USED TO EXAMINE WHETHER THERE IS EVIDENCE OF SPATIAL COINTEGRATION BETWEEN SPOT AND FUTURES PRICE PAIRS FOR CANOLA IN WESTERN CANADA. THE RESULTS PROVIDE EVIDENCE OF A LONG RUN RELATIONSHIP BETWEEN THE SPOT AND THE FUTURES PRICE PAIRS, WHICH IS INDICATIVE OF THE ABILITY TO ARBITRAGE ACROSS SPACE; HOWEVER, THE LONG RUN RELATIONSHIP DOES NOT EXIST ACROSS ALL TIME PERIODS AND DEPENDS ON THE SIZE OF THE BASIS.

The purpose of this research poster is to examine whether there is evidence of spatial cointegration between spot prices offered by elevators and the futures price for the crop years 1998 through 2005. The ability to arbitrage the physical commodity across space is indicative of a long run relationship between the spot and the futures price. This research tests for a long run relationship using threshold cointegration. The results provide insight about the linkages between spot prices across markets and can be used to identify locations that do not follow a long run relationship, which may be an indication of a lack of ability to arbitrage. This finding is important because a lack of ability to arbitrage may present elevators with the opportunity to exert market power.

(A) Ask us to describe threshold cointegration using this graph
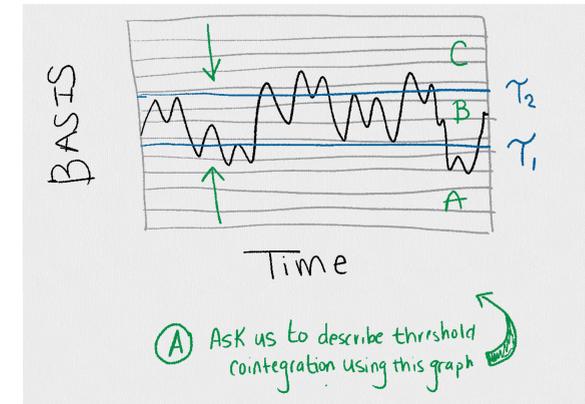
BACKGROUND ON THE CANADIAN CANOLA MARKET

The term canola was first applied in 1978 to an edible version of rapeseed. It was discovered by western Canadian plant breeders who were searching for rapeseed varieties that were not toxic to animals. Eventually they found a very healthy oilseed. Nutritional scientists identified canola oil as being low in trans fatty acids. This is a good quality because trans fatty acids elevate cholesterol levels. Switching to canola oil is recommended by the Academy of Nutrition, the Dietetics and American Heart Association. Being branded a "healthy" oil has led to increased worldwide demand for canola.

Canola production in Canada has been increasing to meet the increased worldwide demand. For the crop years under investigation the predominant increase in supply stems from yield increases. Canola is one of the most profitable crops to grow on the Canadian prairies (Brewin and Malla, 2012).

Much of the increased worldwide demand for canola comes from Asia. Asia is the primary destination for Canadian canola seed exports, purchasing 69% of Canadian canola exports in 2012 (Statistics Canada, 2013). Almost all canola seed being exported from Canada leaves through the ports of Vancouver and Prince Rupert which are located along the west cost of Canada (Canadian Grain Commission, 2012).

The spot price for canola decreases as you move east from Alberta, to Saskatchewan, and Manitoba. This is because canola needs to be transported to the ports of Vancouver or Prince Rupert. The map in the bottom right hand corner displays the discount or premium for delivering in different regions across Canada.

Image courtesy of John Kasawa at FreeDigitalPhotos.net

METHODOLOGY ECONOMETRIC MODEL

The dataset selected to investigate spatial cointegration contains the weekly average spot prices for six elevator groupings across Western Canada between the crop years of 1998 and 2005. This unique dataset was compiled with data provided by ICE Futures Canada (formerly the Winnipeg Commodity Exchange). The figure in the bottom right hand corner depicts the location for each of the six elevator groupings. Take note that each of the six elevator groupings is located within a different delivery region (Par, Eastern, Central East, Central West, and Peace River). Each delivery region is assigned a discount or premium relative to the par region.

The first step in the empirical methodology is to determine the order of integration of the spot and futures price series. This is necessary because the definition of cointegration stipulates that two I(d) series, Y_t and X_t are cointegrated if they are tied together by a long run relationship such as $Y_t = \delta_1 + \delta_2 X_t + \delta_3 t + \varepsilon_t$ where ε_t is I(d-1). If the series are not integrated of the same order then, by definition, they are not cointegrated.

If the series are found to be integrated of the same order a threshold autoregressive (TAR) process is estimated for spot futures–spot price pairs following a novel approach proposed by Mann (2012) and Sephton and Mann (2013). The empirical methodology allows between zero and three thresholds and endogenously selects the optimal number using an information criteria approach loosely following Gonzalo and Pitarakis (2002). The thresholds divide the observations into different regimes based on the size of the basis. After selecting the optimal number of thresholds the null hypothesis of non-cointegration is tested using the sup-Wald test proposed by Seo (2008).

Monte Carlo simulations by Mann (2012) and Sephton and Mann (2013) provide evidence that the methodology performs well with respect to selecting the number of thresholds and has good size and power properties that are robust to the specific data generating process.
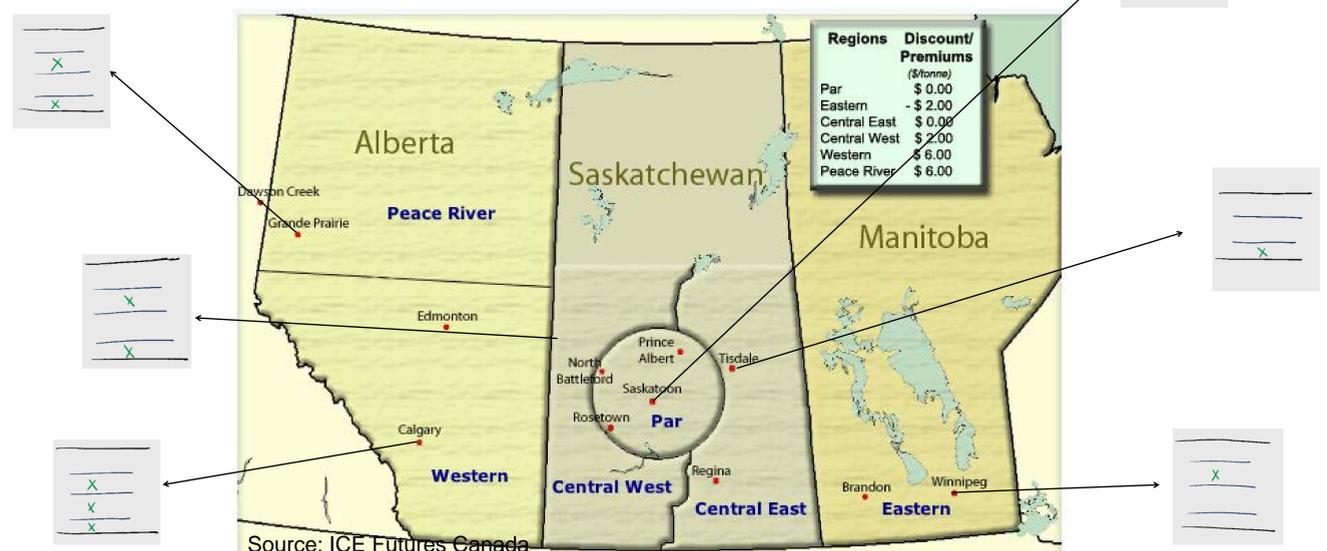
The sketch in the upper right hand corner presents hypothetical results for the TAR process. **Please ask us to use this sketch to explain threshold cointegration and describe the nitty gritty details behind the methodology!**

RESULTS FROM THE ECONOMETRIC MODEL

The results of several unit root tests concluded that each of futures and spot price series was I(1). Since each of the futures-spot price pairs were integrated of the same order the analysis continued by estimating the TAR process. The results of the TAR process indicated that all six of the futures-spot price pairs were (threshold) cointegrated. This means that the price pairs followed a long run relationship in which an attracter acted to pull the series together when they deviated from each other.

The results of the TAR process also indicated that each of the futures-spot price pairs contained at least one threshold. The regions between the thresholds were tested to determine whether the futures-spot price pairs were cointegrated across all time periods. The results differed by elevator grouping. Of particular interest is that the results depended on the size of the basis; all six of the futures-spot price pairs were cointegrated when the basis was wide and five of the futures-spot price pairs were not cointegrated when the basis was narrow. The map below summarizes the results.

The writing on the map below summarizes the results. **Please ask us to explain how to interpret the results!**

CONCLUSIONS AND PRODUCER IMPLICATIONS

The finding that the futures-spot price pairs were (threshold) cointegrated means that there was a long run relationship between the spot and futures price pairs between the 1998 and 2005 crop years, which is indicative of the ability to arbitrage across space. This is good news for canola producers because it means that the ICE futures contract can be used for price discovery and price risk management.

The finding that the existence of a long run relationship did not exist across all time periods may initially be a cause of concern; however, the futures-spot price pairs were always cointegrated when the basis was wide and almost never cointegrated when the basis was narrow. This provides evidence that elevators were not executing market power and may indicate that elevators were not taking advantage of profitable arbitrage opportunities.

Please ask us to elaborate on the policy implications and discuss our future research plans!

Regions	Discount/Premiums ($/tonne)
Par	$ 0.00
Eastern	- $ 2.00
Central East	$ 0.00
Central West	$ 2.00
Western	$ 6.00
Peace River	$ 6.00

Source: ICE Futures Canada

Decreasing Spot Price