The Informational Content of the Basis: Evidence from Canadian Barley, Oats, and Canola Futures Markets

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INTRODUCTION

Efficient methods to capture and use new information pertaining to commodity futures are of great interest to all participants in these markets. Recent works by Khoury and Martel (1985, 1986, 1989) abandon the earlier assumption of uniform dissemination of new information to all participants and introduce the problem of optimal hedging when new information is asymmetrically distributed between hedgers and speculators. Their basic proposition is that the basis provides information to hedgers about the tendency of future prices on both futures and cash markets, and that accordingly it operates on the margin of hedging decisions.

This study empirically examines this property of Khoury and Martel's model, namely, that the basis is positively correlated with the average future change in spot prices and negatively correlated with that of futures prices, in the context of a dynamic interaction between both markets. To address this issue, the lead-lag relationship between cash and futures markets is examined using a dynamic analysis. The rate of convergence of cash and futures prices is then compared. It is expected that the results of these examinations will shed some light on the informational content of the basis as well as on the dominant role of futures markets over cash markets.

Empirical evidence found in the literature supports the view that for commodity futures, variations in the basis are related to the cost of storage. Some evidence is

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found that the futures price is made up of forecasted cash price plus an expected risk premium. This article seeks also to examine the signaling role of the basis in the context presented above.[1]

THEORETICAL BACKGROUND

Assume a risk-averse hedger who, at time 0, has (or will have) a certain quantity of storable commodity to be sold at time 1 at the then prevailing spot price $\tilde{P}_1$. Although Khoury and Martel's model assumes three points in time, the analysis here is presented in a one-period framework, since only one decision is of interest here.

The rationale behind Khoury and Martel's model (1985, 1986, 1989) is that for reasons of economies of scale and of specialization, speculators (especially the large ones) receive more and better information regarding the furture conditions in spot and futures markets at a relatively lower cost than hedgers. They are, therefore, in a better position to estimate future prices of futures contracts, and on this basis determine their current price levels. From a practical perspective it may happen, especially in some agricultural commodities in the U.S., that hedgers are better informed than speculators. Such a situation is not critical to the development of the model, since the condition remains that the information of one group of participants is superior to that of the other. For simplicity, it is assumed here that hedgers are the less well informed group. Hedgers formulate, on their own, an expectation of the spot price at time 1 but need the superior information of speculators to dissipate the uncertainty surrounding this estimate; and through this adjustment, a more precise prediction of the corresponding futures price[2] is reached. More specifically, let

- $F_0, \tilde{F}_1$: the price of a futures contract for the commodity to be hedged at the beginning and at the end of the period respectively
- $P_0, \tilde{P}_1$: the spot price of the commodity to be hedged at the beginning and at the end of the period respectively

where F_0 and P_0 are known to hedgers and speculators at time 0 and generally speaking $F_0 \neq P_0$. As just emphasized, hedgers have a subjective estimate of $E(\tilde{P}_1)$ and $E(\tilde{F}_1)$ while speculators have a statistically more efficient estimate of both, that is:

$$\sigma^2_{\tilde{F}_1(h)} > \sigma^2_{\tilde{F}_1(s)}$$

and

$$\sigma^2_{\tilde{P}_1(h)} > \sigma^2_{\tilde{P}_1(s)}$$

[1]The futures price quoted for this contract until 1987 was for "rapeseed," after which it became known as "canola/rapeseed," and in 1989 just "canola." The change in designation reflects the fact that some differences exist between the original rapeseed plant and the new genetically improved variety (low in erucic acid and glucosinolates) known as canola. No disruption in the price series of the commodity was observed consequent on this change.

[2]The situation of asymmetric information assumed in this model is permanent for two reasons: (1) the free transfer of speculators' superior information to hedgers is ruled out because of moral hazard and/or the loss of lucrative trading opportunities by speculators; and (2) the cost (in terms of time and money) to hedgers of acquiring this information on their own generally exceeds its benefit to them.

where

$\sigma^2_{(h)}, \sigma^2_{(s)}$: the variance as estimated by the hedgers and speculators, respectively

Knowing that speculators have a more precise estimate of the parameters of the distribution of F_1 and that F_0 reflects their anticipation of $\tilde{F}_1$, hedgers can view the basis (i.e., the difference between F_0 and P_0) as a signal "α" that provides them with additional information about the direction of change in subsequent spot and futures prices. More specifically, following Khoury and Martel (1985), it is assumed that hedgers use a Bayesian approach to estimate $E(\tilde{F}_1)$. In a full information setting where $\sigma^2_{\tilde{F}_1(s)}$ is known to hedgers, their estimate of $E(\tilde{F}_{1(h)})$ would be:

$$E(\tilde{F}_1) = \frac{E(\tilde{P}_1)\left(\frac{1}{\sigma^2_{\tilde{P}_1(h)}}\right) + F_0\left(\frac{1}{\sigma^2_{\tilde{F}_1(s)}}\right)}{\frac{1}{\sigma^2_{\tilde{P}_1(h)}} + \frac{1}{\sigma^2_{\tilde{F}_1(s)}}} \tag{1}$$

In the context of asymmetric information, it is assumed that $\sigma^2_{\tilde{F}_1(s)}$ is not known to hedgers. Only α is known to them. By using this signal, α, they can reach an estimate of $\tilde{F}_1$ in the following way:

$$E(\tilde{F}_1) = P_0 + \Pi(\alpha) \tag{2}$$

Where $\Pi(\alpha)$ is an increasing function of α; and $\Pi(\alpha) \leq \alpha$ for $\alpha \neq 0$. In particular, if[3] $\sigma^2_{\tilde{P}_1(h)} = \sigma^2_{\tilde{F}_1(s)}$, then from (1) and (2) one can obtain:

$$\Pi(\alpha) = \frac{\alpha}{2} \tag{3}$$

Thus, when $F_0 > P_0$ (i.e., when the signal $\alpha > 0$), one can calculate that from (2) and (3): $E(\tilde{F}_1) = P_0 + \Pi(\alpha) < F_0$ (since $\Pi(\alpha) < \alpha$) which indicates to hedgers that the futures price will tend to decline relative to F_0. Futhermore, with $\alpha > 0$, it also follows from (2) and (3) that $E(\tilde{F}_1) > P_0$. Given that spot and futures prices must converge at maturity, that is $E(\tilde{F}_1) = E(\tilde{P}_1)$ at contract's expiration, the spot price will be on a rising trend between now and time 1. Conversely, if the basis is negative (i.e., $\alpha < 0$) it indicates that spot prices will tend to fall whereas futures prices will tend to rise relative to F_0. If this proposition is true[4], then one should observe the following relationship:

$$\begin{bmatrix} E(\tilde{P}_1) - P_0 = \alpha_c + \beta_c(F_0 - P_0) + \epsilon_c \\ E(\tilde{F}_1) - F_0 = \alpha_f - \beta_f(F_0 - P_0) + \epsilon_f \end{bmatrix} \begin{matrix} \text{(4a)} \\ \text{(4b)} \end{matrix}$$

where β_c and β_f are expected to be positive.

[3]This assumption applies, for instance, to the case where "the hedger has no reason to believe that the speculator's estimate of the variance of the futures price at time 1 is different from his estimate of the variance of the spot price at time 1." The above equality then follows from Laplace's "principle of insufficient reason." See Khoury and Martel (1985), p. 599.

[4]It should be emphasized that this property of the signal does not hinge on the fact that the futures price and the spot price must converge at maturity (i.e., at time 2); but derives rather from the special information role of the basis in the context of asymmetric information as shown in eqs. (1) to (3). Indeed the convergence of spot and futures prices at maturity is not a sufficient condition for the spot price to rise and the futures prices to fall when $\alpha > 0$, and conversely when $\alpha < 0$. A positive alpha ($F_0 > P_0$) at harvest time, for example, when excess supply is likely to arrive on the spot market, may in principle be compatible with a declining trend in both spot and futures prices until maturity.

Assuming that futures prices lead cash prices, one also expects[5] $\beta_c > \beta_f$. If the above equations can be shown to hold in practice, they will strengthen the argument that the basis can be used by rational hedgers as a signal to reduce the uncertainty surrounding their estimate of F_1.[6]

It should be noted that the dynamic relationship between the cash and futures markets illustrated in the system of eqs. (4), could be modelled from different perspectives, using a different set of assumptions. For example, Garbade and Silber (1983) rely on the cost of storage and cash-futures arbitrage to derive the same dynamic price relationship.

The foregoing interpretation of the basis is more general than the classical view in the literature. The basis is traditionally viewed as a return to storage, and particularly so in the case of seasonally produced commodities (French (1986) and Fama and French (1987)). In this sense, it can be argued that the basis provides information on the likely direction of future spot prices. More precisely, as time to maturity shortens, spot prices rise because of increasing storage costs, and consequently the basis declines on average. A positive basis thus becomes associated with an increase in spot prices and vice-versa. This argument, however, does not contradict the fact that, in the context of asymmetric information, hedgers can use the basis of this period, which they view as a signal, to reduce the uncertainty of their expectations about futures prices in the following period (Khoury and Martel (1989)). In this sense, the information revealed by the basis may well include the cost of storage, but is not limited to it. Given this interpretation of the basis, it should be clear that the aim of equations (4(a)) and (4(b)) is to verify the informational content of the basis within a dynamic interaction between spot and futures markets.

Cootner (1960), Dusak (1973), Hazuka (1984), and others postulate that the futures price can be split up into a forecast of the future cash price plus an expected risk premium. This study postulates that the futures price has the power to forecast cash prices. The purpose, however, is not to identify the exact nature of the information revealed by the basis, but rather to test whether or not that information has a signaling role in determining the direction of change in cash and futures prices.

METHODOLOGY AND DATA

The system of eqs. (4) is expressed in an expectational form and applies to a single-period context. Eqs. (4(a)) and (4(b)), however, may be empirically extended in a multi-period context to account for the dynamic aspects of Khoury and Martel's signaling model and to assess the daily lead-lag relationship between futures and spot markets, yielding:

$$\begin{bmatrix} P_t - P_{t-1} = \alpha_c + \beta_c(F_{t-1} - P_{t-1}) + \epsilon_t^c \\ F_t - F_{t-1} = \alpha_f - \beta_f(F_{t-1} - P_{t-1}) + \epsilon_t^f \end{bmatrix} \begin{matrix} \text{(5a)} \\ \text{(5b)} \end{matrix}$$

where F_t and P_t are the natural logarithms of daily quoted futures and spot prices respectively at time t.[7]

[5]Indeed, if it is shown that $\beta_c > \beta_f$ then it follows that the futures market leads the cash market since spot prices will then converge towards futures prices at maturity. See Garbade and Silber (1983).

[6]In Khoury and Martel's model, the signal (α) also operates on hedgers' estimates of $\sigma^2_{\tilde{F}_1}$, through its impact on $\sigma^2_{\tilde{F}_1(\alpha)}$. This aspect of their model will not, however, be developed here since the data available does not lend itself to such an empirical investigation.

[7]These empirical relations are built on the assumption that expectations are, on average, realized. Therefore: $E(\tilde{F}_t) = F_t$ and $E(\tilde{P}_t) = P_t$.

The system of eqs. (5) is the same as both equation (13) in Garbade and Silber's (1983) multi-period model and the equation in footnote (1) of Oellermann et al. (1989). The ratio $\beta_c/(\beta_c + \beta_f)$, as shown by Garbade and Silber (1983), indicates the direction of market convergence. A ratio value of one signifies that cash prices always converge toward futures prices; whereas a value of zero indicates the opposite. Since expectations here are primarily made in futures markets before being transferred to cash markets, one expects a ratio value close to one; in other words, β_f would be less than β_c.

As indicated by Garbade and Silber (1983), system of eqs. (5) can be solved to measure the rate of convergence (δ) of spot prices toward futures prices as follows:

$$F_t - P_t = \alpha + \delta(F_{t-1} - P_{t-1}) + \epsilon_t \tag{6}$$

where

$$\alpha = \alpha_f - \alpha_c$$
$$\delta = 1 - \beta_f - \beta_c$$
$$\epsilon_t = \epsilon_t^f - \epsilon_t^c$$

The δ coefficient indicates the rate of convergence of cash and futures prices over day to day time periods. Small (large) values of δ would indicate quick (slow) convergence, since only a small (large) fraction of the basis on day t-1 would persist to day t.

To gauge the maturity effect of the informational content of the basis, and to verify to a greater extent the price leadership role of the futures market, eq. (5(a)) is rewritten by substituting for the dependant variable, the daily cash price change $(P_t - P_{t-1})$, the change between the cash price at week t before maturity and the cash price at maturity $(P_m - P_t)$. This leads to the following regression equation:

$$P_m - P_t = \alpha + \beta(F_t - P_t) + \epsilon_t \tag{7}$$

Equation (7) is identical to eq. (6) in Fama and French (1987). As these authors indicate, the above equation provides a direct test of the informational content of the basis and, equivalently, a test of the forecasting power of the futures price. Under the twin hypothesis that the basis contains information about the cash price at maturity and that the futures market leads the cash market in the cash discovery process, one expects the estimate of the β coefficient in eq. (7) to be positive and statistically significant.

The analysis can be carried one step further by using the basis to assess the type of information conveyed to the cash and futures markets during the period sampled. The standard approach in this respect uses futures prices instead of the basis and relates the variance of the change in futures prices to that of changes in cash prices. Depending upon the type of information conveyed, the ratio of the variance of futures to cash price changes could be greater than, smaller than or equal to one. The prevailing view in the literature is that the above ratio is less than one when the information conveyed concerns current period supply and demand conditions, and the opposite when it concerns expectational information regarding future period supply and demand.

The market for barley and oats in Canada is strongly influenced by the policies of the Canadian Wheat Board, a Crown Agency, which acts as the sole exporter and gives suppliers an equal opportunity to deliver grain through a quota system. By announcing a support price early in the season, and standing ready to adjust it if needed, the board smoothes out supply and demand shocks in these two markets.[8] Such is not the case for canola, which is marketed entirely by private traders (Hore, (1984)). Moreover, while the bulk of the barley and oats production is consumed domestically, half of the production of canola is exported, mainly to Japan. Thus, one would expect the price volatility of barley and oats to be smaller than that of canola in both cash and futures markets. Furthermore, the most influential information prevailing in barley and oats markets should relate to current domestic supply and demand balances;[9] whereas in the case of canola, it should be of the expectational type relating more to international market conditions.[10]

The variances of cash and futures price changes as well as the variance of the basis across the three markets are compared. Then the ratio of the variance of futures price changes to cash price changes and the ratio of the variance of basis to cash price changes are compared across the three markets. It is expected that the variance of cash price changes will be greater than that of futures price changes or of the basis for barley and oats compared to canola. An examination of these ratios should shed some light on the predictive power of the basis compared to that of futures prices. The idea behind this analysis is to gauge the relative responsiveness of the basis and of the futures prices to new information. If the ratio of the variance of the basis to cash price changes is much larger than that of futures to cash price changes, one might expect the basis to have a greater forecasting power than the futures. Such an indirect test of predictive power is used in a similar fashion by Fama and French (1987) and by French (1986).

To conduct these tests we first compute the variances of the cash and futures price changes for each of: 41 contracts, in the case of canola, and 42 contracts, in the case of barley and oats. Next, we compute the cross-sectional variances of the basis and of cash price changes for each of the 36 weeks before maturity for the three commodities under examination. These variances are then averaged for each commodity to compute the above ratios.

Daily data of settlement prices and corresponding cash prices of barley, canola and oats are used in this study. The first two commodities are chosen because Winnipeg conducts the only canola and barley futures market in the world. Carter (1989) reports that canola and barley futures in Winnipeg are effectively arbitraged against corn and soybean futures in Chicago. Thus, in spite of differences in volume of transactions, the canola and barley markets can be considered as efficient as the corn and soybean markets in the U.S.A.. The oats futures is among the least active on the Winnipeg market. It is included in the study for comparison purposes.

The time period covered by this study extends from March 1980 to July 1988 and all data are obtained from the Winnipeg Commodity Exchange. To establish a continuous price series, a nearby contract is used and, two weeks before expiration, the next nearby contract is used and so on. This procedure is similar to that followed by Oellermann et al. (1989) and Brorsen et al. (1984).

To estimate eq. (7), and to compute the cross-sectional variances, futures prices two weeks before maturity are used as a proxy for the spot price at maturity. The substitution of futures prices for cash prices is necessary to account for the higher

[8]As of July 1989, the Wheat Board no longer intervenes in the oats market.

[9]Supply and demand balance is calculated as total supply less utilization.

[10]It should be noted that if the actions of the Canadian Wheat Board in the barley and oats markets, or exports in the canola market were predictable by market participants, they would be incorporated into their decisions thus mitigating the impact of the superior information of speculators. Information at our disposal leads one to believe that such is not the case.

liquidity and better reporting of prices in the futures market compared to the cash market.[11] Furthermore, because futures volume usually declines sharply in the last few days before maturity, the futures settlement price two weeks before maturity is used instead of the futures price at maturity.[12] A similar argument is made by Rajaraman (1986).

EMPIRICAL RESULTS

Table I documents the effects of the basis on the direction of change in futures and spot prices. These results are the OLS regression estimates[13] for equations (5(a)), (5(b)), and (6). To assess the dynamic interaction between spot and futures markets for the three commodities under study, these results need to be analyzed jointly. However, for expositional ease, they are presented in three successive panels.

Panel A reports the estimated value of β_c coefficients from eqs. (5(a)) for the three commodities. As expected, all β_c coefficients reported here are positive and statistically significant. These results indicate that the basis acts as a signal for the direction of change of the future cash prices. As expected, a positive basis in one period implies that on average, the cash price will rise in the next period.

Panel B reports the estimated β_f coefficients calculated from regression eq. (5(b)). Although all β_f coefficients are positive, only one is statistically significant, namely the coefficient associated with the oats futures. Overall, the results of this panel suggest that, with one exception, there is no relationship between the basis and changes in futures prices. From these results it is possible also to infer that, generally speaking, the cash market does not influence the futures market.

However, according to the model in this article, the results from the simultaneous system of eqs. (5(a)) and (5(b)) presented in panels A and B above should be analyzed *jointly* and *not separately*. Indeed, a joint interpretation of the results of these two equations brings into sharp focus the lead-lag relationship between cash and futures markets. As indicated earlier, the ratio $\beta_c/(\beta_c + \beta_f)$ combines the results of (5(a)) and (5(b)) for such a dynamic interpretation. Given that β_f is not statistically different from zero, the value of the above ratio stands close to one for barley and canola and is equal to 0.80 for oats. Thus, in the case of barley and canola, it can be said that expectations are formed in futures markets, then transmitted to cash markets without feedback. In the case of oats, however, a weak feedback effect is observed. Similar results are found by Khoury and Yourougou (1989) in the case of the Winnipeg wheat market. Given the relatively low trading volumes of both wheat and oats, these results probably stem from the thinness of these markets in Winnipeg. These findings are similar to those reported by Oellermann et al. (1989) but are generally stronger than those reported by Garbade and Silber (1983) in the U.S.A. Kawaller, Koch, and Koch (1987) find similar results, namely that futures prices lead spot prices in stock index futures markets. Overall, the results of this analysis suggest that the futures market for the commodities under study is

[11]A statistical test reveals that the mean values of futures prices two weeks before maturity and those of cash prices at maturity are not significantly different for all contracts under examination.

[12]Discussions with the senior economist at the Chicago Board of Trade and with the President of the Winnipeg Commodity Exchange indicate that such a procedure is appropriate since reported futures prices at maturity are notoriously distorted.

[13]Since futures price changes may be related to spot price changes, it may appear preferable to estimate system of eqs. (5) using the Seemingly Unrelated Regression (SUR) technique rather than O.L.S. In our case, both techniques will yield the same result since the independent variable is the same in 5(a) and 5(b).

Table I
LEAD-LAG RELATIONSHIP BETWEEN FUTURES AND SPOT MARKETS FOR THE BARLEY, OATS, AND CANOLA COMMODITIES TRADED ON THE WINNIPEG EXCHANGE

	Barley	Oats	Canola
Panel A $P_{jt} - P_{jt-1} = \alpha_c + \beta_c(F_{jt-1} - P_{jt-1}) + \varepsilon^c_{jt}$			
α_c	−0.000	0.000	−0.000
	(−1.20)	(1.11)	(−1.26)
β_c	0.082	0.089	0.032
	(7.19)	(6.71)	(5.75)
R^2	0.023	0.020	0.015
F	51.70	44.96	33.02
	[0.00]	[0.00]	[0.00]
DW	1.74	1.80	1.91
Panel B $F_{jt} - F_{jt-1} = \alpha_f + \beta_f(F_{jt-1} - P_{jt-1}) + \varepsilon^f_{jt}$	**Barley**	**Oats**	**Canola**
α_f	0.000	0.000	0.000
	(0.08)	(0.47)	(0.27)
β_f	0.004	0.022	0.001
	(0.34)	(1.92)	(0.11)
R^2	0.000	0.002	0.000
F	0.11	3.68	0.013
	[0.74]	[0.06]	[0.91]
DW	1.79	1.76	1.89
Panel C $F_{jt} - P_{jt} = \alpha + \delta(F_{jt-1} - P_{jt-1}) + \varepsilon_{jt}$	**Barley**	**Oats**	**Canola**
α	0.000	−0.000	0.000
	(1.78)	(−1.00)	(1.59)
δ	0.922	0.889	0.968
	(111.32)	(92.16)	(178.78)
R^2	0.85	0.793	0.936
F	12616.17	8492.68	31963.89
	[0.00]	[0.00]	[0.00]
DW	1.90	2.06	1.98

( ) Indicate t-statistics.
[ ] Indicate P-value for the F-test.

used as the primary point of price discovery and, in this sense, they are consistent with the informational content hypothesis of the basis.

Panel C of Table I sets out the estimated results of the rate of convergence δ. The results obtained here indicate that, on average, over 90% of the information contained in the basis in a given day persists to the following day. These findings are consistent with those reported by Khoury and Yourougou (1989) for wheat, by Oellermann et al. (1989) for feeder cattle and by Garbade and Silber (1983) for five different contracts. Such large values of significance for (δ) are consistent with the earlier observation about the signaling effect of the basis in panels A and B.[14]

While the empirical results in panel B indicate that the estimated values of β_f are not statistically significant in two cases out of three, it is nontheless true that β_c and β_f are both positive in all cases. This observation supports, albeit in a weak sense, the properties of Khoury and Martel's model, namely, that a positive basis implies that futures prices will tend to decline while cash prices simultaneously tend to rise. More precisely, these results suggest that the basis, in its signaling role, reveals the direction of change in cash prices, and to a much lesser extent that of futures prices.

Table I focuses on a day-to-day analysis of the relationship between the basis at time t and the subsequent change in cash prices at time $t + 1$. To carry this analysis one step further, the relationship between the basis calculated at time t, and the difference between the cash price observed at time t with that observed at maturity is examined by running regression eq. (7) cross-sectionally, using a maximum likelihood autoregressive procedure. This approach is particularly suitable for this purpose since that data exhibit strong first order autocorrelation. Table II contains the estimates of the beta coefficients for nine regression equations corresponding to nine selected weeks to maturity chosen at regular four week intervals. The figures shown are quite representative however of the results obtained for all 36 weeks to maturity.

It may be argued that the autocorrelation shown in the data may be due to omitted variables. It may also seem appropriate to adjust futures prices for time and interest rate before testing the lead-lag relationship in the above analysis. However, since grain futures prices usually exhibit periods of carrying as well as inverse car-

Table II
DIRECT EVIDENCE OF THE PREDICTIVE POWER OF THE BASIS: ESTIMATES OF BETA COEFFICIENTS OF THE REGRESSION MODEL

$$F_{m-2} - P_t = \alpha + \beta(F_t - P_t) + \varepsilon_t$$

Weeks to maturity	Barley	Oats	Canola
4	1.4835	0.5822	1.2191*
8	0.7021	1.8463**	1.1236*
12	1.1408***	2.0978*	1.0940*
16	1.7610*	1.9220*	1.1029*
20	1.5731*	1.7321*	0.9291**
24	1.0638*	2.3435*	1.0381*
28	0.8496**	1.1230**	1.1534*
32	1.4931*	2.1783*	1.1412*
36	1.4297*	2.3708*	0.9949*

*Statistically different from zero at $\alpha = 1\%$.
**Statistically different from zero at $\alpha = 5\%$.
***Statistically different from zero at $\alpha = 11\%$.

[14]It should be noted however that if the hedger were interested in the convergence of cash and futures prices over periods longer than day-to-day, such as month-to-month for example, he needs not be concerned with the information contained in the basis and carried over on a daily basis, such as the results reported here. See also Garbade and Silber (1983).

since grain futures prices usually exhibit periods of carrying as well as inverse carrying charges, a simple trend adjustment is generally sufficient. The same test is, therefore, repeated after adjustment for the price trend but the results are not different from the ones reported here.

Table II shows that in all cases the basis is positively correlated with the difference between the cash price at maturity and the cash price at various weeks before maturity. The table also shows that in the case of canola, this relationship is always significant at the 5% level. For the other contracts, it is significant at the 5% level in all cases except three for barley and one for oats. These results confirm the earlier findings that the basis indicates the direction of change of futures cash prices. More significantly, they also demonstrate that the basis provides statistically reliable information about cash prices several weeks before maturity. Thus, a positive basis indicates that cash prices will rise on average between now and maturity; whereas a negative basis is indicative of the opposite. This reinforces the earlier conclusion that prices are discovered in futures markets, then transmitted to cash markets.

Table III compares the average standard deviations of cash and futures price changes, as well as those of the basis, across the three markets under examination. With the exception of cash price changes for oats, the standard deviations for barley and oats are smaller than those for canola. These results apply to price changes in both cash and futures markets, as well as to the basis, and are consistent with expectations. The ratios of the average variances of futures over cash price changes indicate that cash price volatility is greater than futures price volatility in all three markets. These results indicate that for the period under examination the information revealed by the futures price in all three markets relates more to current period supply and demand conditions than to expectational information.

It should be noted that if the futures price at time "t" is a mere reflection of the cash price at time "$t + 1$," the average variance of the basis would then be very

Table III
THE INFORMATIONAL CONTENT OF THE BASIS AND INDIRECT EVIDENCE OF THE FORECASTING POWER IN THE BASIS

	Barley	Oats	Canola
Average standard deviation			
Basis: $(F_t - P_t)$	0.0361*	0.0357*	0.0434*
$\Delta P_t = P_t - P_{t-1}$	0.0130*	0.0152*	0.0140*
$\Delta F_t = F_t - F_{t-1}$	0.0102*	0.0107*	0.0118*
Ratio of average variance (σ^2)			
$\dfrac{\bar{\sigma}^2 \text{ of Basis}}{\bar{\sigma}^2 \text{ of } \Delta P_t}$	0.10	0.06	0.25
$\dfrac{\bar{\sigma}^2 \text{ of } \Delta F_t}{\bar{\sigma}^2 \text{ of } \Delta P_t}$	0.629	0.463	0.772
Average correlation between F_t and P_t	0.806	0.877	0.762
$\dfrac{\bar{\sigma}^2 \text{ of } F_t}{\bar{\sigma}^2 \text{ of } P_t}$	0.676	0.699	0.613

*Statistically different from zero at $\alpha = 1\%$.

close to that of the change in cash prices. According to these results, however, the variance of the basis is much lower than that of cash price changes in all three markets.

The results show however that the forecasting power of the basis is stronger in the canola than in the other two markets, probably because of the differences in the market structures alluded to earlier. Indeed in the case of barley and oats, the predictive power of the basis is severely reduced because of the interventions of the Wheat Board in setting prices and quantities in the cash market. Such is not the case in the canola market where supply and demand freely fluctuate and the predictive power of the basis is consequently more apparent.

It is also apparent from Table III that there is a significant difference between the ratios of the average variances of basis to cash price changes and those of the average variances of futures price changes to cash price changes across the two types of markets. These differences could be indicative of the fact that the type of information prevalent in the barley and oats markets relates mainly to current domestic supply and demand conditions, whereas in the canola market, it also relates to expectational worldwide conditions.

IV. CONCLUSION

This article addresses the issue of the informational content of the basis using barley, oats and canola futures for the period March 1980 to July 1988. It is found that futures prices lead cash prices on a day-to-day basis, as well as for varying periods before maturity. It is also found that the feedback effect from cash to futures is weak in the case of oats and nonexistent in the case of the other two commodities. The analysis also indicates that, on average, over 90% of the information content of the basis in a given day persist the following day.

Overall, the results of the study are weakly consistent with the signaling hypothesis of Khoury and Martel's (1989) model. Indeed, it is found that the basis reveals the direction of change in cash prices and, to a much lesser extent, that of futures prices.

An interesting issue not addressed in this article relates to the impact of demand and production shocks on the informational content of the basis. Further research on this topic would require an in-depth analysis of the shocks influencing demand and supply conditions on both cash and futures markets such as unexpected good or bad weather, unexpected quota adjustments by the Canadian Wheat Board, etc.... The results of such a study would no doubt enhance our understanding of the type of information revealed by the basis.

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