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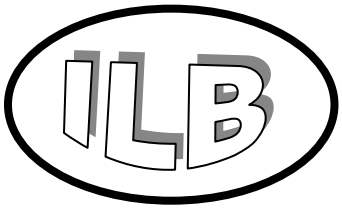

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Do Agricultural Commodity Firm Stock Price and Agricultural Commodity Price Move Together?

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Abstract
The researh aims at explaining stock performance of processing companies in function of commodity performance on commodity markets. The results show that stock prices of food companies do not significantly depend on agricultural market prices. So, risks of agricultural market price volatility cannot be hedged using food firm stocks, whose markets are more liquid.

Objective
The objective is to explain stock performance of processing companies in function of commodity performance on commodity markets. If results are robust, onet could be able to hedge commodity price fluctuations in using stocks whose markets are a lot more liquid.

The paper is organized as flows. First, it roots the the research in theoretical foundations. Second, the methodology is presented. Third, results are shown and analyzed. Fourth, conclusion is drawn.

1 Theoretical foundations

1.1 Output producers and input users

According to the economic theory, for users of commodity - manufacturing companies - when input cost increases, profit decreases. And for commodity sellers, when selling price increases, profit increases. Further the case of commodity may be divided into durable commodities that are renewable and exhaustible commodities. The research focuses on renewable commodities, like agriculturals.
Several studies have focused on the price transmission of agricultural prices form farmers to consumers via food processors and retailers. However, no one focused on processors' stock price.

1.2 Efficiency of commodity futures markets and stock markets

In 1980, Tschoegl investigateded the efficiency in the gold market with respect to the information incorporated in sequences of successice price changes aver the 1974-1997 period. He could not demonstrate that the market was inefficient.

But, Geman (2005) scrutinized commodity futures markets in oder to price commodity derivatives. She noticed that commodity futures markets often faced liquidity problems, not only options but also many futures contracts. So, hedging against risks of commodity price fluctuations could be more efficient in using firm stocks producing/using the commodity.

1.3 Stock price explained by commodity produced or used

Kia (2003) studied US and Canadian companies and found that commodity price index and the domestic-foreign price differential were significant components of the stock price determination.

Focused on gold, Brimelow (1996) indicated that historical gold mining firms stocks outperform twice or three times bullion price: if gold moves up 10%, mining stock prices go up 20% or 30%.

Blose & Shieh (1995) showed that the value of gold mine was a function of the return of gold, production costs, and the level of gold reserves. The research work was done with a sample o 23 publicly traded gold

mining companies using monthly data over the period 1981 – 1990. The gold price elasticity of the company's stock was greater than one.

Tufano (1998) studied the exposure of 48 North American gold mining firms to fluctuations in gold prices. He showed that the average mining stock increased by 2 percent for each 1 percent increase in gold prices. Further, larger firm stock experienced gold price shocks more strongly than did small firm stocks. Tufano explained it by the high speed at which stock markets incorporated gold price fluctuations for larges companies.

Wang et al. (2002) studied whether food recalls (i.e. food products that have been recalled from the market due to bad quality or infection, in this case meat infection), had an impact on the value of the corresponding companies. They found that recalls had significant negative effects around the event dates. The recalls also increased the volatility of the companies' stocks as well as the stocks of other companies in the same industry.

2 Hypotheses, methodology and means

2.1 Hypotheses

The hypothesis is that it is possible to explain stock performance of processing companies in function of commodity performance on commodity markets.

2.2 Methodology

The methodology is based on the foundation of modern portfolio theory laid by Markowitz (1959). Observing that most investors invest in multiple securities, he hypothesized that there would be some benefit in purchasing a portfolio. He showed that investing in a portfolio of securities may reduce the variability of returns, a measure of riskiness. So, part of risk is diversified away. He also found efficient portolios which maximize returns for a given level of risk. But the Markowitz micro-model of portfolio choice requires restritive assumptions on characteristics of assets and investors:

- one period model;
- markets ar highly efficient: information is freely available, no transactions cost, no tax, perfect divisible assets;
- the market portfolio is efficient;
- investors are risk-averse and well diversified;
- investors have the same expectations and can choose between assets on the basis of expected return and variance; then, probability distributions for asset returns are all normally distributes or the investor's utility function is quadratic.

Further, the Markowitz model is very demanding in available data for generating efficient portfolio. It requires N(N+3)/2 estimates, N expected returns, N variances and N(N-1)/2 unique covariance returns.

This limitation lead to the emergence of the single-index model by Sharpe (1964) and Lintner (1965) to forecast asset pricing. Rooted in the Markowitz market model approach is used to eliminate the elements of each firm's price change that depend on the market. In market equilibrium, the model expresses a linear ex-ante function between the return on each stock of firm i and the return of the market portfolio.

(Equation 1) $R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$

where,

- i = 1… N, is a firm index,
- t = 1… T, is a day index,
- R_{it} is the rate of return on firm i for day t,
- R_{mt} is the rate of return on the market portfolio for day t,
- α_i measures the mean return over the period not explained by the market,
- β_i measures the systematic risk on firm i, that is the sensitivity of firm i to changes in the market portfolio's rate of return,
- and ϵ_{it} is a statistical error term, with $\sum\epsilon_{it} = 0$.

The model only requires 3N+2 estimates: estimates of alpha, beta and variances for each stock, estimate of expected return on the market index and estimate of the variance of returns on the market index. Researchers have criticized the model, because they have found that other factors beyond market index may explain the stock returns of a firm (Stock and Watson, 1989, p. 352-353). Further, the model requires stringent assumptions:

- investors' utility functions are unknown and may change over time,
- very often, returns on assests (stocks, commodity) are not normally distributed,
- markets are not perfect: there exist frictions, transaction costs, taxes, indivisibilities.

Furthermore, investors are assumed to behave similarly over the period tested. Despite its shortcomings, the model provides a simple and straightforward measurement and plausible results to lead to meaningful benchmarks by taking market risk and firm stock return relationships into account.

Such one-factor model is adapted to the present situation in order to explain stock performance of processing companies in function of commodity performance on commodity futures market. So the model is as follows:

(Equation 2) $R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i R_{ct} + \delta_i R_{ct-1} + \epsilon_{it}$

where,

- R_{it} is the weekly log-return on stock of firm i for day t, firm i using mainly commodity c in its operating process,
- R_{mt} is the weekly log-return of stock market for day t.
- R_{ct} is the weekly log-return of commodity futures market corresponding to the commodity business of the firm for day t.
- R_{ct-1} is the one-week lagged weekly log-return of commodity futures market corresponding to the commodity business of the firm for day t.
- α_i measures the mean return over the period not explained by the market,
- β_i measures the systematice risk on firm i, that is the sensitivity of firm i to changes in the market portfolio's rate of return,
- γ_i measures the systematice risk on firm i, that is the sensitivity of firm i to changes in the commodity futures market portfolio's rate of return,
- δ_i measures the systematice risk on firm i, that is the sensitivity of firm i to changes in the commodity futures market portfolio's rate of return with one-week lag,
- and ϵ_{it} is a statistical error term, with $\sum \epsilon_{it} = 0$.

For each firm i, the estimates of a_i , b_i, c_i, and d_i of α_i , β_i , γ_i and δ_i respectively, are produced by running an ordinary least-squares regression according to equation 2. The R^2 statistic of the regression indicates the percent of variation in asset i's log-returns that is explained by, or associates with the log-return of on stock market log-return and/or commodity market log-return.

So, the regression of the log-return of the company's stock is run on the log-return of market index and log-return of wheat index. This kind of regression is the one that Tufano uses, and is justified in theory, as the log-returns should be normally distributed, therefore the assumptions of ordinary least squares hold.

All regressions were rerun in a year by year basis, in order to study the changes of the coefficients with time.

2.3 Data

The model is applied to competitive industrial sectors with corporations quoted on stock exchange with commodity traded on futures markets. Focus is made on the wheat futures contracts traded on the Chicago Board of Trade (CBOT, belonging to the CME group).

Stock performance is measured by weekly returns. It includes dividends. Stock price ans commodity prices are available on « Datastream ». Data cover the period January 1996- February 2007, before the financial and commodity crisis of 2007-2011. In total we have a sample of 49 companies from several markets.

3 Results

Results show that the wheat index is not significant into any of the regressions. Only a handful of companies have a significant sensitivity on wheat return (9 companies out of 49).

- Most companies studied come from Japan (15) and US (12).
- Only 3 out of 15 companies in Japan had a significant coefficient on wheat, even on high significance levels (12%).
- Only 2 out of 12 US companies had a significant coefficient on wheat, even on high significance levels (12%). Surprisingly Du Pont turned out to be significant while Monsanto was not.
- Other companies studied from various countries are in agreement with the above conclusions, For instance, Syngenta was significant.
- i.e., their stocks do not seem to follow movements of wheat, because in the relevant regression the wheat coefficient is not significant.

Times series: All regressions were rerun in a year by year basis, in order to study the changes of the coefficients with time.It is interesting that the year of 2001, that includes the September 11 incident, has the maximum percentage of significant companies in wheat. The American economy was on a downhill, which was further enhanced by the September 11 incident.he percentage of significant companies in the wheat industry is, apart from 2001, very low (10% or less) in all years.

Table 1.

Wheat processing firm stock price in function of wheat price: Results by company, January 1996 – February 2007

Name	CANADA BREAD CO.	DOVER INDUSTRIES	SEPPS GOURMET FDS.
Market	Canada	Canada	Canada
Start Date	27-févr-96	27-févr-96	18-oct-99
End Date	12-févr-07	12-févr-07	12-févr-07
market coeff	0.3627 (6.11e-006)	0.04101 (0.445)	-0.1095 (0.772)
wheat coeff	-0.068 (0.0895)	-0.01754 (0.516)	-0.04651 (0.8)

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Name	BISCUITS GARDEIL	CHATZIKRANIOTIS MILLS	MLS C SARANTOPOUL	KATSELIS SONS CR	SKANE MOLLAN	GROUPE MINOTERIES	HIESTAND R	SYNGENTA	LOTUS BAKERIES	FINSBURY FOOD	INTER LINK FOODS	REAL GOOD FOOD CO.
Market	France	Greece	Greece	Greece	Sweden	Switzerland	Switzerland	Switzerland	Belgium	UK	UK	UK
Start Date	27-févr-96	27-déc-99	27-févr-96	27-févr-96	06-juil-98	12-oct-98	27-oct-97	13-nov-00	27-févr-96	27-févr-96	24-août-98	29-sept-03
End Date	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07
market coeff	0.1184 (0.318)	1.265 (7.43e-021)	0.8796 (5.01e-020)	0.8439 (6.96e-046)	0.02306 (0.726)	0.1874 (0.0153)	0.5705 (2.63e-018)	0.7422 (9.59e-030)	0.2387 (0.000244)	0.2832 (0.0222)	0.4897 (3.44e-006)	0.51 (0.106)
wheat coeff	-0.1075 (0.191)	0.0004964 (0.996)	-0.0159 (0.859)	0.00492 (0.925)	-0.03347 (0.542)	-0.05226 (0.273)	0.1157 (0.00618)	0.09038 (0.0181)	-0.02796 (0.432)	-0.01532 (0.815)	0.03707 (0.509)	-0.1362 (0.17)

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Name	COMO	CYBELE	FIRST BAKING	NITTO FUJI FLOUR MILL	MASUDA FLOUR MILL.	NICHIRYO BAKING	NISSHIN SEIFUN	ONTON FOOD INDUSTR	OFUKU FLOUR MILLS	TORIGOE	YAMAZAKI BAKING
Market	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan	Japan
Start Date	08-déc-97	01-août-05	27-févr-96	27-févr-96	27-févr-96	27-févr-96	27-févr-96	27-févr-96	27-févr-96	27-févr-96	27-févr-96
End Date	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07
market coeff	0.1803 (0.0164)	0.492 (0.00186)	1.012 (3.49e-020)	0.4567 (2.1e-020)	0.2223 (0.00159)	0.2061 (0.064)	0.4546 (1.15e-020)	0.1567 (0.000206)	0.5624 (3.77e-009)	0.5415 (2.67e-023)	0.5125 (1.03e-024)
wheat coeff	-0.04034 (0.449)	-0.1441 (0.079)	0.005006 (0.944)	0.01339 (0.678)	0.09022 (0.0583)	-0.04147 (0.582)	0.06458 (0.043)	-0.02184 (0.443)	0.01968 (0.758)	-0.01543 (0.663)	-0.03731 (0.249)

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Name	DAEHAN FLOUR MILLS	KIRIN	ORION	SEOUL FOOD IND	SILVER STAR	KAWAN FOOD	UANTAN FLOUR MILL	ALAYAN FLOUR MILL	ONG GUAN FLOUR MI	UNITED FLOUR MILL
Market	Korea	Korea	Korea	Korea	Korea	Malaysia	Malaysia	Malaysia	Singapore	Thailand
Start Date	27-févr-96	27-févr-96	27-févr-96	27-févr-96	04-août-03	08-août-05	27-févr-96	27-févr-96	27-févr-96	27-févr-96
End Date	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07
market coeff	0.5205 (3.35e-018)	0.4218 (0.00416)	0.7851 (5.41e-036)	0.8899 (2.67e-013)	1.159 (6.53e-005)	0.3805 (0.109)	1.35 (3.71e-049)	0.8482 (1.45e-054)	0.09772 (0.245)	0.01279 (0.953)
wheat coeff	0.112 (0.0894)	0.07692 (0.645)	0.06624 (0.32)	-0.1208 (0.372)	-0.219 (0.212)	-0.02726 (0.705)	-0.004959 (0.946)	0.05556 (0.197)	0.03464 (0.556)	0.1378 (0.252)

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Name	MOLINO J SEMINO B	BIMBO A
Market	Argentina	Mexico
Start Date	27-févr-96	27-févr-96
End Date	12-févr-07	12-févr-07
market coeff	0.1733 (0.00737)	0.5712 (5.88e-014)
wheat coeff	0.0697 (0.337)	-0.009771 (0.811)

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Name	YN CHEESECAKE & DE	FLOWERS FOODS	GENERAL MILLS	TERSTATE BAKERIES DI	KELLOGG	NEW DGN.ASIA	RALCORP HDG.	TASTY BAKING	MONSANTO	PONT E I DE NEMOU	DOW CHEMICALS
Market	US	US	US	US	US	US	US	US	US	US	US
Start Date	27-févr-96	26-mars-01	27-févr-96	27-févr-96	27-févr-96	01-mai-00	27-févr-96	27-févr-96	23-oct-00	27-févr-96	27-févr-96
End Date	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07	12-févr-07
market coeff	0.7569 (0.0315)	0.6026 (9.5e-008)	0.2675 (4.31e-009)	0.3044 (0.0234)	0.2882 (3.4e-007)	1.521 (0.000162)	0.3101 (0.000615)	0.3239 (0.000105)	0.7985 (8.82e-013)	0.8503 (2.32e-043)	0.8316 (4.49e-034)
wheat coeff	-0.1626 (0.4)	0.06216 (0.281)	-0.003162 (0.898)	-0.09106 (0.217)	-0.00923 (0.764)	0.1421 (0.501)	0.02961 (0.55)	0.07609 (0.0959)	-0.05144 (0.379)	0.06885 (0.027)	0.06308 (0.0733)

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TOTAL **9 / 49**

In Bold window, the companies for which the coefficient for wheat is significant.

Table 2.

Commodity processing firm stock price in function of commodity price: summary of results on the period January 1996 – February 2007

	Sample period										
WHEAT	*janv-96 déc-96*	*janv-97 déc-97*	*janv-98 déc-98*	*janv-99 déc-99*	*janv-00 déc-00*	*janv-01 déc-01*	*janv-02 déc-02*	*janv-03 déc-03*	*janv-04 déc-04*	*janv-05 déc-05*	*janv-06 févr-07*
number of companies with significant coefficient in wheat	**7**	**2**	**7**	**6**	**2**	**8**	**4**	**5**	**4**	**7**	**4**
Total number of companies for the sample	**34**	**36**	**39**	**40**	**44**	**45**	**45**	**48**	**48**	**50**	**50**
percentage	0,21	0,06	0,18	0,15	0,05	0,18	0,09	0,10	0,08	0,14	0,08

4 Tentative explanation of results

According to the economic theory, when production cost increases, profit decreases. It is the case for raw material costs such as commodity costs for manufacturing companies. Wheat companies do not have such a direct sensitivity to wheat price, as gold companies would have to gold would have to oil. In the case of wheat, Kellogg for instance would have a lot of other processes entering their revenue flows (marketing, logistics management, etc.).

4.1 Hedging to reduce costs of bankruptcy

According to Modigliani-Miller (1958), costs of bankruptcy risks affect the pricing of corporations. Hedging on futures markets may reduce risks of commodity price fluctuations. Observing small number of deals on most futures agricultural commodity markets, company using agricultural commodities do not hedge often. So their costs of bankruptcy risks are higher when prices of agricultural commodities increase.

Corporations act in their owners' interest, thus, they must to maximize shareholders' share value. This is executed through a series of business and financial decisions. Business decisions are presented first and then financial decisions are described. Business decisions involve investment decisions. Investments are conducted to increase profits and then firm value. According to the Modigliani-Miller separation theorem (Modigliani and Miller, 1958), investment decisions are independent from financing decisions. The most important financial decision is to choose the level of financial leverage. Corporations will increase their financial debt as long as bankruptcy costs remain low. Hence, corporations will maximize their value while maintaining bankruptcy costs at low level.

4.2 Bargaining power: perfect competion versu imperfection competition

<u>In terms of bargaining power with clients</u>
Bargaining power may be quite strong for somme commodity producers operating in cartels such as the the OPEC for oil of many cartels observed in the copper markets. However such a phenomenon is less common for agricultural commodities although food markets are oligopolies are widespread.

Cartels were only fined in very limited food industries: the cartel of vitamins for example. But no cartel was fined for agricultural commodity before the year 2010.
However, many authors have studied retail food prices on the basis of cost-push theories. They analyzed food manufacturers reaction to increases in agricultural input costs. Such increases may be "passed through" by to consumers in the form of higher product prices.

Holloway (1991) analyzed the farm-retail price spread for eight major food commodity groups: beef and veal, pork, poultry, eggs, dairy, processed fruits and vegetables, fresh fruit and fresh vegetables. He found no significant departure from perfect competition in the retail makets during the period 1955-83.

Schroeter & Azzam (1991) looked at pork prices and farm prices of market hogs. They found that farm/wholesale margins are more consistent with competitive performance in the period 1972-1988 than before. Further, they confirmed a positive relationship between marketing margin and a mesure of price risk.

Butault (2008) showed that food companies transfered any decrease in agricultural commodity prices to their clients from 1979 to 2004 in France. He concluded that globally food companies seem to not hold any bargaining power on their output markets.

<u>In terms of costs, farm inputs are lower for food products that are more and more processed:</u>
Following Goodwin and Brester (1995), Morrison and MacDonald (2003) observed that food prices in the US were less responsive to agricultural price shocks since the 1980s because food bought by consumers is more and more processed. So, agricultural materials were a reduced share of food-processing costs. They found a weaker linkages between farm and food prices.

Urbanchik (1997) compared changes in the US consumer price index (CPI) for food to the Index of Prices Received by Farmers for All Farm Products (PFR) which was a proxy for agricultural prices. He found a relative stability of food price inflation contrasting with the volatility of commodity prices over the period 1984-1996.

Food products have evolved and incorporated more and more processing and convenience services. Based on prices farmers receive for commodities, the farm value share of the retail price of food has almost continuously declined durin the last 50 years in the USA, with a share of 41% in 1950 to an estimated share of 19% in 2006 (Christian & Rashad, 2008). Then, change in agricultural commodity price affect food price in a smaller and smaller proportion.

But Food manufacturers may be pressed by food retailer's market power

Bontemps *et al.* (2008) found that French retailers exert some market power vis a vis consumers and vis a vis fresh tomato suppliers. They demonstrated that in absence of retail market power, the consumer price of French round tomatoes would have decreased by about 1.2% to 4.5% depending on year, between 2000 and 2006. Such a market power concerned large volumes since tomato was the main vegetable consumed in France after potato.

Bontemps *et al.* (2008) also found that the producer price of round tomatoes would have been 6 to 24% higher than the actual observed on markets. The producer price of round tomatoes would have been 13 to 54% higher. Tomato producers were hurt: they had to produce less and at a small price. Further, price distorsions were higher in winter when supply mainly came from imports.

Food retailers exert some power on food manufacturers. Most food processors cannot easily pass cost increases to food retailers. However, there exists some exceptions. Food giant firms like Nestlé, Danone, Kraft, Unilever can pass price increases through retailers and consumers. It is due to their branding power. The enjoy some monopolistic power attached to their strong brand worldwide.

In terms of power among competitors: Food price stickiness

Rottemberg (1982) and Cecchetti assessed that price rigidity to cost changes might be due to fear of uncertain responses from rival firms that put considerable risk on pricing decisions: any firm price increase not followed by competitors might lead to loss of market share, revenue, goodwill and profit. Any price decreases might lead to increased market share or to harmful price wars that may induce predatory pricing.

According to Shonkwiler and Taylor (1988), firm altered price only in response to changes in production cost caused by input price changes and/or technological progress. Transitory changes did not result in price changes. They found evidence of sticky prices at firm level in the frozen concentrated orange juice business. For major processors in Florida, changes in bulk price of inputs such as orange juice or labor or packing costs, "must pass significant threshold before listed retail prices are changed".

With French food prices observed in 27,000 shops, Guédès (2008) confirmed the findings with data of 2007-2008 in observing that the strong increase in agricultural prices led into moderate increase in food prices. For instance from June to November 2007, the price of wheat increased by 58% from 158 €/t to 250 €/t, while the consumer price of a "baguette (very common French type of bread) increased by 4.7% on average, with variations from - 20% to 12.9%. Later, baguette price remained quasi-stable during the three following months, while milling wheat price fluctuated aroud 250 €/t. Declerck and Weaver (2011) extended the work on price stickyness of bread price w.r.t. wheat price and noticed some ratchet effect in the US and French markets: when wheat price rose, bread price increased, but bread price did not decrease when wheat price went down. They suggested that wheat price increase was an argument provided by retailers to pass some increase in bread price even though wheat only accounted for 6 to 10% of bread making costs.

5 Conclusion and perspectives

Applied to the case of wheat, food processors' stock prices do not significantly depend on agricultural market prices. So, agricultural market prices cannot be hedged using food processors' stock prices.

Further study made be made with other agricultural commodities and energy and mineral commodities.

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