On the information content of futures prices, Application to LME nonferrous metal futures

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ON THE INFORMATION CONTENT OF FUTURES PRICES[1]
Application to LME nonferrous metal futures

by

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ABSTRACT

The objective of operations on futures markets may be either hedging, or speculation. In this paper, we wish to give a description of futures markets with two groups of operators with heterogeneous expectations : hedgers-speculators, and pure speculators. The existence of carry-over costs is taken into account in the case of commodity trading, as well as in the case of financial futures. An equation, giving a simplified expression of the futures price, is derived. Applications to nonferrous metal futures (aluminium, copper and nickel) commodity markets are proposed.

Keywords : futures markets, expectations, commodity markets, hedging, speculation, portfolio management.

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[2] This paper describes preliminary results and should not be quoted without the authors' permission. Comments, however, are welcome.

ON THE INFORMATION CONTENT OF FUTURES PRICES
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1. Introduction

It is well known that operations on futures and derivative markets may either aim at *hedging* some other operations on spot markets against price variations, or at *speculating*, or making a profit out of such price variations. Whereas hedging is riskless, or almost riskless in general, speculation always carries some kind of risk, and it can be demonstrated that the profit achieved by a speculator is commensurate with the risk taken (Brealey and Myers, 1981). The theory of futures markets has been oriented in several directions, including aiming at explaining the basis, or the difference between spot and futures prices for a given commodity or asset; numerous works have indeed been devoted to the basis since Keynes' theory of normal backwardation (1930). In this paper, we intend to derive a model of speculation and hedging including hedgers-speculators, and pure speculators, with different information available, the speculators being more informed about the market of the underlying commodity. The fact that futures prices do incorporate some information about the expected spot prices has been empirically studied by Fama and French (1987), and by Ma (1989), and more recently, theoretically and empirically, by Perrakis and Khoury (1998), and by Booth, So and Yiuman Tse (1999). We propose here an interpretation of our model in terms of insights for future spot prices incorporated into the basis. Empirical verification with applications to nonferrous metal futures (aluminium, copper and nickel) commodity markets are proposed.

2. The model

The basis of the theory is the optimization behavior of the agents, based on their respective utility functions. Let us therefore define :

- The *hedgers-speculators' utility function,* expressed as :

$$U_{SH}(\Pi) = E_{SH}(\Pi) - \frac{b_{SH}}{2}[\Pi - E(\Pi)]^2 \qquad (1)$$

- The *speculators' utility function,* expressed in a similar manner :

$$U_S(\Pi) = E_S(\Pi) - \frac{b_S}{2}[\Pi - E(\Pi)]^2 \qquad (2)$$

The argument Π stands for the profit achieved by either the speculator or the speculator-hedger; $E_{SH}(\Pi)$ and $E_S(\Pi)$ stand for the respective expectations of the profit for the speculator-hedger and the speculator, conditional to the information that they both have ; clearly, the conditional variance of the hedgers-speculators, which represents the risk that they take, conditionally to their information, is :

$$\text{Var}_{SH}(\Pi) = E_{SH}\{[\Pi - E(\Pi)]^2\} \quad (3)$$

In a similar manner, one may express the pure speculators' conditional variance :

$$\text{Var}_{S}(\Pi) = E_{S}\{[\Pi - E(\Pi)]^2\} \quad (4)$$

Let us now express the hedgers-speculators' profit ; within the framework of a simplified two-period model, let p_0 be the spot price of the commodity at time 0 and $p_{1,i}$ be the price at time 1, after the period of time under study has elapsed, for state of the world i :

$$\Pi_{SH,i} = x_{SH}[F_{1,i} - F_0] + y_{SH}[p_{1,i} - p_0(1 + r + s) + c + d_1] \quad (5)$$

In this equation, y_{SH} is the hedgers-speculators' position on the spot market, which is assumed to be exogenous, according to either the quantity expected for demand at time 1, with $y_{SH} > 0$ if the hedgers-speculators are buying the quantity y_{SH} at time 0, expecting the price of the commodity to increase, and $y_{SH} < 0$ if the hedgers-speculators are selling the quantity y_{SH} at time 0, expecting the price of the commodity to decrease. p_0 is the spot price of the commodity at time 0; F_0 is the futures price of the commodity at time 0 for delivery at time 1; $p_{1,i}$ and $F_{1,i}$ are, respectively, at time 1 and for state of nature i, the spot price of the commodity, and its futures price for delivery at time 1. r is the interest rate of the riskless asset, and s the storage cost of one monetary unit of the commodity for the period of time under study. d_1 is the dividend that might be distributed (for an investment in a stock) during the period and c is the so-called convenience yield, ie the profit that may be derived from the final use of the commodity. In the case of financial commodities, s and c are usually small and may be neglected, but this is not the case for physical commodities.
Let z_{SH} be the excess position of the hedgers-speculators over their position on the spot market, such that :

$$-x_{SH} = y_{SH} + z_{SH} \quad (6)$$

$z_{SH} = 0$ corresponds to the "naive" one-to-one hedging position, in which the hedger-speculator holds a short position exactly equal to the quantity of commodity bought at time 0, or a long position exactly equal to the quantity of commodity sold at time 0, and to the quantity bought at time 1.

Under these conditions, if there is a perfect correlation between spot and futures prices, it may be shown that maximizing the hedgers-speculators' expected utility will give :

$$x_{SH} = -(y_{SH} + z_{SH}) = \frac{E_{SH}(P_1) - F_0}{b_{SH}\sigma_F^2} - y_{SH} \quad (7)$$

In the case of a very strong aversion to risk, so that the first term of the right handside of (7) is negligible, the "naive" one-to-one hedging holds.

Let us now consider the pure speculators' profit for state of nature i :

$$\Pi_{S,i} = x_S \, (F_{1,i} - F_0) \tag{8}$$

Hence, the expected utility of pure speculators may be expressed as :

$$E_S[U[\Pi)] = x_S \, [E_S(p_1) - F_0] - \frac{b_S}{2} x_S^2 \, Var_S(p_1 - p_0) \tag{9}$$

We assume here that speculators are better informed at time 0 about the future price p_1 at time 1, and that, if :

$$p_1 = p_0 + \tau + \varepsilon \tag{10}$$

where τ and ε are random variables such that $E(\tau) = \tau_0$ and $E(\varepsilon) = 0$, whereas $Var(\tau) = \sigma_\tau^2$, and $Var(\varepsilon) = \sigma_\varepsilon^2$, all these being historical expectations and variances. But, assuming that the informed traders know part of the random return $\tau + \varepsilon$, being able to know the outcome τ at time 1, their expectation of the return becomes :

$$E_S(p_1) - p_0 = E(\tau + \varepsilon \,|\tau) = \tau + E(\varepsilon \,|\tau) = \tau \tag{11}$$

Their conditional variance is now simply :

$$Var_S(p_1 - p_0) = Var(\tau + \varepsilon \,|\tau) = Var(\varepsilon \,|\tau) = \sigma_\varepsilon^2 \tag{12}$$

assuming that τ and ε are independent variables. Assuming that the hedgers-speculators have no special information except historical data and the distribution of τ and ε, for them :

$$E_{SH}(p_1) - p_0 = E(\tau + \varepsilon) = \tau_0 + E(\varepsilon) = \tau_0 \tag{13}$$

And :

$$Var_{SH}(p_1 - p_0) = Var(\tau + \varepsilon) = \sigma_\tau^2 + \sigma_\varepsilon^2 = \sigma_F^2 \tag{14}$$

Taking into account equation (13), (7) becomes :

$$x_{SH} = \frac{p_0 + \tau_0 - F_0}{b_{SH}\sigma_F^2} - y_{SH} \qquad (15)$$

Finally, the speculators' demand will be :

$$x_S = \frac{E(p_0 + \tau + \varepsilon|\tau) - F_0}{b_S\sigma_\varepsilon^2} = \frac{P_0 + \tau - F_0}{b_S\sigma_\varepsilon^2} \qquad (16)$$

Expressing market clearance through $x_S + x_{SH} = 0$, one obtains :

$$x_S + x_{SH} = \frac{p_0 + \tau - F_0}{b_S\sigma_\varepsilon^2} + \frac{p_0 + \tau_0 - F_0}{b_{SH}\sigma_F^2} - y_{SH} = 0 \qquad (17)$$

Finally, the equilibrium futures price is :

$$F_0 = p_0 + \frac{\frac{\tau_0}{b_{SH}\sigma^2} + \frac{\tau}{b_S\sigma_\varepsilon} - y_{SH}}{\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2}} \qquad (18)$$

Finally, let :

$$\alpha_{SH} = \frac{\frac{1}{b_{SH}\sigma^2}}{\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2}} \qquad (19)$$

And :

$$\alpha_S = \frac{\frac{1}{b_S\sigma_\varepsilon}}{\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2}} \qquad (20)$$

Clearly, one has :

$$\alpha_{SH} + \alpha_S = 1 \qquad (21)$$

Hence, a simplified expression for is obtained :

$$F_0 = p_0 + \alpha_{SH}\tau_0 + \alpha_S\,\tau - \frac{y_{SH}}{(\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2})} =$$

$$p_0 + \tau_0 + \alpha_{SH}\,(\tau - \tau_0) - \frac{y_{SH}}{(\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2})} \qquad (22)$$

with $\alpha_{SH} > 0$, $\alpha_{SH} > 0$, while the remaining term, which may be interpreted as covering a risk premium and the carryover cost, is either negative (for a short hedge) or positive (for a long hedge).

But, according to (13), one has :

$$\tau_0 = p_1 - p_0 + \varepsilon \qquad (23)$$

So that equation (22) becomes :

$$F_0 - p_0 = (p_1 - p_0)(1 - \alpha_{SH}) + \alpha_{SH}\,\tau - \frac{y_{SH}}{(\frac{1}{b_{DS}\sigma^2} + \frac{1}{b_S\sigma_\varepsilon^2})} + \varepsilon \qquad (24)$$

Expressing p_1, this equation becomes :

$$p_1 = p_0 + \frac{F_0 - p_0}{1 - a_{SH}} + \frac{a_{SH}}{1 - a_{SH}}t - \frac{y_{SH}}{(1 - a_{SH})(\frac{1}{b_{DS}s^2} + \frac{1}{b_S s_e^2})} + \varepsilon' \qquad (25)$$

The spot price after one period is a linear function of the spot price, and of the basis with the coefficient of the spot price being 1, and with a positive coefficient for the basis.

Equation (25) may actually be completed by expressing y_{SH} as a function of some market variables, such as turnover and inventories. It may be assumed reasonably that it is an increasing function of the ratio of turnover to inventories, so that overall it may be assumed to be an increasing function of turnover, and a decreasing function of inventories.

3. Results and discussion

In this section, we are applying our previous theoretical analysis to three-months LME-futures for aluminium, copper and nickel, using daily data covering the period 1990-2000; including spot and three-month futures prices, LME inventories and turnover, as supplied by the LME.

The LME, established in 1877, is the largest derivatives market for common non-ferrous metals, along with the COMEX and the CBOT for copper derivatives. It also offers silver futures and options, along with the COMEX and the CBOT. It has now a complex membership of over 100 major firms and operates on a 24-hour basis. The resulting trade is enormous, valued at some $10 billion per day (Table I).

Table I

METAL TRADING STATISTICS

official turnovers, futures and options, 1991-1997

	1991	1992	1993	1994	1995	1996	1997
Primary Aluminium	5,732	9,257	10,984	15,836	15,302	15,583	24,191
Copper	7,385	7,945	16,012	19,392	19,743	20,108	16,906
Lead	707	986	1,038	1,988	1,781	2,234	2,387
Nickel	732	1,485	2,189	3,547	3,403	3,159	4,689
Tin	360	534	625	1,219	1,219	1,131	1,131
Zinc	2,022	4,528	4,331	5,557	5,419	4,979	7,676
Aluminium Alloy		7	111	149	211	293	390
GRAND TOTAL	16,938	24,742	35,290	47,688	47,150	47,487	57,373

All figures above are in 000s of lots. Aluminium Alloy lots are of 20 tonnes, Nickel lots of 6 tonnes and Tin lots of 5 tonnes. For all other metals, lots are of 25 tonnes. Aluminium Alloy commenced traing 3-months on 6th October 1992, with cash trading commencing on 4th January 1993.

The main function of the LME is hedging, representing 75-85% of turnover. The metal passes through a number of processing stages before it becomes a finished product. Between each stage there can be a considerable time during which a company's ability to match physical purchases with its physical sales reduces, resulting in possible exposure to price risk. To guard against such risk, it is prudent to hedge each physical transaction by entering into a forward contract on the LME. With planning, contracts so that the LME buy/sell back price will match almost exactly the physical contract price. So the physical profit perceived on entering the hedge has been protected. All LME contracts may be completed by delivering or receiving the metal, but market operators (producers, physical trading companies, processors, stockists and users) prefer to enter directly into over-the-counter contracts for physical metal. The delivery is in the form of warehouse warrants (bearer documents entitling the holder to take possession of a specified tonnage of metal at an LME approved warehouse). Warrants are issued by the warehouse companies on receipt of metal and states its quality, its exact tonnage, shape and location. Only a small percentage (around 2%) of LME contracts result in a (warrant) delivery. The vast majority of contracts are, however, bought or sold back before delivery date.

The US dollar is the major currency used at LME, in which transactions on the floor are made and which is used for official prices. However, sterling, deutschmarks and japanese yen are also used for clearing purposes for all LME metals. We present the prices of some metals in the Table II.

Table II

Average official LME Prices for the year 1997 In US Dollars per tonne

	Primary Aluminium	Aluminium Alloy	Copper Grade A	Standard Lead	Primary Nickel	Tin	Special High Grade Zinc
Cash Buyer	1,598.01	1,457.37	2,274.48	623.21	6,910.89	5,636.64	1,317.23
Cash Seller & Settlement	1,598.83	1,462.07	2,275.70	624.08	6,916.09	5,642.96	1,318.27
Cash Mean	1,598.42	1,459.72	2,275.09	623.64	6,913.49	5,639.80	1,317.75
3-months Buyer	1,618.16	1,480.31	2,220.03	632.61	7,013.47	5,665.06	1,302.38
3-months Seller	1,618.88	1,483.44	2,221.08	633.41	7,018.49	5,670.04	1,303.25
3-months Mean	1,618.52	1,481.88	2,220.55	633.01	7,015.98	5,667.55	1,302.81
15-months Buyer	1,630.68	1,540.61	2,060.49	641.06	7,257.13	5,771.84	1,264.66
15-months Seller	1,635.68	1,560.57	2,070.49	646.05	7,277.13	5,781.84	1,270.45
15-months Mean	1,633.18	1,469.94	2,065.49	643.55	7,267.13	5,776.84	1,267.55
27-months Buyer	1,623.53		2,003.08		7,389.19		1,233.13
27-months Seller	1,628.53		2,013.08		7,409.19		1,238.92
27-months Mean	1,626.03		2,008.08		7,399.19		1,236.03

The following sterling equivalents have been calculated, on the basis of daily conversions:

- Copper Cash Seller + Settlement: £1,390.23
- Copper 3-months Seller: £1,360.58
- Lead Cash Seller & Settlement: £381.26
- Lead 3-months Seller: £387.97

The aluminium and copper contracts have a size of 25 tonnes. Quotations are reported up to two decimal place, with the minimum price movement being 50 cents per tonne. The three-month contract is a contract where the date of delivery is daily for three months forward. For the contract of nickel, only the size is modified (6 tonnes).

Description of data

Daily data of aluminium, copper and nickel contracts are obtained from LME. Only transaction data occurring during trading days of the LME are. However, we are met with any obstacles. Some data were missing. One way to respond to this problem is to take securities of previous day. Furthermore, some data are recalculated on a daily basis (as inventories).

The resulting dataset contains 2930 observations. Graphics describing the three commodities prices are provided in Figure I, II, III. We note then that spot and three-month futures prices appear to be similar for the aluminium and nickel contracts. But there are a short difference between the two prices series for copper.

Standard uniroot tests were performed on the variables. The results show that these variables was stationary.

The econometric implementation of (25) was carried out on daily LME data for aluminium, copper and nickel spot and 3-month futures prices. We can rewrite this equation in this way :

$$P_1 = \alpha + \beta\, p_0 + \gamma\,(F_0 - p_0) + \eta\,(\text{turnover/inventories})_{t=1} \qquad (26)$$

where α represents $\frac{a_{SH}}{1-a_{SH}}t$, a constant term

γ represents $\frac{1}{1-a_{SH}}$

η represents $-\frac{1}{(1-a_{SH})(\frac{1}{b_{DS}s^2}+\frac{1}{b_S s_e^2})}$.

The theoretical model points out that β should be equal to 1, γ should be positive and superior to 1 and η should be positive.

SPOT AND FUTURES PRICES FOR ALUMINIUM

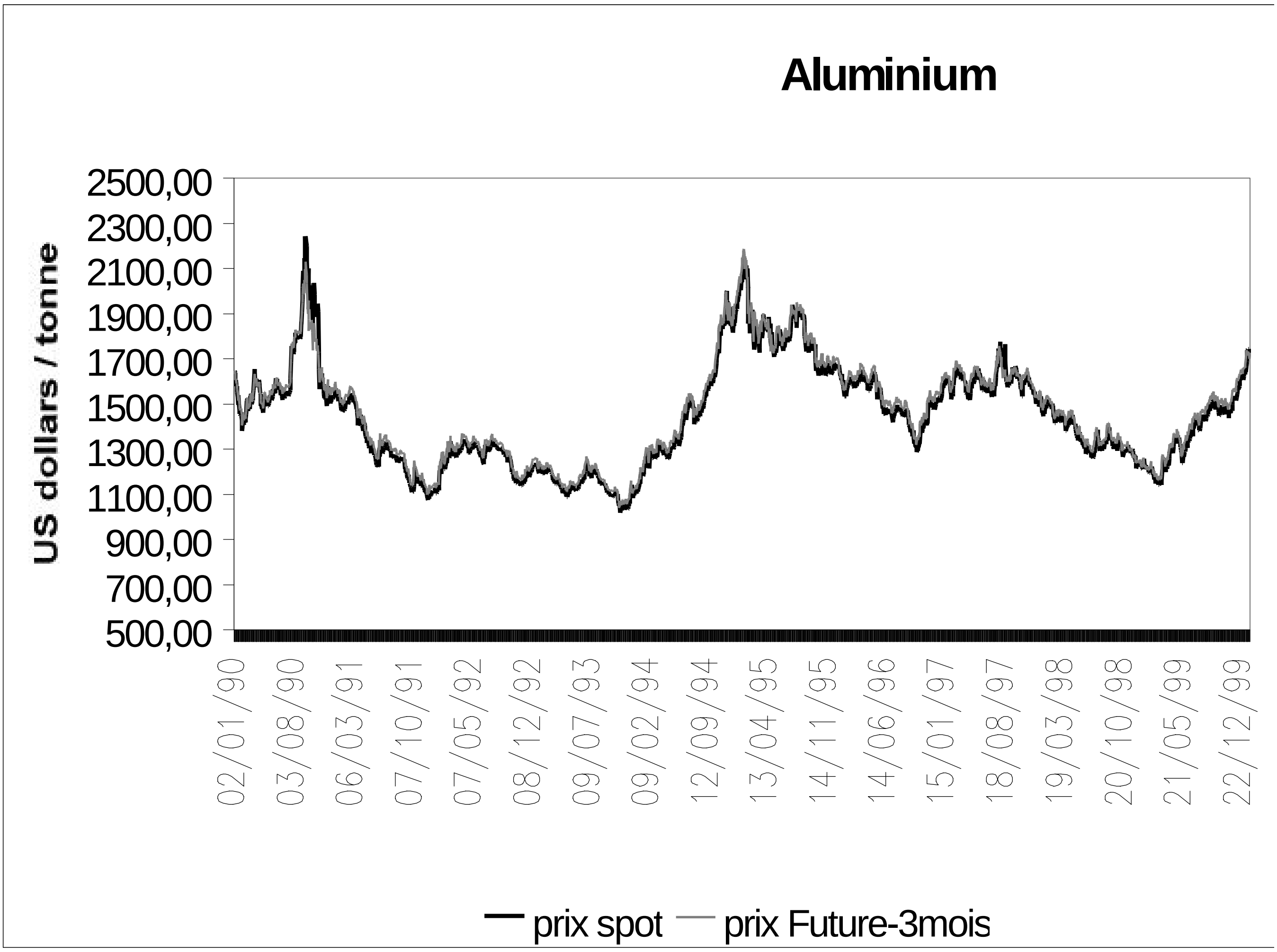

Figure I

SPOT AND FUTURES PRICES FOR COPPER

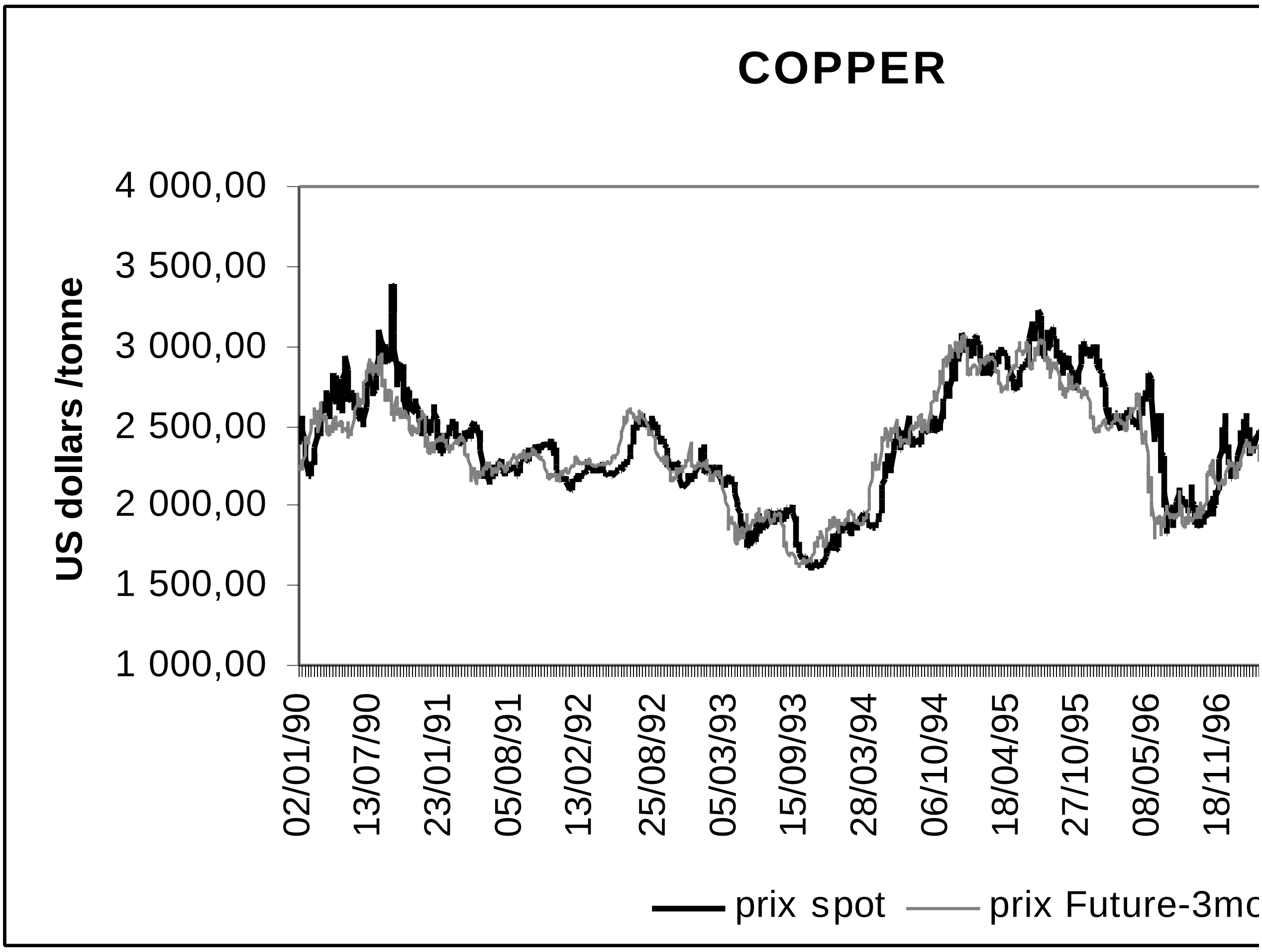

Figure II

SPOT AND FUTURES PRICES FOR NICKEL

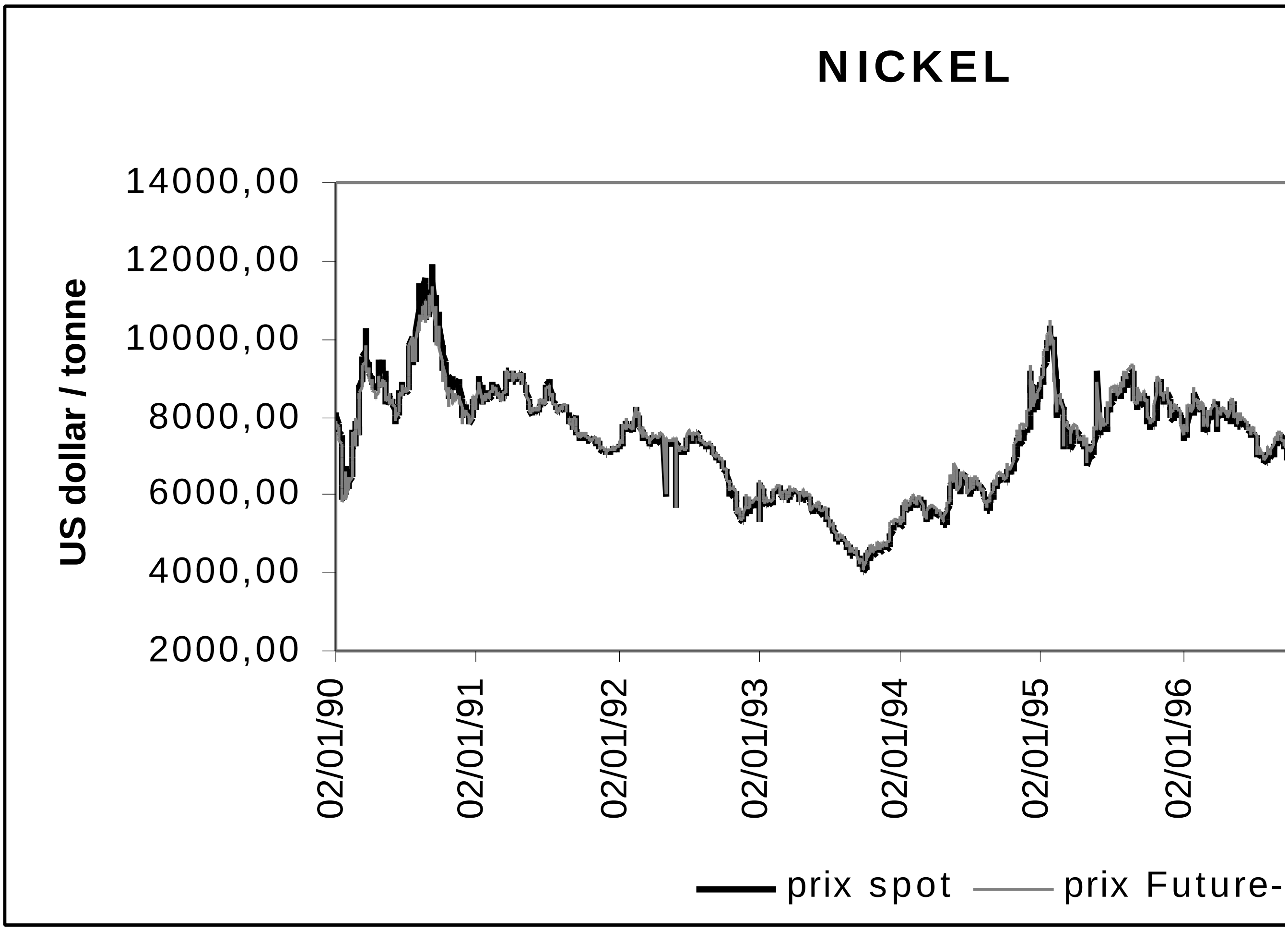

Figure III

In our empirical application, we first carry out a regression of spot prices p_{t+65} observed at time t + 65 working days against the spot price p_t at time t, and the basis at time t :

$$p_{t+65} = \alpha + \beta\, p_t + \gamma\, (F_t - p_t) \tag{27}$$

Table III exhibits the ordinary least squares estimates of the coefficients β and γ, together with the constant term α of this regression equation.

TABLE III

OLS Regression for $p_{t+65}=\alpha+\beta p_t+\gamma(F_t-p_t)$

Aluminium	Coefficient	Standard error	t-Statistic	p-value
α	305.8881	18.6425	16.4081	0.0000
β	0.7823	0.0126	62.0350	0.0000
γ	0.4870	0.0511	9.5310	0.0000

Note : $R^2 = 0.5944$, p-value is 0 for the test

Copper	Coefficient	Standard error	t-Statistic	p-value
α	195.9055	28.7308	6.8187	0.0000
β	0.9101	0.0132	68.8328	0.0000
γ	0.6907	0.0859	8.0385	0.0000

Note : $R^2 = 0.7112$, p-value is 0 for the test

Nickel	Coefficient	Standard error	t-Statistic	p-value
α	1353.1386	90.2632	14.9910	0.0000
β	0.8108	0.0127	63.7131	0.0000
γ	0.1165	0.0432	2.6998	0.0070

Note : $R^2 = 0.6091$, p-value is 0 for the test

This first regression gives satisfactory results that follow the model, with significant positive coefficients, as expected, for both variables, as indicated in Table III. Furthermore for all the commodities, the coefficients for the spot price are all close to 1, but all coefficients for the basis aren't larger than 1, as expected from the model.

Secondly, we are carry out a regression considering all variables existing in the model. That is a regression of spot prices p_{t+65} observed at time t + 65 working days against the spot price p_t at time t, the basis at time t and a term representing the turnover and inventories at time t + 65 :

$$p_{t+65} = \alpha + \beta\, p_t + \gamma\, (F_t - p_t) + \eta\, (\text{turnover/inventories})_{t+65} \tag{28}$$

Table IV exhibits the ordinary least squares estimates of the coefficients β, γ and η, together with the constant term α of this regression equation.

TABLE IV

OLS Regression for

$p_{t+65}=\alpha+\beta p_t+\gamma(F_t-p_t)+\eta(\text{Turnover/Inventories})_{t+65}$

Aluminium	Coefficient	Standard error	t-Statistic	p-value
α	309.8014	18.5796	16.6742	0.0000
β	0.7773	0.0126	61.7207	0.0000
γ	0.5047	0.0509	9.9055	0.0000
η	0.0175	0.0035	5.0499	0.0000

Note : R^2 = 0.5983, p-value is 0 for the test

Copper	Coefficient	Standard error	t-Statistic	p-value
α	198.7315	28.7291	6.9174	0.0000
β	0.9072	0.0132	68.4703	0.0000
γ	0.6848	0.0856	7.9978	0.0000
η	0.0066	0.0024	2.7439	0.0061

Note : R^2 = 0.712, p-value is 0 for the test

Nickel	Coefficient	Standard error	t-Statistic	p-value
α	1364.4547	90.4396	15.0869	0.0000
β	0.8079	0.0128	62.9878	0.0000
γ	0.1168	0.0431	2.7077	0.0068
η	0.4079	0.2250	1.8129	0.0700

Note : R^2 = 0.6096, p-value is 0 for the test

This regression gives medium results, with significant positive coefficients, as expected, for both variables, as indicated in Table IV. Furthermore, the coefficients for the spot price are all close to 1, but all coefficients for the basis aren't larger than 1, as expected from the model. On the other hand, the coefficient η is positive but is not significant for the copper and nickel.
The fact that the basis coefficients are not larger than 1 and that some aberrant point are found among the transaction data indicates us to use a another method of regression. That's why in order to try to improve this results, we have making a robust regression.
Table V exhibits the least trimmed squares estimates of the coefficients β, γ and η, together with the constant term α of equation (28).

TABLE V

Robust Regression for

$p_{t+65}=\alpha+\beta p_t+\gamma(F_t-p_t)+\eta(\text{Turnover/Inventories})_{t+65}$

Aluminium	Coefficient	Standard error	t-Statistic	p-value
α	312.5026	14.6392	21.3470	0.0000
β	0.7482	0.0098	76.5709	0.0000
γ	1.2400	0.0782	15.8520	0.0000
η	0.0327	0.0029	11.3923	0.0000

Note : R^2 = 0.7134, p-value is 0 for the test

Copper	Coefficient	Standard error	t-Statistic	p-value
α	181.2014	27.1876	6.6649	0.0000
β	0.9125	0.0125	72.7410	0.0000
γ	0.6858	0.0812	8.4463	0.0000
η	0.0161	0.0025	6.3970	0.0000

Note : $R^2 = 0.7403$, p-value is 0 for the test

Nickel	Coefficient	Standard error	t-Statistic	p-value
α	1342.5686	74.9152	17.9212	0.0000
β	0.7945	0.0107	74.2399	0.0000
γ	0.0803	0.0351	2.2886	0.0222
η	0.2196	0.1893	1.1600	0.2462

Note : $R^2 = 0.6961$, p-value is 0 for the test

The results reported in Table V are consistent with those of Table IV. For aluminium, the coefficient of the basis is significantly larger than 1. this confirms the presence of information in the spot and futures markets. However, in the cases of copper and nickel the estimated coefficients doesn't reveal information about these markets. The use of a robust regression is not improve the estimated coefficients values for copper. Only the coefficient of turnover/inventories is becoming significant. Whereas for nickel, the results of this regression was weaker. Note that the significance of the regression is higher for the three commodities indicating that the model seems to be suited.

4. Conclusions

In this paper, we wish to give a description of futures markets with two groups of operators with heterogeneous expectations : hedgers-speculators, and pure speculators. The existence of carry-over costs is taken into account in the case of commodity trading, as well as in the case of financial futures. An equation, giving a simplified expression of the futures price, is derived. This expression was tested with data of nonferrous metal futures (aluminium, copper and nickel) commodity markets traded on the London Metal Exchange.

The empirical results show that only aluminium reveal the presence of some information between spot and futures markets.

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Appendix 1

Robust approximation by the method Least Trimmed Squares

The method Least Trimmed Squares (LTS) introduced by Rousseeuv (1984) for compensate to application difficulties of Ordinary Least Squares. Suppose the linear model is :

$$y_i = X_{oi}^T b_0 + e_i, i = 1 \ldots n,$$

where β_0 is a p-dimension vector and the term y the dependent variable. So we have a n×p matrix. We can write the expression of the residual term :

$$r_i(\beta) = y_i - X_i^T \beta, i = 1 \ldots n,$$

The estimator LTS minimizes the sum of the q smallest squared residuals :

$$\sum_{i=1}^{q} r_{(i)}^2(\beta)$$

where $r_{(i)}(\beta)$ represent the ith ordered residual.

Appendix 2

Data description and sources

Aluminium

London Metal exchange, daily official cash settlement, 3-month futures, futures volumes and stocks from January 1990 to January 2000. The aluminium deliverable must be primary aluminium of minimum 99.70% purity and should be in the form of ingots, t-bars or sows.
(LME statistics)

Copper

London Metal exchange, daily official cash settlement, 3-month futures, futures volumes and stocks from January 1990 to January 2000. The copper delivered must be electrolytic copper purity and should be in the form of either cathodes or wirebars.
(LME statistics)

Nickel

London Metal exchange, daily official cash settlement, 3-month futures, futures volumes and stocks from January 1990 to January 2000. The nickel delivered must be primary nickel of minimum 99.80% purity and must be in the form of either cathodes or pellets or briquets.
(LME statistics)