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On the Use of Quadratic Trends in Natural Resource Prices' Modeling

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Abstract The use of quadratic trends for modeling natural resources' prices is a common practice. However, as shown in this paper, the specification of the trend as a second degree polynomial is the least preferable with respect to a set of model selection criteria, when compared to very simple models that involve trigonometric trend functions. All models are estimated on the price series of aluminum, copper, iron, lead, nickel, silver, tin, zinc, bituminous coal, petroleum and natural gas, providing in most cases evidence against the long-run increase of the corresponding natural resource real prices, with interesting policy implications.

Key words Oscillatory trend - quadratic trend - Hotelling rule - natural resource prices - model selection
JEL classification: C22, E3.

1 Introduction

Natural resource pricing defines, to a large extend, the stock and flows of natural resources over time, which has direct implication for the achievement of sustainable development (Tietenberg and Lewis, 2012). The implications of increased natural resource scarcity and its effect on economic growth have been discussed since the 18th century. Malthus (1798) and Ricardo (1817) held that agricultural land scarcity implied strict limits on population growth and the development of living standards. In his seminal article, Harold Hotelling (1931) offered his well-known counterargument: Competitive firms would manage exhaustible resource stocks to maximize present-value profits; competitive extraction paths would therefore match those chosen by a social planner seeking to maximize intertemporal social surplus; and subject to the caveat of social and private discount rates equality; equivalence between competitive outcome and the work of a rational social planner would be achieved. The Hotelling rule provides the fundamental no-arbitrage condition that every competitive or efficient resource utilization path has to meet. In its basic form it indicates that along such a path the price of an exhaustible resource has to grow with a rate that equals the interest rate.

The issue of the specification of trends in natural resource prices has been considered by a significant number of researchers during the last century. Barnett and Morse (1963) examined trends in the prices and unit costs of extractive goods in the United States. Smith (1979) employed an econometric analysis of annual (1900-1973) price data of four aggregate resource groups and concluded that the trend in mineral prices was negative with the rate of decline decreasing over time in absolute magnitude. Slade (1982) allowed for the presence of technological progress which reduces the production cost and therefore the price paths for nonrenewable natural resources can be U-shaped. The empirical findings of Berck and Roberts (1996) suggested that it is more adequate to consider that resource prices exhibit trend over short time of periods, while this trending behaviour is not reflected in the large samples. Slade and Thille (1997) developed another theoretical model (different than Slade 1982) which is able to produce substantial periods of falling prices.

Another strand of the literature on commodity prices considered the possibility that the evolution of real prices is governed by stochastic trends. Ahrens and Sharma (1997) considered the prices of eleven natural resources. They applied a set of unit root tests on each price series. The combined results of these tests could not reject the unit root hypothesis only for two price series, while they provided evidence against the existence of a stochastic trend for the prices of three natural resources. For the rest five price series, however, the results of the unit root tests were inconclusive, highlighting the weaknesses of the corresponding unit root testing procedures. Pindyck (1999) examined whether the evolution of the real prices of oil, coal and natural gas is governed by stochastic trends. Pindyck made a significant remark concerning the failure of the augmented Dickey-Fuller test to reject the null hypothesis of a stochastic trend due to small sample size. He also identified the inability of a quadratic trend specification to capture the long term evolution of real prices. In order to increase the flexibility of the quadratic trend specification, he then developed a model where the coefficients of the constant and linear terms follow autoregressive processes. In other words, Pindyck used the quadratic trend specification as a starting point in order to develop a more general stochastic trend model.

From another perspective, Postali and Picchetti (2006) argued that the Geometric Brownian Motion can perform well as a proxy for the movement of oil prices. On the other hand, they pointed out that this type of approximation is reasonable in adequately small samples, because when the sample covers one hundred or more annual observations, the evidence supports a trend-stationary behavior with structural breaks for the price of oil. Lee, List and Strazicich (2006) also considered the case of structural breaks. Their results rejected stochastic trend behavior under the alternative of a quadratic trend with two breaks for the same eleven price series used by Ahrens and Sharma (1997).

Summarizing the results of the aforementioned literature, we come to the following conclusions: (a) There is no evidence that second degree polynomials (in other words, quadratic functions with or without linear terms) are able to capture the long-term evolution of natural resource prices. (b) The empirical evidence does not support either the existence of unit root components in these prices. (c) The introduction of either structural breaks or (stochastic) changes on the coefficients of the quadratic trend in models for the prices of natural resources seem to outperform a unit root specification of these prices.

The failure of the simple quadratic functions to succeed in capturing the evolution of natural resource prices seems to be a result of one very specific characteristic: quadratic functions are explosive. On the other hand, the "success" of the ³structural break³ or ³stochastic coefficient³ approaches relies on the fact that they allow for a non-explosive behaviour of the real prices. This observation, brings back into the surface the ³rule³ of Hotelling. This rule, in a more general setting which is compatible with the existing evidence on natural resource prices, can be re-stated as follows: "the price of an exhaustible resource that corresponds to a competitive or efficient resource utilization path, will oscillate around the interest rate."

In this paper we argue that the use of quadratic trend functions as a starting point for the devolopment of models for the evolution of natural resource prices is structurally inadequate. Motivated by the theoretical premises provided by Hotelling, we evaluate the performance of a quadratic trend specification for the real prices of the main fuel and metal resources that have been considered in the literature reviewed above with respect to models based on very simple trend functions that allow oscillatory behavior of the real prices. Specifically, by using a set of model selection criteria we find that simple trigonometric trend models, outperform Slade's (1982) quadratic trend model, as well as a more general one, that nests both the trigonometric and quadratic models. The use of (simple) trigonometric functions is not novel in time series analysis. However, this option has been neglected from the literature on natural resource prices. Our results provide evidence supporting the view that oscillatory behavior is more common than the existence of a long-run monotonic trend, linear or quadratic, in the real prices of natural resources.

The paper is organized as follows: Section 2 presents four competitive trend specifications for the price of a natural resource commodity. These specifications are estimated on the price series of eleven major natural resources. The estimated models are then evaluated by means of three well-known information criteria (Akaike, Schwarz, Hannan and Quinn). Section 3 assesses the ability of the three information criteria to distinguish the true data generating process among the four specifications. Specifically, for the cases where the three criteria disagree we perform a simulation study in order to examine which criterion provides stronger evidence. The results of the simulation study combined with the model selection of the three information criteria support the ability of very simple trigonometric trend functions to capture the dynamics of the real price for nine out of the eleven natural resources. On the other hand, the existence of a quadratic trend finds support in only six cases. Section 4 concludes the paper.

2 Model Estimation and Selection

Let the real price, y_t, of a natural resource commodity be equal to the sum of a deterministic, $g(t; 8)$, and a stochastic component. Following Slade (1982), the empirical literature has specified $g(t; 8)$ as a quadratic polynomial of t. In order, however, to allow for more than one full U-shaped cycles we suggest the following specification:

$$g(t; 8) = c_0 + c_1 t + c_2 t^2 + c_3 \left(\sin\left(\frac{t}{d}\right) + 1 \right) + c_4 t \left(\sin\left(\frac{t}{d}\right) + 1 \right), \; d > 0. \tag{1}$$

The two extra terms, $(\sin(\frac{t}{d}) + 1)$ and $t(\sin(\frac{t}{d}) + 1)$ in (1) capture the potentially oscillating behaviour of the real price, while d controls for the number of the sinusoidal cycles that are likely to be present in a sample of T observations. For example, for T=100, a d equal to 7.5, 10, 15 or 30 corresponds to approximately 2, 1.5, 1 and 0.5 cycles, respectively. The above specification nests the following three cases:

Case 1: The General model, in which $c_i \neq 0$, $i \in \{0, 1, 2, 3, 4\}$.

Case 2: The Polynomial model, in which $c_3 = c_4 = 0$.

Case 3: The Oscillatory model, in which $c_1 = c_2 = 0$. This case can be further decomposed into two additional subcases, according to whether the coefficient c_4 is equal to zero. Specifically, if both c_3 and c_4 are different from zero, we refer to this case as Oscillatory-I model. The second case, occurs when $c_1 = c_2 = c_4 = 0$ and $c_3 \neq 0$. We refer to this case as Oscillatory-II model. It is worth noting that both Oscillatory-I and Oscillatory-II models are very simple and a selection of one of them against the Polynomial model, on the basis of a "goodness-of-fit" criterion, does not raise any overfitting issues.

The next step is to estimate the following equation

$$p_t = g(t; 8) + u_t \,, \tag{2}$$

where g(t; 8) corresponds to each of the four models (General, Polynomial, Oscillatory-I and Oscillatory-II), on the real prices of the main fuel and mineral resources. Specifically, historical real prices (at constant 1998 U.S. dollars) for aluminum, copper, iron, lead, nickel, silver, tin and zinc were obtained from U.S. Geological Survey for the period 1900-2010, while historical real prices for bituminous coal, petroleum and natural gas (at constant 2005 U.S. dollars) were collected from Energy Information Administration for the periods 1949-2010, 1900-2010 and 1922-2010, respectively. As far as measurement units are concerned, we have used 8/ton for aluminum, copper, iron, lead, nickel, tin, zinc and bituminous coal, 8/kgr for silver, 8/barrel for petroleum and 8/(1000 cubic feet) for natural gas. At his point we must emphasize the fact that our goal is not to propose the most sophisticated model for the modeling of natural resource prices, but to evaluate the status of the quadratic trend specification as the main starting point for their study.

Because in all cases u_t exhibits a very high degree of persistence, any nonparametric corrections are likely to produce misleading inferences on the trend coefficients. Vogelsang (1998) found that when u_t is a near-to-unit root process, the nonparametric corrections produce Wald tests that suffer from severe size distortions. As the largest root, g, approaches unity, the empirical sizes become very large and deteriorate with the sample size, since the unit-root asymptotics become dominant. On the other hand, the approach of parametric GLS corrections exhibits much better properties, producing test statistics with empirical sizes very close to their corresponding nominal ones. Moreover, when g is close to one, GLS was found to exhibit very good power properties (see also Canjels and Watson, 1997).

All models are estimated by GLS, for each of the eleven commodities. The error term, u_t, is assumed to follow either an AR(1) or an AR(2) or an ARMA(1,1) process. The results from these three alternative specifications are largely the same, and therefore we discuss the results only for the AR(1) case.The estimation of the frequency parameter, d, is obtained by a minimization of the sum of squared residuals using a sufficiently fine grid of values for d, which corresponds to a step of .5.

Table 1 presents the selected models from the application of the information criteria suggested by Akaike (1973), Schwarz (1978) and Hannan and Quinn (1979), denoted by AIC, SIC and HQ respectively. We make the following observations:

(TABLE 1 AROUND HERE)

(a) All information criteria agree for the cases of aluminum, gas, iron, petroleum, silver and tin. Specifically, all information criteria select the Polynomial model for aluminum, the Oscillatory-II model for gas, the Oscillatory-I model for iron, and the General model for petroleum, silver and tin.

(b) For the rest five resources, the models do not agree. However, only for zing three diferent models are selected, while for coal, copper, lead and nickel, two of the three criteria agree.

(c) Of the cases where the three information criteria do not agree, the Polynomial model is selected only for nickel, while it is not selected by any of the information criteria for the cases of coal, copper, lead and zink.

The results of Table 1 provide a preliminary indication that supports the adequacy of models involving oscillatory components for the modeling of natural resource prices. However, in order to robustify the interpretation of these results we have to investigate the extent to which AIC, SIC and HQ are capable of detecting the correct model within a set, M, of competitive models which consists of the General, the Polynomial, the Oscillatory-I and the Oscillatory-II models defined above. Next section focuses on this issue.

3 Evaluation of the Model Selection Criteria

To investigate the ability of AIC, SIC and HQ to detect the correct model between the ones described in cases 1 to 3, we conduct a Monte Carlo study. Concerning the trend function, we examine four alternative scenarios, namely, we consider the cases where $g(t; 8)$ follows (i) the General model, (ii) the Polynomial model, (iii) the Oscillatory-I model, and (iv) the Oscillatory-II model. For each scenario, we examine the percentages by which the AIC, SIC and HQ select the correct model between the four models mentioned above. The number of replications is equal to 5000 and the sample size is set to 100. The models are estimated by Generalised Least Squares (GLS), in which the error term is assumed to follow an AR(1) process, $u_t = gu_{t-1} + v_t$, while the true parametric structure of the error is assumed to be known. Additional experiments, in which the order, p, of the AR(p) specification in GLS is higher than the true lag order of the autoregressive representation of u_t, have also been conducted, with results similar to those of the "full information" case. Concerning the parameters, 8, of the trend functions, we explored many alternative parameter settings. Our interest, however, lies on the real prices of the of the set of commodities, C := (coal,copper,lead,nickel,zinc}, for which the models selected by the three information criteria do not coincide. Specifically, we use the following procedure:

(a) For each commodity in C we estimate models (i) - (iv).

(b) We use the estimated values of each model to generate the replications, as described in the previous paragraph.

(c) For each replication, we re-estimate models (i) - (iv) and we use AIC, SIC and HQ to select between the re-estimated models.

(d) We report the percentages, at which each information criterion selects the candidate models, given that the true data generating process (DGP) is the one whose estimated values had been used for the generation of the replications.

The results of the Monte-Carlo simulations that correspond to the real prices of coal, copper, lead, nickel and zinc are reported in tables 2 to 6, respectively. We observe the following:

(i) Recall that for the real prices of coal the General model was selected by AIC and SIC, and the Oscillatory-I model was selected by HQ. When the Monte-Carlo study is based on the estimates obtained using the real prices of coal (table 2), we have the following results: If the data were generated by the General model, the selection rate of any other model by any of the model selection criteria would be approximately 0%. This fact provides evidence against the hypothesis that the DGP is described by the General model because the Oscillatory-I model was selected by HQ. If the data were generated by the Polynomial model, the selection rates of the General model by SIC, and of the Oscillatory-I model by HQ would be only 1% and 4%, respectively. This fact provides evidence against the hypothesis that the Polynomial model describes the DGP. If the data were generated by the Oscillatory-I model, the selection rates of the General model by AIC and SIC would be 30% and 7%, respectively. Although the selection rate that corresponds to SIC is not large, it is over 5%. Finally, if the data were generated by the Oscillatory-II model, the selection rates of the General model by AIC and SIC would be 18% and 2%, respectively, while the selection rate of the Oscillatory-I model by HQ would be 9%. The very small selection rate of the General model by SIC in this case, provides evidence against the hypothesis that the Oscillatory-II model describes the DGP. Concluding, we note that evidence is provided against the existence of a polynomial component in the DGP (being described by either the General or the Polynomial model). On the other hand, the results of the Monte-Carlo study do not provide strong evidence against the possibility of the specific selection in table 1, when the DGP is described by the Oscillatory-I model.

(ii) Concerning copper, the General model was selected by AIC, while the Oscillatory-II model was selected by SIC and HQ (table 1). When the Monte-Carlo study is based on the estimates obtained using the real prices of copper (table 2), we observe the following: If the data were generated by the Polynomial or the Oscillatory-I models, the selection rates of the Oscillatory-II model by SIC and HQ would be approximately 0%. This fact provides evidence against the hypothesis that the DGP is described by either the Polynomial or the Oscillatory-I model. Another significant result of the Monte Carlo simulation is that when it is based on the estimates from the General model, the rates at which SIC and HQ select the Oscillatory-II model are high (61% and 28%, respectively). When the Monte Carlo simulation is based on the estimates from the Oscillatory-II model, the selection rate of the General model by AIC is significant too (27%). These results imply that between the four candidate models, the General and the Oscillatory-II are the ones that better capture the dynamics of copper's real price. The combined use of the three selection criteria, however, is not able to identify with high conviction which of these two models better fits the data. Nevertheless, the selection of the General model or the Oscillatory-II model, instead of the Polynomial one, clearly implies that the oscillatory term is a significant component of a model that aims to capture the dynamics of copper's real prices.

(iii) The results are similar concerning the real prices of lead. Specifically, as in the case of copper, the General model was selected by AIC, while the Oscillatory-II model was selected by SIC and HQ. The results and the conclusions of the Monte Carlo simulations which were based on the estimates from the real prices of lead (table 2), are also similar to the ones that correspond to copper.

(iv) As far as nickel is concerned, the results are significantly different than the ones of the previous cases. Specifically, the General model was selected by AIC, while the Polynomial model was selected by SIC and HQ. When the Monte-Carlo study is based on the estimates obtained using the real prices of nickel (table 5), we have the following ewsults: If the data were generated by the General model, the selection rate of the Polynomial model by SIC and HQ would would be 31% and 12% respectively. If the data were generated by the Polynomial model, the selection rate of the General model by AIC would be 47%. Therefore, when the values of the parameters are the ones estimated on the real prices of nickel, the model selection criteria cannot identify with high conviction the correct model between the General and the Polynomial. If the data were generated by the Oscillatory-I model, the selection rate of the General model by AIC would be 36%. On the other hand, the rates at which SIC and HQ would select the Polynomial model are 11% and 5% respectively, implying that given the selection of the Polynomial model by HQ it is rather not probable that the data were generated by the Oscillatory-I model. Finally, if the data were generated by the Oscillatory-II model, the selection rate at of the General model by AIC would be 25%. On the other hand, the rates at which SIC and HQ would select the Polynomial model would be 10% and 8% respectively. In this case, it is again less probable that the data were generated by the Oscillatory-II model (although the 8% selection rate does not provide as strong evidence as the corresponding 5% selection rate when the data were generated by the Oscillatory-I model).

(v) Concerning the real prices of zinc, the General model was selected by AIC, the Oscillatory-I model was selected by SIC and the Oscillatory-II model was selected by HQ. We observe that when the Monte Carlo simulation is based on the estimates obtained using the real prices of zing we have the following results: If the data were generated by the Polynomial or the Oscillatory-I models, the selection rates of the Oscillatory-II model by HQ would be 3% and approximately 0%, respectively. Furthermore, if the data were generated by the Oscillatory-II model, the selection rate of the Oscillatory-I model by SIC would be 4%. On the other hand, if the data were generated by the General model, the selection rates of the General model by AIC, the Oscillatory-I model by SIC and the Oscillatory-II model by HQ would be 77%, 21% and 23%, respectively. Therefore, the Monte Carlo simulations provide evedence against the hypothesis that the data were generated by one of the Polynomial, Oscillatory-I and Oscillatory-II models, while, at the same time renders probable the specific models' selection when the data are generated by the General model.

The results of the analyses of the previous and current sections can be summarized as follows:

(a) Among the four simple candidate models for the description of the trend function of the real prices of eleven natural resources, the Polynomial (quadratic trend) model was selected alone only for aluminum, while it was also selected as a possible alternative to the General model for the real prices of nickel.

(b) The General model was the only model selected for petroleum, silver, tin and zinc. It was also selected as a possible alternative to the Polynomial model for nickel, and to the Oscillatory-II model for copper and lead.

(c) The Oscillatory-I model was the only model selected for coal and iron.

(d) The Oscillatory-II model was the only model selected for gas, while it was also selected as a possible alternative to the General model for the real prices of copper and lead.

4 Conclusions

This paper revisited the literature on the long-run trend of natural resource real prices. Simple models that support oscillatory trend behavior were introduced and tested against the standard quadratic trend model and a more general model that nests both oscillatory and quadratic trends on eleven natural resource prices via the model selection criteria of Akaike (AIC), Scharz (SIC) and Hannan and Quinn (HQ).

The aforementioned models were first estimated using the series of real prices of eleven major natural resource commodities. Then, AIC, SIC and HQ were applied for each commodity and each estimated model. The three information criteria agreed only for six of the eleven commodities. Specifically, they selected models with oscillatory and not quadratic trends for gas and iron, models with both oscillatory and quadratic trends for petroleum, silver and tin, and a model with a quadratic and not an oscillatory trend for aluminum.

For each of the rest five commodities the selected models by the three criteria did not coincide. In order to assess the performance of the model selection criteria in these cases, a Monte Carlo study was conducted based on the estimated values of the parameters for each model. The results of the study provided evidence that contributed in the refinement of our analysis. Specifically, it was found that most probably, the real prices of coal can be described by a model that includes an oscillatory trend and does not include a quadratic trend. It was also found that zinc most probably follows a trend which includes both a quadratic and an oscillatory component. For copper and lead, although the Monte Carlo study provided evidence against the existence of a quadratic trend alone, it could not select with high conviction between a model with an oscillatory trend and a model with both oscillatory and quadratic components. Finally, for nickel, the Monte Carlo study provided evidence against the existence of an oscillatory trend alone. Nevertheless, it could not select with high conviction between a model with a quadratic trend and a model with both oscillatory and quadratic components.

Our study provided evidence that supports the existence of oscillatory componets in the trends of the real prices of nine of the eleven major natural resource commodities, namely, coal, copper, gas, iron, lead, petroleum, silver, tin, and zinc. On the other hand, the existence of a quadratic trend component was identified in the real prices of six of the eleven commodities, namely, aluminum, nickel, petroleum, silver, tin, and zinc. Given the very simple structure of the oscillatory models introduced in this study, the results of our analysis highlight the importance of the inclusion of oscillatory components when modeling natural resources prices. They also support the view of Jacks (2013) who, mainly using descriptive statistics, found indications of cyclical components in the real prices of thirty commodities. Given the theoretical premises of economic theory (Hotelling, 1931), a direct consequence of our results is that the quadratic trend specification is structurally inadequate to be used as a starting point for the devolopment of models for the evolution of natural resource prices.

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A Tables

Table 1. Performance of Information Criteria: Percent Selections of the Competitive Models (%, rounded to the nearest integer)

T	d	AIC 7.5	AIC 10	AIC 15	AIC 30	SIC 7.5	SIC 10	SIC 15	SIC 30	HQ 7.5	HQ 10	HQ 15	HQ 30
	True=Gen.	43	41	74	72	8	10	32	31	22	23	56	54
100	Pol.	53	57	26	28	80	85	67	69	70	73	44	46
	OsI	4	2	0	0	12	5	1	0	8	4	0	0
	OsII	0	0	0	0	0	0	0	0	0	0	0	0
	True=Gen.	100	100	100	100	98	99	98	100	100	100	100	100
200	Pol.	0	0	0	0	2	1	2	0	0	0	0	0
	OsI	0	0	0	0	0	0	0	0	0	0	0	0
	OsII	0	0	0	0	0	0	0	0	0	0	0	0
	Gen.	24	23	25	24	3	3	3	3	10	10	11	11
100	True=Pol.	73	74	75	76	92	92	97	97	86	86	89	89
	OsI	3	3	0	0	4	5	0	0	4	4	0	0
	OsII	0	0	0	0	1	0	0	0	0	0	0	0
	Gen.	20	20	19	20	1	1	1	1	6	7	6	6
200	True=Pol.	80	80	81	80	99	99	99	99	94	93	94	94
	OsI	0	0	0	0	0	0	0	0	0	0	0	0
	OsII	0	0	0	0	0	0	0	0	0	0	0	0
	Gen.	14	16	16	18	1	2	1	2	6	6	6	8
100	Pol.	27	27	5	12	25	26	2	14	27	29	4	13
	True=OsI	53	54	23	70	50	56	11	84	55	58	18	79
	OsII	6	3	56	0	24	16	86	0	12	7	72	0
	Gen.	19	20	19	19	1	1	1	1	7	7	6	6
200	Pol.	0	0	0	0	0	0	0	0	0	0	0	0
	True=OsI	81	80	72	81	99	99	63	99	93	93	75	94
	OsII	0	0	9	0	0	0	36	0	0	0	19	0
	Gen.	17	14	12	15	1	1	1	1	6	4	4	5
100	Pol.	2	10	12	11	1	5	5	4	2	8	9	7
	Os.I	15	14	14	9	5	5	4	3	10	10	8	6
	True=OsII	66	62	62	65	93	89	90	92	82	78	79	82
	Gen.	13	12	12	12	0	0	0	0	3	3	2	2
200	Pol.	0	3	2	0	0	1	1	0	0	2	2	0
	Os.I	15	14	14	15	3	3	3	3	9	7	8	9
	True=OsII	72	71	72	73	97	96	96	97	88	88	88	89

Table 2. Natural Resource Prices: Model Selection and Estimation (p-values below)

Metal	Criteria	Model	c_0	c_1	c_2	c_3	c_4	g	d
ALUMINUM	AIC, HQ,	Pol.	13.451	-.280	.002			.661	
	SIC		.000	.000	.000			.000	
COAL	AIC, SIC,	Gen.	-.589	-.012	.000	-.054	.000	.839	6.5
			.000	.000	.000	.024	.279	.000	
	HQ	OsI	.029			-.071	.001	.885	9
			.000			.000	.000	.000	
COPPER	AIC, HQ,	OsII	2.761			.847		.801	7.5
	SIC		.000			.063		.000	
NATURAL GAS	AIC, HQ,	OsII	.065			-.030		.721	30
	SIC		.000			.000		.000	
IRON	AIC, HQ,	OsI	.827			-.418	.009	.808	10
	SIC		.000			.000	.000	.000	
LEAD	AIC, HQ,	OsII	1.245			.194		.777	7.5
	SIC		.000			.164		.000	
***NICKEL	AIC, HQ,	Pol.	15.911	-.272	.002			.723	
	SIC		.000	.016	.012			.000	
*PETROLEUM	AIC, HQ,	Pol.	.192	-.005	.000			.804	
	SIC		.079	.216	.031			.000	
SILVER	AIC, HQ,	OsII	162.510			90.690		.719	10
	SIC		.006			.043		.000	
TIN	AIC, HQ,	OsII	18.977			-4.404		.851	15
	SIC		.000			.056		.000	
*ZINC	AIC, SIC	OsI	1.459			.482	-.005	.598	7.5
			.000			.012	.017	.000	
	HQ	Pol	2.276	-.020	.000			.647	
			.000	.227	.363			.000	