Bull and bear markets in commodity prices and commodity stocks: Is there a relation?

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Abstract

The extent to which prices of commodities such as oil and gold affect stock prices of firms engaged in their production, and in the stock market in general, has received attention in both the theoretical and empirical literature with mixed results. Instead of focusing on the direct relation between prices, this paper investigates the relation between different market phases. Specifically, it identifies bull and bear markets in commodity prices and in stock prices of firms whose primary business involves mining and marketing the relevant commodities, and investigates whether a relationship between them exists. The aggregate indices of the sectors related to commodities and the market overall are also considered. The empirical analysis is conducted for the Canadian stock market due to the importance that mining and energy stocks have in its composition. The results suggest that there is little evidence that the market phases identified for the individual stocks are related to those for the commodity prices.

Keywords: Commodity Prices; Stock Prices; Bull and Bear Markets; Duration Analysis

JEL Classification Numbers: C22, E32, G11

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1 Introduction

Over the past years the connection between commodity prices, such as gold and oil, and the stock market has received substantial attention for many reasons. First, investors are interested in whether stock returns of companies whose primary business is in commodities actually reflect changes in the prices of the underlying commodities. For example, investors in gold mining stocks are concerned with the extent to which increases in gold price are mirrored in the returns of gold mining stocks. This connection was especially important in the past as investing in commodity stocks was considered to be an alternative to investing to commodities themselves [1]. A second reason for examining the relationship between commodity prices and the aggregate stock market this time is the increasing importance of stock market wealth in household wealth. Through this channel, commodity fluctuations can have an indirect effect in aggregate demand, and thus in the real economy.

Consequently, it is important to establish whether such a connection exists or not, and if it exists, how strong it is. The literature investigating these two questions has been focusing on gold and oil, and the results are mixed. For example, even though some researchers contend that gold mining stocks represent an investment in gold price thus such a relation does exist, others argue that since stocks also incorporate risks that are uncorrelated with the price of gold such a connection is actually not present. The same type of mixed results one will obtain if she examines the relation of gold price to the aggregate stock market. Finally, even though crude oil price changes are often considered to be an important factor for understanding fluctuations in stock prices, especially at an aggregate level, the direction of such a relationship is not clearly identified in the literature.

In this paper, we also examine the question of whether such a relationship exists, but from a different perspective. Instead of focusing on the direct relation between prices of commodities and companies stocks, we investigate the relation between their market phases, i.e., their observed bull and bear markets. In particular, we examine whether being in a bull or bear market in commodities can provide information about whether the stocks of firms whose primary business is in commodities or the aggregate stock market index are in a bull or bear market. In the finance literature, bull and bear markets in stock markets have been introduced as longer periods of price rise and price decline respectively (Chauvet and Potter, 2000).

Why, instead of focusing on the relationship between prices, we examine the relation between the market states? First, information on the state of any asset market is relevant for investors who may follow a market

[1] During the past decade due to the "financialization" of commodities, i.e. the creation and trading of financial instruments indexed to commodity prices, such as Exchange Traded Funds (ETFs), this aspect of demand for commodity stocks became less important. Irwin and Sanders (2011) provide a detailed discussion regarding the emergence of ETFs for commodities.

timing strategy: obtain a long position in the asset under a bull market, and a neutral or short position under a bear market. Investors that do not engage in market timing strategies may incorporate the different behavior of asset returns (see Perez-Quiros and Timmermann, 2000, for the stock markets) in their risk management. Finally, bull and bear markets can affect asset pricing, as they are an important source of time variation in risk premia (see, for example, Veronesi, 1999; Gordon and St-Amour, 2000; Ang et al., 2006).

Second, if we examine the relationship between the markets of commodities and commodity stocks, instead of the prices, we can filter out short-term fluctuations that can be an important factor in stock price dynamics. Companies' idiosyncratic risks influence the stock price in ways that may not be related to the behaviour of the underlying commodity. For example, risk exposure of activities overseas may have a dramatic effect in a companys valuation despite an increase in the price of the commodity[2]. Focusing on the overall trends, as described by the bull and bear markets, removes the impact of this type of distortions.

Our analysis is restricted in three commodities: oil (West Texas Intermediate) and gold, which are also the main focus of the existing literature, and an aggregate index representing metals and minerals, which to our knowledge has not received any attention in the past. Furthermore, instead of examining the relationship to the US stock market, we focus to the Canadian stock market, by considering the relevant Toronto Stock Exchange indices (composite and sector indices), and stocks of commodity companies listed in it. Our motivation is, primarily, the importance that commodity-related companies have in the Canadian stock market; the material and energy sectors account jointly for 50% of the market capitalization of the TSX composite index, and 58% of world's public mining companies are listed on the Toronto Stock Exchange. Additionally, we are also able to examine how the difference in currencies, United States dollars for the commodities and Canadian dollars for the equities, may affect the relationship between the markets.

For each series, the associated bull and bear markets are identified using the Lunde and Timmermann (2004) algorithm. This is a data-based identification algorithm that defines bull/bear markets as periods where prices do not deviate much from the local peak/trough of the current market, hence it does not impose any model structure on the data. The analysis is conducted in two directions. First, the identified bull and bear markets are examined independently for each series. In particular, we examine the durations of the bull and bear market phases, and the distributional characteristics of the series' returns under each phase. Second, the explanatory power that commodity markets convey in identifying bull and bear markets for the stock market indices and the individual stocks that are related to them is examined.

We find that there are substantial differences with respect to the market duration characteristics with

[2] "Kinross, gold producers vow to fight back as shares tumble despite rising prices", Globe and Mail, May 2012; "Eldorado Golds big Greek mining problem", Globe and Mail, April 2013.

commodity markets having longer durations compared to stock prices. Our results also suggest that commodity price markets allow us to partly forecast only the markets for their respective stock market sector indices, and not for the individual stocks.

The paper is organized as follows. Section 2 briefly reviews some of the existing literature on the subject. Section 3 discusses the methodology for identifying the bull/bear markets. Presentation of the data and discussion of results are provided in Section 4, and Section 5 concludes the paper.

2 Literature Review

The literature on whether a relationship exists between commodity prices and commodity-related stocks is extensive and dates back to the beginning of the 1980s. If we first examine the literature related to gold, the results are mixed. Khoury (1984) argues that unstable dividends, political risks, currency exchange risks, and business risks disassociate the price of gold from the returns of the firm's securities. Rock (1988) suggests that investing in mining stocks is the worst way to expose in gold due to the non-gold price related risk associated with these companies. Blose and Shieh (1995) explicitly describe the influence of gold price on the returns of gold mining stocks. Their model demonstrates that the sensitivity of the value of the mine with respect to the price of gold depends on the size of gold reserves, the production costs of the mine, the value of firm's assets unrelated to mining, and the level of gold prices. Using monthly returns, they find that for companies whose primary business is gold mining, the gold price elasticity of the company's stock is greater than unity.

Instead of focusing on individual stocks, another stream of literature examines the relationship between the gold price and the aggregate stock market. The results are again mixed. Aggarwal and Soenen (1988), and Jaffe (1989) find that the correlation between gold and the stock market is positive but small. On the other hand, Tschoegl (1980), Carter et al. (1982), Blose and Shieh (1995), Larsen and McQueen (1995), Lawrence (2003), and McCown and Zimmerman (2006) find that gold is uncorrelated with the stock market. Finally, Blose (1996) finds that gold is negatively correlated with the stock market, and Baur and Lucey (2010) show that gold serves as a good safe haven for stocks in falling stock markets, as gold can be considered an asset that is uncorrelated with a portfolio of stocks in times of market stress.

Turning our attention to crude oil price changes, even though they are considered an important factor for understanding fluctuations in stock prices, the direction of such a relationship is not clear. For example, Kling (1985) finds that crude oil price increases are associated with stock market declines, but Chen et al.

(1986) suggest that oil price changes actually have no effect. Similarly, even though Jones and Kaul (1996) find a stable negative relationship between oil price changes and aggregate stock returns, Huang et al. (1996) discover no negative relationship between stock returns and changes in the price of oil futures. Sadorsky (2001) finds a positive relationship between oil price and Canadian oil and gas stock prices. More recently, Kilian and Park (2009) investigate the effects of oil price shocks in the US stock market. They find that the effect depends on whether the change in the price of oil is driven by demand or supply shocks in the oil market. Finally, Gorton and Rouwenhorst (2006) find evidence that the equities of commodity-based companies cannot serve as substitutes for commodity futures, whereas they have a much higher correlation with the stock market than with commodity futures.

Finally, there several existing studies that investigate bull and bear markets in commodity prices. He and Westerhoff (2005) develop a behavioral commodity market model with consumers, producers, and heterogeneous speculators. They find that by introducing price boundaries they can categorize commodity prices in either a bull or bear market. Later, Westerhoff and Reitz (2005) provide empirical evidence from the US corn market, that an increasing number of technical traders do stimulate the occurrence of bull and bear markets. Cashin et al. (1999) examine the durations and magnitudes of real price cycles for 36 commodities using a cycle-dating algorithm to find local peaks and troughs in their data in order to identify booms and slumps. Deaton and Laroque (1992) suggest that real commodity prices are often dominated by long periods of doldrums punctuated by sharp upward spikes. Lee et al. (2006) find that natural resources prices are stationary around deterministic trends with structural breaks in the intercepts and trend slopes, a result that is compatible with the notion of bull and bear markets. Finally, Blose and Gondhalekar (2013) examine the difference in the weekend returns that gold has during bull and bear market phases.

3 Methodology

Data-based identification is mainly concerned with converting the abstract notion of rising/declining stock prices, when defining bull and bear markets, into more quantitative criteria that enable the construction of actual identification algorithms. One early criterion was introduced by Fabozzi and Francis (1977) who suggest a definition of bull/bear markets in terms of critical bounds for the stock returns. Similarly, Kim and Zumwalt (1979) define bull/bear markets in terms of the returns: bull markets are defined as periods where returns exceed the average return or the risk free return,or zero, the remaining periods being identified as bear markets. It can be noticed that both approaches rely on returns sharing some common underlying

characteristics throughout the entire sample (such as common mean, common standard deviation, or the like), and detect bull/bear markets as extremes within this set of returns. This is also a definition of bull/bear markets implied in Regime Switching model estimation (Schaller and van Norden, 1997).

An alternative definition, which is less restrictive, is based the local traits of asset prices. Bull/bear markets are defined as periods when prices are not too far away from the local peak/trough of the current market. Therefore, bull/bear markets are detected relative to the characteristics of the current market, not the entire sample. This approach has been used by Pagan and Sossounov (2003) and Lunde and Timmermann (2004). Kole and van Dijk (2012) provide an extensive comparison between the different approaches in identifying bull and bear markets, and they discuss the relevant merits of different approaches. They suggest that data-based rules are preferable when the interest is in the obtaining the market tendency, and when an ex post series of bull and bear markets is required.

In this paper, we employ the Lunde and Timmermann (2004) algorithm due to its advantages. First, compared to Pagan and Sossounov (2003) who constrain an identified market to last at least four months, and two adjacent markets to last at least 16 months combined, they do not impose any such restrictions. Furthermore, this algorithm does not use criteria for defining bull markets whenever returns exceed some critical value, unlike other comparable algorithms (Fabozzi and Francis, 1977; Kim and Zumwalt, 1979).

3.1 The Lunde-Timmerman Algorithm

The Lunde-Timmerman data-based algorithm (Lunde and Timmermann, 2004), henceforth referred to as the LT-algorithm, provides a rule that one can iterate in order to determine whether an observation belongs to a bull/bear market.

The algorithm can be described as follows:

Let p_{min} be the smallest of the prices so far observed in a current bear market and p_{max} be the largest of the prices so far observed in a current bull market. Denote by λ_1 and λ_2 the critical percentages (filters) of the bear and bull markets respectively.

For each of the two states the preceding price can belong to, one of three things will happen:

- **Bull state:**
  - $p_{max} < p$: The bull market continues, and p becomes the new p_{max}
  - $p_{max}\,(1-\lambda_2) < p \leq p_{max}$: The bull market continues, and there is no change in the value of p_{max}

- $p \leq p_{max}\,(1-\lambda_2)$: The bull market terminates and is replaced by a bear market with p as its first observation. Furthermore, p is the p_{min} of this bear market.

- **Bear state:**

  - $p < p_{min}$: The bear market continues, and p is the new p_{min}
  - $p_{min} \leq p < p_{min}\,(1+\lambda_1)$: The bear market continues, and there is no change in the value of p_{min}
  - $p_{min}\,(1+\lambda_1) \leq p$: The bear market terminates and is replaced by a bull market with p as its first observation. Furthermore, p is the p_{max} of this bull market.

Putting it in words, the algorithm considers a change from a bull (bear) to a bear (bull) market if the price drops (increases) by more than a pre-specified percentage.

There are two main implementation issues for the LT-algorithm: i) the choice of filters, and ii) short-term fluctuations and filtering. If there is a drift in the stock price series from which one derives the bull/bear markets, one has to adjust the filter (λ_1, λ_2) so as to account for this (Lunde and Timmermann, 2004). In particular, if the series exhibits an upward trend, an asymmetric filter with $\lambda_1 > \lambda_2$ is required so that in order to go from a bear market to a bull market, the stock price would have to increase more than it would have to decrease to go the other way. How to deal with short-term fluctuations is at the researcher's discretion. Pagan and Sossounov (2003) set a lower limit for the allowed duration of a single market, as well as for the combined duration of two adjacent markets. This reflects the point of view that some movements in stock prices are too brief to be actual markets. Nevertheless, how to distinguish between short-term fluctuations and actual markets is on many occasions a subjective matter.

4 Empirical Analysis

4.1 Data

This paper uses monthly data for the period 1982:1 to 2011:06, whenever this is possible, i.e. there are stocks whose prices enter the sample later. Commodity prices are obtained from the Primary Commodity Prices dataset compiled by the International Monetary Fund (Metal Index and Oil (Western Texas Intermediate) prices) and by KITCO (Gold Spot Price), whereas values for stock market indices and individuals stocks are obtained from COMPUSTAT (see Appendix) [3]. Since this paper focuses on the Canadian stock market,

[3] Western Canadian Select oil, being produced by Canadian oil companies, is traded at a discount compared to Western Texas Intermediate, due to its lower quality. Nevertheless, both prices still highly correlated, so we can still employ WTI for extracting bull and bear markets for Oil.

all data series are converted, if required, to Canadian dollars, and their value in real terms is calculated by employing the Consumer Price Index series for Canada.

During our sample period, definitions of the stock market indices for the energy, gold, and metals and mining sectors have been altered (see Table B1), and for a few months both the new and the old series coexisted. Consequently, the final series used for identifying bull and bear markets for each sector is a mix of the two available series as we switched to the new definition as soon as it became available [4]. This switch does not cause any problems in our identification of the bull and bear markets, despite the two definitions of the sector exhibiting different values. The LT-algorithm examines the existence of upward or downward trends; during the overlap period both the old and the new sector index series have the same trends, and they exhibit similar monthly returns. A final note regarding the selection of individual stocks in each sector: instead of considering a large number of firms, the sample was restricted to firms whose market capitalization on June 2011 was in the top decile.

Figures 1 to 3 depict the time evolution of the commodity prices expressed in real Canadian dollars versus the S&P/TSX Composite Index, also expressed in real values. From a first glance, it appears that a comovement between the commodity price and the stock index exists only for the oil price (WTI): the correlation between the index and the oil price is approximately equal to 0.80, whereas the correlation between their real returns is approximately equal to 0.35. The descriptive statistics for the monthly real returns of all series are provided in Table B2. The following remarks can be made: a) commodity (oil price, gold price, and metal index) returns are considerably more volatile that the stocks and stock market indices (coefficients of variations are at least twice as high), b) mean returns are higher for individual stocks, and c) all return series exhibit excess kurtosis, i.e. there is higher probability for extreme values (e.g. the maximum monthly return observed for the Canadian Natural Resources company is 167%).

4.2 Results

When the LT-algorithm is presented, we discuss the issues regarding the choice of the threshold parameters (λ_1, λ_2). There are two major concerns: a) the magnitude of the parameters, which determines how frequently switches between markets occur, and b) whether we should consider an asymmetric filter to account for an upward trend.

In this paper, we use the same asymmetric filter for all series under investigation: $\lambda_1 = 0.25, \lambda_2 = 0.20$. Even though these values may be deemed relatively large compared to the ones observed in the literature

[4]For example, for the energy sector, the S&P/TSX Oil and Gas Index, available from January 1982 until June 2002, was replaced by the S&P/TSX Energy Index. The latter first became available in November 2000.

for stock market indices, they can be justified by the minimum and maximum values that we observe for the monthly real returns for the individual stocks (a range from -70% to 170%). Furthermore, the asymmetric filter accounts for the upward trend that exists in stock prices. The application of the LT-algorithm in each series generates a sequence of ones (dates for which the prices are identified as belonging to a bull market), and zeros (dates for which the prices are identified as belonging to a bear market). These resulting series will be subsequently used to determine whether a relation exists between the markets identified for the commodities and those for the stocks.

The presentation and discussion of results will be divided in two parts. The first part will discuss the bull and bear market properties (durations and returns' distributional characteristics) separately for each series. The second part will examine the relation of the bull/bear markets identified in commodities with the bull/bear markets identified in stock market indices and individual stocks.

4.2.1 Bull and Bear Market Properties

The distributional characteristics of the real returns under the bull and the bear markets are provided in Tables B3 and B4, respectively. We can notice that the returns during the bull market phase have a positive mean compared to a negative mean during the bear market phase. On the other hand, the returns' variance is higher under a bull market for the majority of the series, with the most notable exceptions being the composite index, and the Alamos Gold stock [5]. Considering the distributions' higher moments, skewness is found to be positive for the bull market returns and negative for the bear market returns for most series, and excess kurtosis is present under both markets, with particularly high values in the case of bull markets.

The bull and bear markets identified for the commodity series and their respective stock market sector indices are depicted in Figures 4-6. It can be noticed that the bull/bear markets are more persistent for the Gold and Metal Index compared to their respective sector indices. For example, looking at Figure 5 we can see that gold price is in a bull market phase almost continuously after 2002, whereas during the same period the S&P/TSX Gold Index exhibited frequent transitions between bull and bear markets. In Figures 7-9 the bull markets for each individual stock along with the bull markets for the relevant commodity are presented. What is evident is that bull and bear markets are considerably more volatile for the individual stocks compared to the underlying commodities.

We can now discuss the duration properties of the identified bull and bear markets in more detail.

[5]The result for the stock market composite index is consistent with the finance literature: bull market is identified as the market whose returns have a positive mean and a low variance. Regardless, it appears that for the commodities, and the commodity-related sector indices and stocks, this is not the case.

Market:	Bull		Bear	
Series	Number	Mean	Number	Mean
Metal Index (CA$)	6	25.8	5	39.8
WTI (CA$)	11	16.7	10	17.0
Gold (CA$)	4	48.5	3	53.3
S&P/TSX Composite	6	37.5	5	25.8
S&P/TSX Energy	8	28.8	7	17.7
S&P/TSX Gold	18	10.4	17	9.8
S&P/TSX Metals and Mining	12	18.6	11	11.9
Energy Stocks				
Imperial Oil Ltd	8	29.8	7	16.6
Suncor Energy	5	37.0	4	8.8
Canadian Natural Resources	17	14.7	16	6.5
Nexen Inc	14	18.6	13	7.2
Talisman Energy	12	18.2	11	12.4
Gold Stocks				
Agnico-Eagle Mines	25	7.6	25	6.5
Kinross Gold Corp.	24	6.8	24	7.2
Eldorado Gold	18	7.6	18	4.8
Alamos Gold	5	14.6	5	5.6
Metal and Mining Stocks				
Imperial Metals Corp.	27	5.7	27	6.0
Lundin Mining Corp.	19	5.6	19	4.9
Inmet Mining Corp.	12	12.6	11	12.5
Teck Resources	15	15.9	15	7.7

Table 1: Characteristics of Market Durations

The average duration for a bear market phase in commodity prices is longer than the average duration of a bull market phase. In particular, the gold price and the Metal Index exhibit only few switches from one market status to the other, whereas switches for oil price are more frequent. Turning our attention to the stock market series, either indices or individual stocks, the average duration of a bull phase is longer than the average duration of a bear phase, the only exceptions being the stocks of Kinross Gold and Imperial Metals. Regarding the average market phase durations, we find that they are significantly higher for the commodities and the stock market indices compared to the individual stocks. We are not surprised by the particular finding. Commodity prices have been observed to follow the so-called super cycles: decades of long price movements (20-70 years to complete the cycle), considered to be demand driven, following world GDP.

4.2.2 Correlations, Conditional Probabilities, and Probit Model Analysis

In order to formally examine whether a relation between the market status for the stock market series and the underlying commodities exist, we consider three different approaches. The first approach is to examine the sample correlations of the series obtained by applying the LT-algorithm. A higher correlation will be indicative of the existence of a relationship. The second involves the computation of the conditional probability of a stock marketrelated series being in bull (bear) market when the commodity is also in a bull (bear) market, either in the same month or in the past month. Conditional probability values that are close

to the unconditional probability values will suggest no information content. The third uses a Probit model; the dependent variable is the market status of the stock series (sector index or individual company), and the independent variable is the market status, contemporary or lagged, of the commodity series.

The markets of the S&P/TSX Composite Index are positively and statistically significantly correlated with the markets identified for the commodity series; the correlations are stronger for the gold price and Metal Index cases. Turning our attention to the sector indices, we observe positive, but smaller in magnitude correlations between their identified markets and the market for the commodity prices.

Focusing on individual stocks, bull and bear markets identified for the energy stock prices are positively correlated with the markets identified for the oil price, but values are small (statistically insignificant for the Imperial Oil and Suncor stocks). The only exception are the markets for the Canadian Natural Resources stock that are significantly positively correlated with the markets for the oil price (a value of 35%). The only gold stock whose identified markets present a positive, and significant, correlation with the gold price's markets is the Eldorado Gold stock. Finally, even though the correlations are positive for all metal and mining stocks, their values are either very small or statistically insignificant (Inmet Mining).

Similar results are observed when we consider the correlations between current market status for the stock market indices and the lagged market status for the commodities[6].

The second alternative measure for the relation between the identified markets are the conditional probabilities. Table B5 presents the probabilities for the sector stock market and the individual stocks, conditional on the commodity markets. If these probabilities differ from the unconditional probabilities of a bull or a bear market for the series under scrutiny, then we can infer that there is information content on the conditioning set. Overall, when the commodities are experiencing a bull market phase, either in the current or the previous period, the probability of the sector indices and the individual stocks experiencing a bull market phase increases relevant to the unconditional value by 10% on average. There are two exceptions: the Agnico Eagle Mines and Kinross Gold stocks. When we consider the instances when commodities experience a bear market phase, the results are similar. It is of interest that the higher changes in probability are observed for Canadian Natural Resources.

Table 2 below demonstrates the instances for which this update is higher than 10%, when the conditioning set is the commodity market status for the previous period:

[6]Tables presenting the correlations are omitted in order to conserve space. They are available upon request.

Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{OM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{OM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Energy	0.765	0.650	0.476	0.350
Canadian Natural Resources	0.831	0.706	0.429	0.294
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{GM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{GM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Gold	0.627	0.531	0.588	0.469
Eldorado Gold	0.693	0.614	0.548	0.386
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{MIM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{MIM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Metals & Mining	0.753	0.630	0.467	0.370
Imperial Metals Corp.	0.590	0.487	0.577	0.513
Notation:	$SM_t = 1(0)$: A bull(bear) market is identified for the series under scrutiny at time t			
	$OM_t = 1(0)$: A bull(bear) market is identified for the Oil (WTI) Price at time t			
	$GM_t = 1(0)$: A bull(bear) market is identified for the Gold Spot Price at time t			
	$MIM_t = 1(0)$: A bull(bear) market is identified for the Metal Index at time t			

Table 2: Probabilities of Bull/Bear Markets Conditional on Identified Market for Commodity Price

The probability update is high for all sector stock market indices, and only for few of the individual stock series.

When the conditioning set becomes the state of the market for the sector stock market index, we also observe an update in the conditional probabilities. There is a higher probability of the stock being in a bull market when the sector itself is in a bull market either in the current or the previous time period, but the magnitude of the updates now depends on the sector: higher for the gold and mining stocks, but lower for the energy stocks. Even though the same pattern emerges when the sector index is in a bear market, the magnitude of the updates is larger.

The third, and final, method is the fit that a Probit model provides as measured by the McFadden R-squared, and the statistical significance of the commodity markets in the specification. The results from the Probit models' estimation are reported in Tables B6-B9. Table B6 examines the case for the S&P/TSX Composite Index.

Table 3 highlights the results for 4 of the model specifications. Specifications 7 and 8 suggest that when the identified markets for all commodities are used as explanatory variables, the McFadden R-squared is approximately equal to 20%. If the markets for the different commodities are used separately (specifications 1 to 6 in Table B6), we notice that the gold market has the highest explanatory power among all commodities (R-squared of 13%). We also examine the case when the lagged market status for the composite index is included (specifications 9 and 10). The McFadden R-squared jumps to approximately 82%, something expected due to the high persistence of the identified markets. On the other hand, only gold and oil market status are found to be statistically significant.

S&P/TSX Composite				
	[7]	[8]	[9]	[10]
constant	-0.480	-0.438	-1.988	-1.951
	(-3.970)	(-3.670)	(-9.528)	(-8.311)
Metal Index	0.738		-0.174	
	(4.483)		(-0.503)	
Metal Index, lagged		0.644		-0.087
		(3.923)		(-0.279)
Gold Price	0.737		0.613	
	(4.516)		(2.004)	
Gold Price, lagged		0.831		0.756
		(5.065)		(2.611)
Oil (WTI) Price	0.382		-0.033	
	(2.422)		(-0.109)	
Oil (WTI) Price, lagged		0.256		-0.566
		(1.620)		(-1.915)
S&P/TSX Composite, lagged			3.750	3.929
			(11.660)	(10.830)
Log-Likelihood	-187.123	-189.702	-42.997	-41.529
McFadden R-squared	19.4%	18.1%	81.4%	82.1%
No Cases "correctly" Predicted	74%	74%	97%	97%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table 3: Probit Model Results for Composite Index, Selected specifications

The case for the S&P/TSX Energy sector index is presented in Table B7. When the identified market for either the oil price or the composite index is considered as the independent variable, the obtained R-squared values are very low (5+%). On the other hand, when the lagged value of the market for the sector index is included, R-squared increases to approximately 75% (specifications 9 and 10) but the market status for oil is found to be insignificant. Similar are the results that we obtain for the S&P/TSX Gold sector index and the S&P/TSX Metals and Mining sector index (Tables B8 and B9): the explanatory power of the commodity market variables is very small, when they are included separately. When the lagged value for the sector market is included, a high value for the R-squared is obtained, but the variables are statistically insignificant.

Table 4 summarizes the most relevant specifications (9 and 10) from Tables B7-B9.

S&P/TSX Capped Index	Energy		Gold		Metals & Mining	
	[9]	[10]	[9]	[10]	[9]	[10]
constant	-1.753	-1.633	-1.390	-1.356	-1.409	-1.402
	(-8.844)	(-8.031)	(-8.589)	(-8.379)	(-8.479)	(-8.392)
Commodity Price (Oil/Gold/Metal Index)	0.376		0.262		0.106	
	(1.512)		(1.405)		(0.474)	
Commodity Price, lagged		0.130		0.195		0.078
		(0.521)		(1.040)		(0.353)
S&P/TSX Capped Index, lagged	3.419	3.429	2.565	2.571	3.002	3.010
	(13.780)	(13.680)	(13.800)	(13.810)	(13.780)	(13.860)
Log-Likelihood	-57.069	-58.091	-110.818	-111.261	-81.435	-81.487
McFadden R-squared	75.1%	74.6%	54.6%	54.4%	65.0%	65.0%
No Cases "correctly" Predicted	96%	96%	90%	90%	94%	94%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table 4: Probit Model Results for Sector Indices

When Probit models are estimated for each individual stock, using the respective commodity, composite, and sector index as explanatory variables, the following observations can be made: a) there is little explanatory power if the commodity market information is used (only exception: the Canadian Natural Resources stock with an R-squared of 10%), b) if the composite and the relevant stock market indices are included in the specification, the R-squared does not increase substantially ($< 12\%$), and c) only the inclusion of the lagged value for the individual stock price market provides high R-squared values [7].

4.2.3 Information content of stock markets for commodity market phases

Our previous analysis follows the existing literature with respect to the direction of the effect: how commodity prices affect stock market series (indices or individual stocks). Regardless, it would be of interest to explore the case of a reverse effect: if we know the status of the stock market (composite and sector indices) what can we infer about the status of the commodity markets? The direction of this effect can be rationalized by the importance of the stock market in consumers' wealth, and thus to their consumption decisions[8]. For example, adverse conditions in the stock market may lead to a decrease in aggregate demand, thus causing demand shocks in commodity prices. Finally, despite considering only Canadian stock market indices, we are still incorporating information from the global stock markets. Over the past three decades, global financial markets have been substantially integrated.

Similar to before, we examine of whether such an effect exists or not in three ways: correlations, conditional probabilities, and Probit models.

Checking the correlations, we observe positive and significant values between the lagged market status values for the S&P/TSX Composite Index and the markets of the individual commodities. Even though the same result is obtained for the case of the individual sector indices, the values observed are smaller. Turning our attention to the conditional probabilities, we examine two cases. First, we examine how the probabilities of observing bull or bear markets in commodity prices change when we condition on the composite index (Table B10). Second, we examine how this probability changes if for each commodity we condition on the status of the respective sector index (Table B11). We notice that there is a significant change in the probability of observing a particular market when S&P/TSX Composite Index is in the same market, with the result being stronger for the case of a bear market. That is, if the index was in a bear market the month

[7] The detailed results are not presented but are available upon request.

[8] Stock market wealth accounts for 24.4 % of the total household wealth in 2006, based on the Flow of Accounts of United States reported by the Federal Reserve System. Consumption accounts for 64.5% of the US Gross Domestic Product during the period 1947-2007 and for about 70 % for the period after 2001. The impact of stock market wealth in consumption is found to be 2-5 cents increase in consumption for every dollar increase in stock market wealth (Poterba, 2000; Dynan and Maki, 2001; Case, Quigley and Shiller, 2005 and 2013).

before, there is a higher probability this month for the commodity to be in a bear market as well. When considering the individual sectors, the results are similar, but the updates in the probabilities are smaller in magnitude.

In the end, we present the results from the Probit model estimation. Given the persistence of the markets, we focus on specifications that included the lagged dependent variable as explanatory variable (specifications 4, 5, and 8-11 in Tables B12-14). When examining the oil market status we find the S&P/TSX Composite Index to be significant in both current and lagged values, but this is not the case for the sector index. McFadden R-squared is approximately 70% in all specifications. If we turn our attention to the gold market status, no information is provided by any of the stock indices (statistically insignificant) with R-squared being around 88%. Finally, for the market status of the Metal Index: when considered separately, the composite index market status and the sector index market status are significant (at 1% level) when the commodity index market lagged values are also included. Nevertheless, if both are considered simultaneously, only the market status S&P/TSX Composite Index remains significant.

4.2.4 Discussion

There are two main findings. The first is that more switches between bull/bear market phases occurred for individual stocks compared to the underlying commodities. Moreover, bull market phases for stock prices last longer, on average. The second finding is that there is little evidence that the bull/bear markets of stock market series, especially for the case of individual stocks, are related to the bull/bear markets of the commodity prices. The effect appears to be primarily on the composite index, and only from the gold and oil commodities. If we consider the other direction, information about the market status for the composite index provides some explanatory power for the market status for the oil and Metal Index commodity series, especially in the case of a bear market. This result does not extend to the sector stock market indices.

At first glance, such a result may appear puzzling, but it can be attributed to various factors. First, differences in the parameters λ_1, λ_2 may have created this discrepancy between the identified markets for the commodities and stocks. The markets for commodities have substantially longer durations than those of stocks: during a given market phase for commodities, more market phases have been experienced by the stocks. This gives the impression that there is no link between commodity and stock markets. If one were to use different values for the filters across the series under investigation, results may be altered.

Since there is no "correct" choice regarding the values that the filters must take, we repeat our analysis for different parameter values across the series under investigation. We select (λ_1, λ_2) to take the values

of (0.25,0.20) for the individual stocks, (0.20,0.15) for the stock market indices, and (0.15,0.10) for the individual commodities. By considering lower threshold parameters for the commodity series, we allow for shorter bull and bear market durations, thus increasing the variability in the identified series. We focus in estimating the conditional probabilities, and the most relevant specifications of the Probit model.

The results for conditional probabilities (Table B15) are not substantially different; some value updates are now larger in size (bull markets for gold stocks), whereas other updates are now lower (bull markets for energy stocks). The results of the Probit model regarding the relationships between the markets are qualitatively similar; metal index markets becomes insignificant (specifications 7 and 8 in Table 5), but gold price and oil price markets retain their explanatory power. When the lagged market status for the composite index is included (specifications 9 and 10), only Gold price market is found to be statistically significant.

S&P/TSX Composite				
	[7]	[8]	[9]	[10]
constant	0.487	0.462	1.888	1.842
	(4.135)	(3.934)	(7.248)	(7.285)
Metal Index	0.255		0.0581	
	(1.594)		(0.226)	
Metal Index, lagged		0.171		0.243
		(1.061)		(0.857)
Gold Price	1.038		0.853	
	(6.759)		(3.283)	
Gold Price, lagged		1.150		0.944
		(7.390)		(3.525)
Oil (WTI) Price	0.807		0.010	
	(5.141)		(0.4036)	
Oil (WTI) Price, lagged		0.691		0.141
		(4.387)		(0.555)
S&P/TSX Composite, lagged			3.471	3.505
			(12.200)	(11.660)
Log-Likelihood	185.017	183.936	52.94801	51.936
McFadden R-squared	19.5%	19.8%	76.9%	77.4%
No Cases "correctly" Predicted	73%	74%	96%	96%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table 5: Probit Model Results for Composite Index (II)

Turning our attention to the Probit models for the sectors, we focus on the specification that include the lagged value of their market status (specifications 9 and 10 in Table 6). Even though the contemporaneous impact of oil and gold markets becomes significant at 10% level (specification 9), this effect disappears as well when the commodity markets are considered in the lagged value.

S&P/TSX Capped Index	Energy		Gold		Metals and Mining	
	[9]	[10]	[9]	[10]	[9]	[10]
constant	1.528	1.417	1.334	1.166	1.312	1.295
	(8.986)	(8.965)	(9.297)	(8.623)	(8.209)	(8.024)
Commodity (Oil/Gold/Metal Index) Price	0.361		0.328		0.163	
	(1.838)		(1.836)		(0.785)	
Commodity Price, lagged		0.028		0.141		0.207
		(0.136)		(0.750)		(1.006)
S&P/TSX Capped Index, lagged	2.853	2.888	2.272	2.409	2.919	2.924
	(14.150)	(14.070)	(12.700)	(12.810)	(14.110)	(14.170)
Log-Likelihood	91.243	92.756	127.068	128.451	92.210	92.015
McFadden R-squared	62.6%	62.0%	48.0%	47.4%	61.7%	61.8%
No Cases "correctly" Predicted	93%	93%	88%	88%	93%	93%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table 6: Probit Model Results for Energy Sector Index (II)

Finally, when Probit models are re-estimated for each stock, we find similar results: the inclusion of the lagged value for the market status provides high R-squared values, but commodity markets are insignificant. Thus, we can infer that the evidence or a lack of relationship between commodity bull/bear markets and stock market bull/bear markets is not sensitive to our choice of threshold parameters (λ_1, λ_2).

The second reason for the result can be the currency used; all prices are expressed in real Canadian dollars. Even though this is not an issue when comparing the stock price series (indices versus individual stocks) as they all trade on the Toronto Stock Exchange, the commodities are actually traded in United States dollars. Markets that could appear in the original values of commodity prices may have disappeared after converting them from US$ to real CA$. Capie et al. (2005) discuss gold working as a hedge against the dollar, and Shafiee and Topal (2010) point out that gold trading can be used to offset the potential movement of real value in the short-term market against US dollar oscillations and inflation. Since both concerns have been addressed in our data, the market impact they have in prices has been removed.

Finally, it can simply be the case that there is no relationship between the markets. WGC (2009) reports that the unique and diverse drivers of gold demand and supply do not correlate highly with changes in other financial assets. It is important to remember that commodity prices are determined by supply and demand in the global markets. This is also more evident if we consider the existence of super-cycles in commodities. Erten and Ocampo (2012) identify that there have been 3.5 non-fuel commodity super-cycles from 1894 to 2009. The early 1970s marks the beginning of the third cycle which turns downward during the mid 1970s and ends in the late 1990s, with a strong downward one phase, whereas the last cycle is ongoing from 2001, with a strong upward phase [9]. They argue that commodity prices and world GDP have a long-term relationship over time because the robust growth episodes in the world economy are accompanied by a rapid pace of

[9] Jacks (2013) also find there is a consistent pattern, in both past and present, of commodity price super-cycles which entail decades-long positive deviations from these long-run trends.

industrialization and urbanization, which in turn require an increasing supply of primary commodities as inputs of production. This hypothesis implies that the super-cycles in world output fluctuations generate corresponding super-cycles in real commodity prices.

On the other hand, Canadian companies stocks are mostly held by Canadian investors, and thus they are subject to fluctuations originating in Canada, which are of short- to medium-run character. This disparity in the underlying causes for price movements can be the main factor behind the lack of relation between the markets. Furthermore, previous studies show that gold price fluctuations have different effects on gold production, and the value of gold mining stock from country to country (Blose and Shieh, 1995; Blose, 1996; Selvanathan and Selvanathan, 1999). Another cause for the lack of relationship can be the effect of the companies' idiosyncratic risks; even if the price of a commodity is going up, the stock price of a relevant company may not be influenced if the company faces problems (for example, risk exposure of activities overseas). However, this effect should disappear if we aggregate individual stocks. This claim is supported by what we see in the paper: even though there is almost no relation for the individual stocks, there is some evidence of relation when the sector indices are considered.

5 Conclusion

We investigate the relation between different market phases, i.e. bull and bear markets, for commodities and commodity-related stocks and stock market indices. Specifically, we use the Lunde Timmermann (2004) algorithm to identify bull and bear markets in oil, gold, and metal, and relevant stock market indices and stocks traded on the Toronto Stock Exchange for the period 01:1982 to 06:2011. Using different criteria, we examine the explanatory power commodity markets conveyed in identifying bull and bear markets for the relevant stock market series.

There are two main findings. The first is that there are substantial differences with respect to the market duration characteristics. Commodity market phases tend to have longer durations compared to stock prices. Furthermore, commodity prices exhibit longer bear phases compared to bull phases, the opposite being true for individual stocks. The second finding is that there is little evidence that the markets identified for the individual stocks are related to those for the commodity prices. On the other hand, it appears that commodity price markets allow us to partly forecast the markets for their respective stock market sector indices. This effect can be attributed to the fact that even though commodity prices are determined in the global market, Canadian stocks are predominately influenced by local factors.

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A Data Series

- Commodities (sources: Primary Commodity Prices dataset/International Monetary Fund, KITCO)
  - Metal index
  - Crude Oil (petroleum), West Texas Intermediate 40 API, Midland Texas, US$ per barrel.
  - Gold, Spot price, US$ per ounce.
- Toronto Stock Exchange, Market Indices (source: COMPUSTAT)
  - S&P/TSX Composite Index established 01/1982
  - S&P /TSX Oil and Gas Index (available till 06/2002), and S&P/TSX Capped Energy Index (available after 11/2000)
  - S&P/TSX Gold/Precious Minerals Index (available till 06/2002), and S&P/TSX Capped Gold Index (available after 11/2000)
  - S&P/TSX Metals/Minerals Index (available till 06/2002), and S&P/TSX Capped Diversified Metals and Mining (available after 03/2002)
- Individual Stocks, listed in Toronto Stock Exchange (source: COMPUSTAT)
  - Imperial Oil Ltd, Energy Sector, SIC: 2911, in S&P/TSX Composite Index since 01/1982
  - Suncor Energy Inc, Energy Sector, SIC: 2911, in S&P/TSX Composite Index since 05/1993
  - Canadian Natural Resources, Energy Sector, SIC: 1311, in S&P/TSX Composite Index between 01/1982-03/1985, and after 11/1991
  - Nexen Inc, Energy Sector, SIC:1311, in S&P/TSX Composite Index since 01/1982
  - Talisman Energy Inc, Energy Sector, SIC: 1311, in S&P/TSX Composite Index since 01/1982
  - Agnico-Eagle Mines Ltd, Gold Sector, SIC: 1040, in S&P/TSX Composite Index since 01/1982
  - Kinross Gold Corp, Gold Sector, SIC: 1040, in S&P/TSX Composite Index since 02/1994
  - Eldorado Gold Corp, Gold Sector, SIC: 1040, in S&P/TSX Composite Index between 02/1997-01/1999, and after 03/2003
  - Alamos Gold Inc, Gold Sector, SIC: 1040, in S&P/TSX Composite Index since 03/2006
  - Imperial Metals Corp, Metals and Mining Sector, SIC: 1000,
  - Lundin Mining Corp, Metals and Mining Sector, SIC: 1000, in S&P/TSX Composite Index since 11/2006
  - Inmet Mining Corp, Metals and Mining Sector, SIC: 1000, in S&P/TSX Composite Index between 02/1988-03/2000, and after 12/2003
  - Teck Resources, Metals and Mining Sector, SIC: 1000, between 02/1997-01/1999, and after 01/1982

B Tables

B.1 Data

	Start Date	End Date	Tic Code
Stock Market Indices			
S&P/TSX Composite	Jan-82	Jun-11	CI0051
S&P/TSX Energy	Jan-82	Jun-11	
Oil and Gas	Jan-82	Nov-00	CI1311
Energy	Dec-00	Jun-11	ENE.C
S&P/TSX Gold	Jan-82	Jun-11	
Gold/Precious Minerals	Jan-82	Nov-00	CI1040
Gold	Dec-00	Jun-11	MET.C3
S&P/TSX Metals and Mining	Jan-82	Jun-11	
Metals & Minerals	Jan-82	Feb-02	CI1000
Diverse Metals & Mining	Mar-02	Jun-11	MET.C2
Energy Stocks			
Imperial Oil Ltd	Jan-82	Jun-11	IMO.
Suncor Energy	Mar-93	Jun-11	SU.
Canadian Natural Resources	Jan-82	Jun-11	CNQ.
Nexen Inc	Jan-82	Jun-11	NXY.
Talisman Energy	Jan-82	Jun-11	TLM.
Gold Stocks			
Agnico-Eagle Mines	Jan-82	Jun-11	AEM.
Kinross Gold Corp.	Jul-83	Jun-11	K.
Eldorado Gold	Dec-92	Jun-11	ELD.
Alamos Gold Inc.	Feb-03	Jun-11	AGI.
Metals and Mining Stocks			
Imperial Metals Corp.	Jan-85	Jun-11	III.
Lundin Mining Corp.	Nov-94	Jun-11	LUN
Inmet Mining Corp.	Jun-87	Jun-11	IMN.
Teck Resources	Jan-82	Jun-11	TCK.B

Table B1: Data Range

	Mean	Median	Min	Max	Std. Dev.	C.V.	Skewness	Ex. Kurtosis
Metal Index (CA$)	0.2%	-0.1%	-21.1%	14.0%	4.3%	20.33	-0.02	1.55
WTI (CA$)	0.3%	0.6%	-33.1%	46.1%	8.0%	25.72	0.37	4.31
Gold (CA$)	0.2%	0.0%	-18.7%	17.3%	4.6%	23.29	0.36	1.73
S&P/TSX Composite	0.4%	0.8%	-22.9%	13.9%	4.5%	10.28	-0.86	3.41
S&P/TSX Energy	0.6%	0.4%	-21.9%	22.5%	6.6%	11.62	-0.09	0.98
S&P/TSX Gold	0.8%	0.1%	-35.2%	55.0%	10.4%	13.08	0.50	2.65
S&P/TSX Metals and Mining	1.1%	0.7%	-33.9%	36.3%	8.5%	8.06	-0.01	2.42
Energy Stocks								
Imperial Oil Ltd	0.8%	0.8%	-22.6%	23.5%	6.7%	8.42	0.30	0.85
Suncor Energy	1.6%	1.7%	-33.5%	26.5%	8.2%	4.98	-0.30	1.82
Canadian Natural Resources	2.2%	1.2%	-49.6%	167.1%	16.7%	7.53	2.94	27.00
Nexen Inc	1.2%	0.6%	-29.8%	50.6%	9.5%	8.11	0.49	2.41
Talisman Energy	1.0%	1.2%	-39.7%	41.9%	9.5%	9.76	-0.04	3.48
Gold Stocks								
Agnico-Eagle Mines	1.4%	0.9%	-42.1%	50.9%	13.8%	10.17	0.23	0.76
Kinross Gold Corp.	1.3%	-0.5%	-38.5%	71.1%	16.1%	12.61	0.89	2.20
Eldorado Gold	2.9%	0.2%	-68.9%	119.7%	20.3%	7.10	1.42	7.11
Alamos Gold	3.6%	3.1%	-31.2%	55.0%	15.3%	4.21	0.60	1.06
Metal and Mining Stocks								
Imperial Metals Corp.	2.3%	-2.0%	-66.5%	191.8%	23.6%	10.31	2.63	16.10
Lundin Mining Corp.	3.7%	-0.2%	-42.4%	195.9%	28.1%	7.52	3.01	15.85
Inmet Mining Corp.	1.1%	0.1%	-44.8%	53.6%	11.9%	10.70	0.55	2.50
Teck Resources	1.4%	1.0%	-59.9%	77.9%	12.9%	8.96	0.81	6.71

Table B2: Real Returns' distributional characteristics

B.2 Results

	Mean	Median	Min	Max	Std. Dev.	C.V.	Skewness	Ex. Kurtosis
Metal Index (CA$)	1.0%	0.5%	-8.5%	14.0%	4.5%	4.73	0.38	-0.09
WTI (CA$)	2.0%	1.7%	-18.6%	46.1%	7.8%	3.90	1.21	5.68
Gold (CA$)	0.5%	0.4%	-18.7%	17.3%	5.0%	9.40	0.08	1.13
S&P/TSX Composite	1.0%	1.0%	-8.1%	11.7%	3.8%	3.85	0.09	-0.04
S&P/TSX Energy	0.8%	0.9%	-98.6%	17.4%	8.9%	11.66	-5.96	64.60
S&P/TSX Gold	2.3%	1.3%	-97.4%	55.0%	13.1%	5.63	-1.70	18.04
S&P/TSX Metals and Mining	1.9%	1.2%	-96.9%	36.3%	10.4%	5.56	-3.42	35.31
Energy Stocks								
Imperial Oil Ltd	1.5%	1.2%	-12.3%	23.5%	6.7%	4.49	0.56	0.48
Suncor Energy	2.1%	1.7%	-15.6%	26.5%	7.5%	3.55	0.40	0.31
Canadian Natural Resources	5.9%	3.3%	-18.0%	167.1%	16.1%	2.72	4.68	40.40
Nexen Inc	2.2%	1.7%	-16.9%	50.6%	9.0%	4.07	1.11	3.36
Talisman Energy	2.7%	2.1%	-17.0%	41.9%	8.8%	3.22	1.08	3.15
Gold Stocks								
Agnico-Eagle Mines	5.6%	4.2%	-19.7%	50.9%	13.7%	2.44	0.62	0.16
Kinross Gold Corp.	7.6%	4.5%	-19.8%	71.1%	17.1%	2.26	1.09	1.57
Eldorado Gold	9.1%	5.6%	-18.6%	119.7%	20.6%	2.25	2.13	7.59
Alamos Gold	6.5%	3.3%	-15.7%	55.0%	14.2%	2.19	1.19	1.47
Metal and Mining Stocks								
Imperial Metals Corp.	12.7%	7.1%	-18.9%	191.8%	27.0%	2.12	2.90	13.80
Lundin Mining Corp.	14.5%	5.6%	-18.7%	195.9%	31.6%	2.17	3.23	13.57
Inmet Mining Corp.	4.6%	2.7%	-15.3%	53.6%	12.4%	2.68	1.11	1.44
Teck Resources	3.9%	2.0%	-19.3%	77.9%	12.5%	3.16	1.99	7.08

Table B3: Bull Market. Real returns' distributional characteristics

	Mean	Median	Min	Max	Std. Dev.	C.V.	Skewness	Ex. Kurtosis
Metal Index (CA$)	-0.4%	-0.4%	-21.1%	10.8%	4.1%	-11.28	-0.55	2.90
WTI (CA$)	-1.5%	-1.0%	-33.1%	24.2%	7.8%	-5.19	-0.46	2.25
Gold (CA$)	-0.2%	-0.3%	-11.2%	16.7%	3.9%	-18.34	0.84	3.01
S&P/TSX Composite	-0.5%	-0.2%	-22.9%	13.9%	5.4%	-10.23	-1.19	3.31
S&P/TSX Energy	-0.7%	-0.9%	-21.9%	22.5%	7.3%	-10.43	0.01	1.72
S&P/TSX Gold	-1.6%	-0.6%	-35.2%	19.0%	9.4%	-6.03	-0.64	0.76
S&P/TSX Metals and Mining	-1.0%	-0.5%	-33.9%	18.5%	8.9%	-8.67	-0.88	2.27
Energy Stocks								
Imperial Oil Ltd	-0.6%	0.0%	-22.6%	17.6%	6.6%	-10.81	-0.24	1.07
Suncor Energy	-0.9%	1.1%	-33.5%	14.5%	10.7%	-12.17	-1.24	1.48
Canadian Natural Resources	-6.6%	-6.2%	-49.6%	25.0%	14.8%	-2.24	-0.14	-0.15
Nexen Inc	-1.7%	-1.2%	-29.8%	22.8%	10.5%	-6.14	-0.31	-0.12
Talisman Energy	-1.8%	-0.5%	-39.7%	19.2%	9.9%	-5.43	-1.10	2.32
Gold Stocks								
Agnico-Eagle Mines	-3.6%	-2.8%	-42.1%	22.2%	12.3%	-3.45	-0.55	0.13
Kinross Gold Corp.	-4.6%	-3.9%	-38.5%	20.7%	12.4%	-2.68	-0.25	-0.30
Eldorado Gold	-7.0%	-6.3%	-68.9%	21.9%	15.5%	-2.21	-0.87	2.41
Alamos Gold	-3.8%	-5.4%	-31.2%	23.2%	15.6%	-4.13	-0.01	-1.03
Metal and Mining Stocks								
Imperial Metals Corp.	-7.6%	-6.0%	-66.5%	25.0%	14.0%	-1.85	-0.84	2.22
Lundin Mining Corp.	-8.6%	-8.2%	-42.4%	22.0%	16.2%	-1.89	-0.03	-0.99
Inmet Mining Corp.	-2.7%	-1.7%	-44.8%	18.6%	10.1%	-3.73	-0.91	1.85
Teck Resources	-3.7%	-2.8%	-59.9%	19.8%	12.4%	-3.37	-1.33	3.97

Table B4: Bear Market. Real returns' distributional characteristics

Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{OM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{OM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Energy	0.772	0.650	0.482	0.350
Imperial Oil	0.712	0.672	0.371	0.328
Suncor Energy	0.867	0.841	0.200	0.159
Canadian Natural Resources	0.859	0.706	0.459	0.294
Nexen Inc.	0.810	0.737	0.341	0.263
Talisman Energy	0.712	0.616	0.488	0.384
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{OM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{OM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Energy	0.765	0.650	0.476	0.350
Imperial Oil	0.710	0.672	0.371	0.328
Suncor Energy	0.851	0.841	0.174	0.159
Canadian Natural Resources	0.831	0.706	0.429	0.294
Nexen Inc.	0.798	0.737	0.329	0.263
Talisman Energy	0.699	0.616	0.476	0.384
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{GM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{GM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Gold	0.634	0.531	0.594	0.469
Agnico-Eagle Mines	0.541	0.540	0.463	0.460
Kinross Gold Corp.	0.517	0.485	0.550	0.515
Eldorado Gold	0.702	0.614	0.569	0.386
Alamos Gold Inc	0.723	0.723	NaN	0.277
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{GM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{GM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Gold	0.627	0.531	0.588	0.469
Agnico-Eagle Mines	0.528	0.540	0.450	0.460
Kinross Gold Corp.	0.511	0.485	0.544	0.515
Eldorado Gold	0.693	0.614	0.548	0.386
Alamos Gold Inc	0.723	0.723	NaN	0.277
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{MIM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{MIM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Metals and Mining	0.768	0.630	0.477	0.370
Imperial Metals Corp.	0.602	0.487	0.585	0.513
Lundin Mining Corp.	0.613	0.535	0.553	0.465
Inmet Mining Corp.	0.577	0.522	0.518	0.478
Teck Resources	0.735	0.672	0.377	0.328
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{MIM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{MIM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Metals and Mining	0.753	0.630	0.467	0.370
Imperial Metals Corp.	0.590	0.487	0.577	0.513
Lundin Mining Corp.	0.594	0.535	0.532	0.465
Inmet Mining Corp.	0.557	0.522	0.503	0.478
Teck Resources	0.721	0.672	0.367	0.328
Notation:	$SM_t = 1(0)$: A bull(bear) market is identified for the series under scrutiny at time t $OM_t = 1(0)$: A bull(bear) market is identified for the Oil (WTI) Price at time t $GM_t = 1(0)$: A bull(bear) market is identified for the Gold Spot Price at time t $MIM_t = 1(0)$: A bull(bear) market is identified for the Metal Index at time t			

Table B5: Probabilities of Bull/Bear Markets Conditional on Identified Market for Commodity Price

S&P/TSX Composite										
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
constant	-0.069	-0.044	-0.205	-0.221	-0.015	0.029	-0.480	-0.438	-1.988	-1.951
	(-0.780)	(-0.496)	(-2.054)	(-2.212)	(-0.153)	-0.307	(-3.970)	(-3.670)	(-9.528)	(-8.311)
Metal Index	1.085						0.738		-0.174	
	(7.188)						(4.483)		(-0.503)	
Metal Index, lagged		1.003						0.644		-0.087
		(6.723)						(3.923)		(-0.279)
Gold Price			1.099				0.737		0.613	
			(7.612)				(4.516)		(2.004)	
Gold Price, lagged				1.131				0.831		0.756
				(7.796)				(5.065)		(2.611)
Oil (WTI) Price					0.741		0.382		-0.033	
					(5.295)		(2.422)		(-0.109)	
Oil (WTI) Price, lagged						0.641		0.256		-0.566
						(4.604)		(1.620)		(-1.915)
S&P/TSX Composite, lagged									3.750	3.929
									(11.660)	(10.830)
Log-Likelihood	-204.439	-207.734	-201.849	-199.813	-217.865	-220.969	-187.123	-189.702	-42.997	-41.529
McFadden R-squared	12.0%	10.4%	13.1%	13.8%	6.2%	4.6%	19.4%	18.1%	81.4%	82.1%
No Cases "correctly" Predicted	67%	65%	71%	71%	64%	63%	74%	74%	97%	97%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B6: Probit Model Results for Composite Index

S&P/TSX Capped Energy Index												
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
constant	0.044	0.059	-0.088	-0.029	-1.585	-0.270	-0.204	-1.563	-1.753	-1.633	-1.816	-1.519
	(0.460)	(0.614)	(-0.792)	(-0.264)	(-8.685)	(-2.225)	(-1.692)	(-7.078)	(-8.844)	(-8.031)	(-7.924)	(-7.405)
Oil (WTI) Price	0.700					0.545			0.376			
	(4.987)					(3.722)			(1.512)			
Oil (WTI) Price, lagged		0.664					0.530	0.181		0.130		
		(4.733)					(3.638)	(0.732)		(0.521)		
S&P/TSX Composite			0.780			0.642					0.424	
			(5.440)			(4.328)					(1.706)	
S&P/TSX Composite, lagged				0.676			0.538	-0.209				-0.158
				(4.737)			(3.645)	(-0.800)				(-0.591)
S&P/TSX Cap. Energy, lagged					3.458			3.491	3.419	3.429	3.410	3.513
					(14.070)			(12.950)	(13.780)	(13.680)	(13.680)	(13.150)
Log-Likelihood	-216.568	-217.421	-214.235	-217.494	-58.226	-207.307	-210.888	-57.816	-57.069	-58.091	-56.825	-58.057
McFadden R-squared	5.5%	5.0%	6.6%	5.0%	74.6%	9.6%	7.8%	74.7%	75.1%	74.6%	75.2%	74.6%
No Cases "correctly" Predicted	65%	65%	68%	66%	96%	71%	70%	96%	96%	96%	96%	96%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B7: Probit Model Results for Energy Sector Index

S&P/TSX Capped Gold Index												
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
constant	-0.237	-0.221	-0.146	-0.068	-1.268	-0.295	-0.220	-1.263	-1.390	-1.356	-1.259	-1.194
	(-2.370)	(-2.212)	(-1.320)	(-0.616)	(-9.622)	(-2.445)	(-1.842)	(-7.278)	(-8.589)	(-8.379)	(-7.414)	(-7.192)
Gold Price	0.580					0.526			0.262			
	(4.266)					(3.545)			(1.405)			
Gold Price, lagged		0.545					0.546	0.281		0.195		
		(4.012)					(3.661)	(1.323)		(1.040)		
S&P/TSX Composite			0.354			0.137					-0.016	
			(2.543)			-0.891					(-0.085)	
S&P/TSX Composite, lagged				0.225			-0.002	-0.241				-0.134
				(1.623)			(-0.012)	(-1.103)				(-0.694)
S&P/TSX Cap. Gold, lagged					2.603			2.596	2.565	2.571	2.606	2.626
					(14.140)			(13.740)	(13.800)	(13.810)	(13.930)	(13.970)
Log-Likelihood	-235.490	-235.930	-241.444	-242.736	-111.804	-235.087	-235.929	-110.598	-110.818	-111.261	-111.801	-111.567
McFadden R-squared	3.8%	3.3%	1.3%	0.5%	54.2%	3.9%	3.3%	54.7%	54.6%	54.4%	54.2%	54.3%
No Cases "correctly" Predicted	62%	61%	57%	55%	90%	62%	61%	90%	90%	90%	90%	90%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B8: Probit Model Results for Gold Sector Index

S&P/TSX Capped Divers. Metals and Mining Index												
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
constant	0.057	0.082	-0.431	-0.347	-1.379	-0.484	-0.393	-1.436	-1.409	-1.402	-1.525	-1.426
	(0.638)	(0.922)	(-3.773)	(-3.075)	(-8.774)	(-4.025)	(-3.338)	(-7.917)	(-8.479)	(-8.392)	(-8.070)	(-7.777)
Metal Index	0.675					0.285			0.106			
	(4.742)					(1.802)			(0.474)			
Metal Index, lagged		0.603					0.247	0.050		0.078		
		(4.259)					(1.574)	(0.205)		(0.353)		
S&P/TSX Composite			1.272			1.171					0.384	
			(8.558)			(7.311)					(1.667)	
S&P/TSX Composite, lagged				1.123			1.034	0.118				0.132
				(7.664)			(6.546)	(0.454)				(0.556)
S&P/TSX Metals and Mining, lagged					3.028			2.967	3.002	3.010	2.884	2.972
					(14.290)			(12.770)	(13.780)	(13.860)	(12.780)	(12.770)
Log-Likelihood	-221.741	-223.557	-194.701	-202.280	-81.550	-193.119	-201.054	-81.371	-81.435	-81.487	-80.173	-81.395
McFadden R-squared	4.9%	4.0%	16.5%	13.1%	65.0%	17.2%	13.6%	65.0%	65.0%	65.0%	65.6%	65.0%
No Cases "correctly" Predicted	63%	63%	75%	73%	94%	75%	73%	94%	94%	94%	94%	94%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B9: Probit Model Results for Metals and Mining Sector Index

Series	$\mathbf{P(\ Com.M}_t = 1 \mid \mathbf{TSX}_t = 1)$	$\mathbf{P(\ Com.M}_t = 1)$	$\mathbf{P(\ Com.M}_t = 0 \mid \mathbf{TSX}_t = 0)$	$\mathbf{P(\ Com.M}_t = 0)$
Metal Index	0.582	0.438	0.814	0.562
Gold Price	0.702	0.548	0.721	0.452
Oil (WTI)	0.627	0.520	0.667	0.480
Series	$\mathbf{P(\ Com.M}_t = 1 \mid \mathbf{TSX}_{t-1} = 1)$	$\mathbf{P(\ Com.M}_t = 1)$	$\mathbf{P(\ Com.M}_t = 0 \mid \mathbf{TSX}_{t-1} = 0)$	$\mathbf{P(\ Com.M}_t = 0)$
Metal Index	0.589	0.438	0.829	0.562
Gold Price	0.696	0.548	0.713	0.452
Oil (WTI)	0.629	0.520	0.674	0.480
Notation:	$TSX_t = 1(0)$: A bull(bear) market is identified for the S&P/TSX Composite Index at time t			
	$Com.M_t = 1(0)$: A bull(bear) market is identified for the Commodity Series under scrutiny at time t			

Table B10: Probabilities of Bull/Bear Markets Conditional on Identified Market for Relevant Sector Index

	$\mathbf{P(\ MIM}_t = 1 \mid \mathbf{TSXMM}_t = 1)$	$\mathbf{P(\ MIM}_t = 1)$	$\mathbf{P(\ MIM}_t = 0 \mid \mathbf{TSXMM}_t = 0)$	$\mathbf{P(\ MIM}_t = 0)$
	0.534	0.438	0.725	0.562
	$\mathbf{P(\ MIM}_t = 1 \mid \mathbf{TSXMM}_{t-1} = 1)$	$\mathbf{P(\ MIM}_t = 1)$	$\mathbf{P(\ MIM}_t = 0 \mid \mathbf{TSXMM}_{t-1} = 0)$	$\mathbf{P(\ MIM}_t = 0)$
	0.541	0.438	0.740	0.562
	$\mathbf{P(\ GM}_t = 1 \mid \mathbf{TSXGM}_t = 1)$	$\mathbf{P(\ GM}_t = 1)$	$\mathbf{P(\ GM}_t = 0 \mid \mathbf{TSXGM}_t = 0)$	$\mathbf{P(\ GM}_t = 0)$
	0.654	0.548	0.572	0.452
	$\mathbf{P(\ GM}_t = 1 \mid \mathbf{TSXGM}_{t-1} = 1)$	$\mathbf{P(\ GM}_t = 1)$	$\mathbf{P(\ GM}_t = 0 \mid \mathbf{TSXGM}_{t-1} = 0)$	$\mathbf{P(\ GM}_t = 0)$
	0.652	0.548	0.572	0.452
	$\mathbf{P(\ OM}_t = 1 \mid \mathbf{TSXEM}_t = 1)$	$\mathbf{P(\ OM}_t = 1)$	$\mathbf{P(\ OM}_t = 0 \mid \mathbf{TSXEM}_t = 0)$	$\mathbf{P(\ OM}_t = 0)$
	0.617	0.520	0.661	0.480
	$\mathbf{P(\ OM}_t = 1 \mid \mathbf{TSXEM}_{t-1} = 1)$	$\mathbf{P(\ OM}_t = 1)$	$\mathbf{P(\ OM}_t = 0 \mid \mathbf{TSXEM}_{t-1} = 0)$	$\mathbf{P(\ OM}_t = 0)$
	0.611	0.520	0.653	0.480
Notation:	$OM_t = 1(0)$: A bull(bear) market is identified for the Oil (WTI) Price at time t			
	$GM_t = 1(0)$: A bull(bear) market is identified for the Gold Spot Price at time t			
	$MIM_t = 1(0)$: A bull(bear) market is identified for the Metal Index at time t			
	$TSXEM_t = 1(0)$: A bull(bear) market is identified for the Energy Sector Index at time t			
	$TSXGM_t = 1(0)$: A bull(bear) market is identified for the Gold Sector Index at time t			
	$TSXMM_t = 1(0)$: A bull(bear) market is identified for the Metal and Mining Sector Index at time t			

Table B11: Probabilities of Bull/Bear Markets Conditional on Identified Market for Relevant Sector Index

Oil (WTI) Price											
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
constant	-1.565	-0.431	-0.452	-1.925	-1.783	-0.416	-0.394	-1.805	-1.661	-2.066	-1.819
	(-10.170)	(-3.773)	(-3.947)	(-8.009)	(-7.646)	(-3.581)	(-3.403)	(-9.132)	(-8.163)	(-7.944)	(-7.091)
S&P/TSX Composite		0.754		0.589						0.534	
		(5.293)		(2.450)						(2.126)	
S&P/TSX Composite, lagged			0.783		0.402						0.384
			(5.477)		(1.672)						(1.555)
S&P/TSX Cap. Energy						0.715		0.391		0.278	
						(4.985)		(1.788)		(1.189)	
S&P/TSX Cap. Energy, lagged							0.677		0.174		0.082
							(4.731)		(0.756)		(0.339)
Oil (WTI) Price, lagged	3.166			3.150	3.113			3.125	3.132	3.125	3.100
	(14.650)			(14.090)	(14.220)			(14.290)	(14.260)	(13.870)	(13.970)
Log-Likelihood	-76.823	-230.769	-229.070	-73.477	-75.221	-232.407	-233.037	-75.404	-76.538	-72.826	-75.163
McFadden R-squared	68.6%	5.8%	6.3%	69.9%	69.2%	5.2%	4.7%	69.2%	68.7%	70.2%	69.3%
No Cases "correctly" Predicted	94%	64%	65%	94%	94%	63%	63%	94%	94%	94%	94%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B12: Probit Model Results for Oil (WTI) Price

Gold Price											
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
constant	-2.080	-0.586	-0.563	-2.111	-2.107	-0.182	-0.182	-2.320	-2.162	-2.349	-2.183
	(-8.892)	(-4.984)	(-4.812)	(-6.933)	(-6.919)	(-1.862)	(-1.862)	(-7.264)	(-7.041)	(-7.059)	(-6.150)
S&P/TSX Composite		1.116		0.075						0.071	
		(7.605)		(0.199)						(0.191)	
S&P/TSX Composite, lagged			1.077		0.063						0.053
			7.361		(0.1679)						(0.143)
S&P/TSX Cap. Gold						0.579		0.455		0.455	
						(4.266)		(1.340)		(1.339)	
S&P/TSX Cap. Gold, lagged							0.574		0.190		0.188
							(4.225)		(0.581)		(0.574)
Gold Price, lagged	4.236			4.208	4.213			4.246	4.212	4.220	4.192
	(12.970)			(11.930)	(11.960)			(12.500)	(12.820)	(11.380)	(11.860)
Log-Likelihood	-30.370	-213.396	-214.812	-30.349	-30.355	-234.539	-234.113	-29.434	-30.204	-29.415	-30.193
McFadden R-squared	87.5%	12.4%	11.6%	87.5%	87.5%	3.8%	3.7%	87.9%	87.6%	87.9%	87.6%
No Cases "correctly" Predicted	98%	71%	70%	98%	98%	62%	62%	98%	98%	98%	98%

*t-statistics are reported in parentheses
** Dependent Variable: Identified market is a Bull market (=1)

Table B13: Probit Model Results for Gold Price

	Metal Index										
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
constant	-1.958	-0.893	-0.952	-2.553	-2.580	-0.598	-0.645	-2.423	-2.442	-2.694	-2.723
	(-10.360)	(-6.978)	(-7.290)	(-10.370)	(-10.300)	(-5.117)	(-5.455)	(-10.520)	(-10.540)	(-10.800)	(-10.870)
S&P/TSX Composite		1.100		0.853						0.678	
		(7.184)		(3.146)						(2.152)	
S&P/TSX Composite, lagged			1.178		0.894						0.708
			(7.571)		(3.262)						(2.223)
S&P/TSX Metals and Mining						0.683		0.659		0.380	
						(4.741)		(2.521)		(1.219)	
S&P/TSX Metals and Mining, lagged							0.747		0.689		0.398
							(5.143)		(2.626)		(1.270)
Metal Index, lagged	3.804			3.786	3.773			3.839	3.832	3.812	3.796
	(13.950)			(13.100)	(13.020)			(13.430)	(13.380)	(13.060)	(12.980)
Log-Likelihood	-45.412	-214.879	-210.595	-41.759	-41.476	-231.093	-228.156	-43.049	-42.855	-41.164	-40.829
McFadden R-squared	81.2%	11.4%	12.9%	82.7%	82.8%	4.8%	5.6%	82.2%	82.3%	83.0%	83.1%
No Cases "correctly" Predicted	97%	67%	68%	97%	97%	61%	62%	97%	97%	97%	97%

*t-statistics are reported in parentheses

** Dependent Variable: Identified market is a Bull market (=1)

Table B14: Probit Model Results for Metal Index

Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{OM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{OM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Energy	0.685	0.536	0.571	0.464
Imperial Oil	0.664	0.672	0322	0.328
Suncor Energy	0.835	0.841	0.154	0.159
Canadian Natural Resources	0.852	0.706	0.400	0.294
Nexen Inc.	0.785	0.737	0.298	0.263
Talisman Energy	0.745	0.616	0.478	0.384
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{OM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{OM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Energy	0.671	0.536	0.561	0.464
Imperial Oil	0.664	0.672	0.322	0.328
Suncor Energy	0.835	0.841	0.154	0.159
Canadian Natural Resources	0.846	0.706	0.400	0.294
Nexen Inc.	0.772	0.737	0.288	0.263
Talisman Energy	0.745	0.616	0.478	0.384
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{GM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{GM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Gold	0.638	0.474	0.689	0.526
Agnico-Eagle Mines	0.627	0.540	0.548	0.460
Kinross Gold Corp.	0.574	0.485	0.604	0.515
Eldorado Gold	0.627	0.614	0.404	0.386
Alamos Gold Inc	0.779	0.723	0.394	0.277
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{GM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{GM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Gold	0.590	0.474	0.640	0.526
Agnico-Eagle Mines	0.608	0.540	0.528	0.460
Kinross Gold Corp.	0.535	0.485	0.565	0.515
Eldorado Gold	0.617	0.614	0.389	0.386
Alamos Gold Inc	0.764	0.723	0.364	0.277
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{MIM}_t = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{MIM}_t = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Metals and Mining	0.644	0.576	0.475	0.424
Imperial Metals Corp.	0.522	0.487	0.538	0.513
Lundin Mining Corp.	0.604	0.535	0.535	0.465
Inmet Mining Corp.	0.649	0.522	0.587	0.478
Teck Resources	0.763	0.672	0.396	0.328
Series	$\mathbf{P(\ SM}_t = 1 \mid \mathbf{MIM}_{t-1} = 1)$	$\mathbf{P(\ SM}_t = 1)$	$\mathbf{P(\ SM}_t = 0 \mid \mathbf{MIM}_{t-1} = 0)$	$\mathbf{P(\ SM}_t = 0)$
S&P/TSX Capped Metals and Mining	0.625	0.576	0.460	0.242
Imperial Metals Corp.	0.530	0.487	0.543	0.513
Lundin Mining Corp.	0.588	0.535	0.520	0.465
Inmet Mining Corp.	0.619	0.522	0.561	0.478
Teck Resources	0.737	0.672	0.376	0.328
Notation:	$SM_t = 1(0)$: A bull(bear) market is identified for the series under scrutiny at time t			
	$OM_t = 1(0)$: A bull(bear) market is identified for the Oil (WTI) Price at time t			
	$GM_t = 1(0)$: A bull(bear) market is identified for the Gold Spot Price at time t			
	$MIM_t = 1(0)$: A bull(bear) market is identified for the Metal Index at time t			

Table B15: Probabilities of Bull/Bear Markets Conditional on Identified Market for Commodity Price (II)

C Figures

C.1 Data

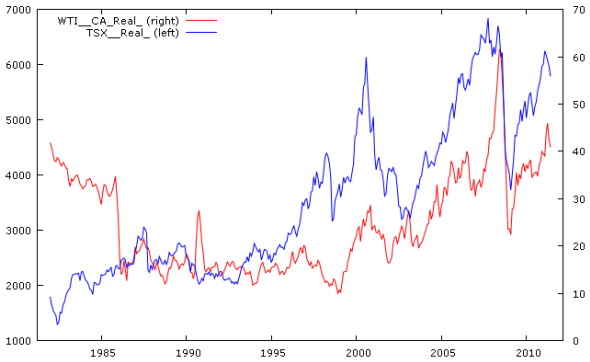


Figure 1: Oil Price (WTI) vs S&P/TSX Composite, real values in CA$

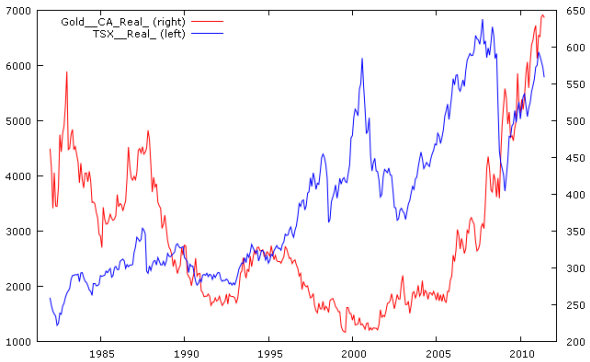


Figure 2: Gold Price (spot) vs S&P/TSX Composite, real values in CA$

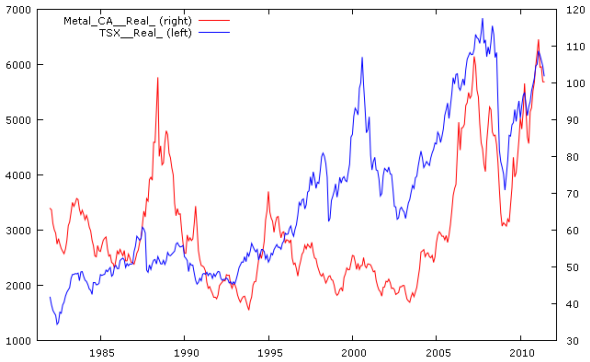


Figure 3: Metal Index vs S&P/TSX Composite, real values in CA$

C.2 Identified Bull and Bear Markets

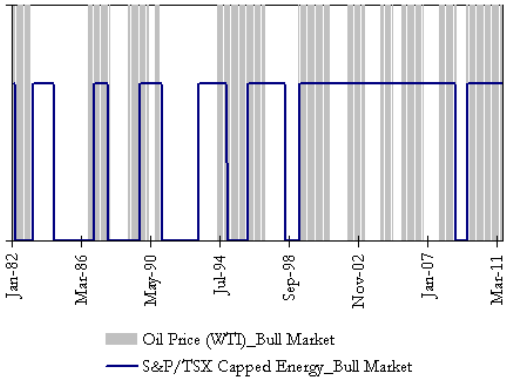


Figure 4: Oil Price (WTI) vs S&P/TSX Capped Energy Index

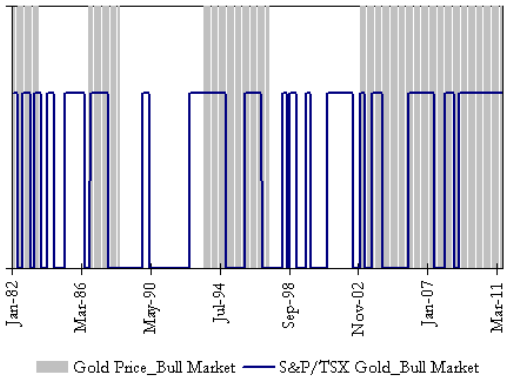


Figure 5: Gold Price (spot) vs S&P/TSX Capped Gold Index

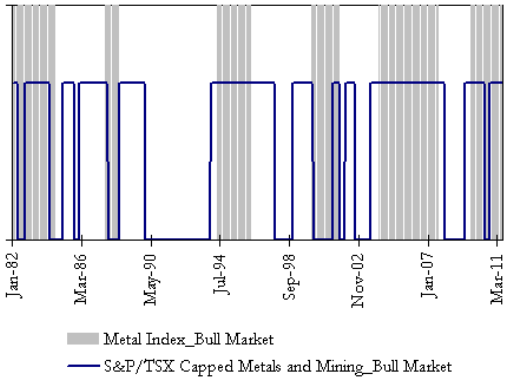
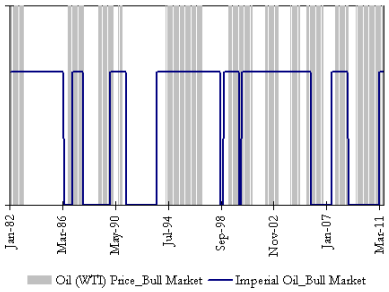
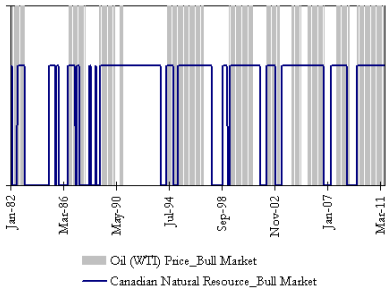


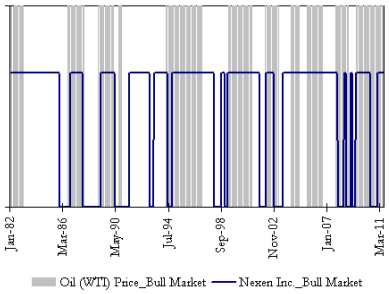
Figure 6: Metal Index vs S&P/TSX Capped Diversified Metals and Mining Index



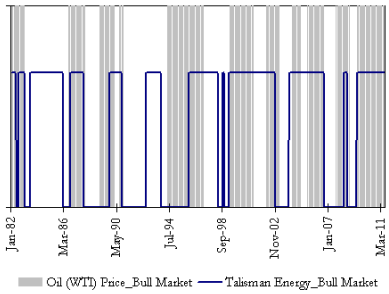
(a) Imperial Oil



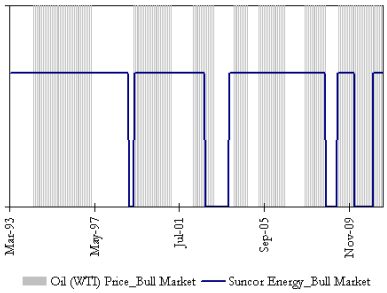
(b) Canadian Natural Resources



(c) Nexen Inc

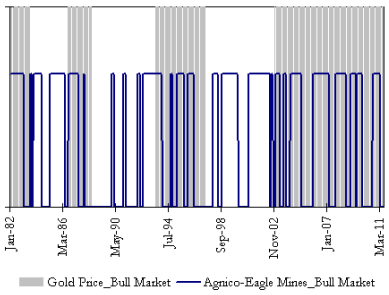


(d) Talisman Energy

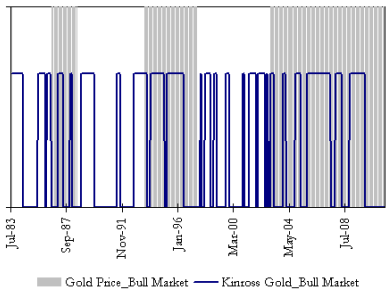


(e) Suncor Energy

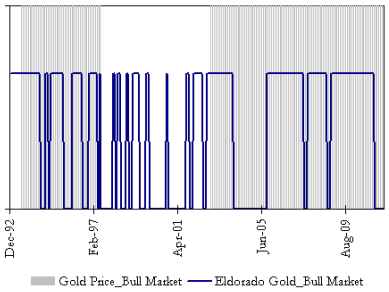
Figure 7: Oil Price (WTI) vs Energy Stocks



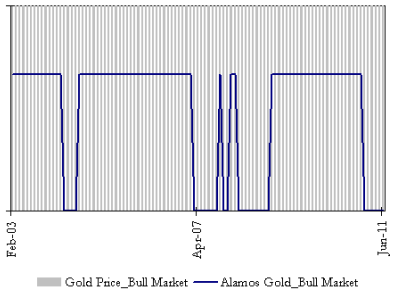
(a) Agnico-Eagle Mines



(b) Kinross Gold Corp.

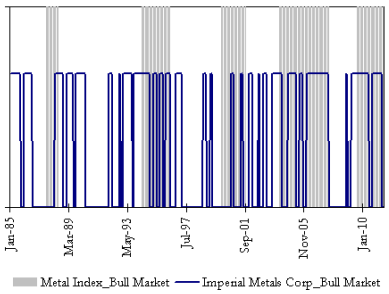


(c) Eldorado Gold

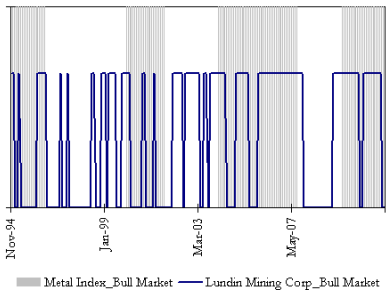


(d) Alamos Gold Inc

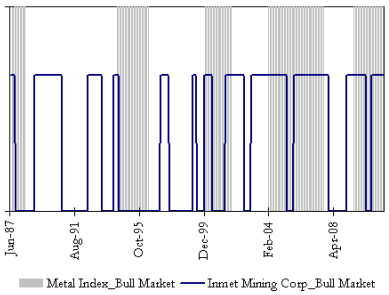
Figure 8: Gold Price vs Gold Stocks



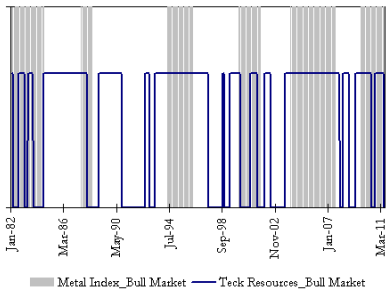
(a) Imperial Metals Corp



(b) Lundin Mining Corp



(c) Inmet Mining Corp



(d) Teck Resources

Figure 9: Metal Index vs Metal and Mining Stocks