Return Predictability When News Means Different Things in Different Times

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Abstract

Return predictability can vary across the business cycle due to the same news conveying different information in different states. Industrial metals such as aluminum and copper contain information about the economy, which gradually diffuses into the equity market. Industrial metal price increases are good news for equities during contractions as investors take this as evidence that growth is emerging. However, increases during expansions can signal an overheating economy and are seen as negative for equities. Whether one finds positive, negative or no predictability depends on the number of expansion versus contraction states in the sample.

Key words: industrial metal, return predictability, gradual information diffusion, business cycle

JEL classification codes: G11, G14

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1. Introduction

There is growing evidence that return predictability is state dependant. Several studies have found return predictors give better signals in economic contractions than expansions.[1] We show the sign as well as the strength of the predictability relation can differ across states due to information signaling good news in one state and bad news in another. Increases in a variable can positively predict stock returns in one state and negatively predict returns in others. McQueen and Roley (1993) and Boyd, Hu, and Jagannathan (2005) demonstrate the same macroeconomic news announcements (like unemployment figures) are often viewed positively by equity investors in one economic state and negatively in another. We apply their insights to return predictability. We show that when a sample period contains a similar number of good and bad news states the negative and positive predictability relations cancel out resulting in the incorrect conclusion that there is no predictability. However, if a sample period is dominated by one state the predictability relation shows up as being strongly negative or positive, depending on the state.

We demonstrate that the same news having different implications in different economic states is a factor behind state dependant return predictability. Industrial metal (aluminum, copper, lead, nickel and zinc) price increases are good news for equities during contractions and bad news during expansions. Industrial metals seem to provide an indication that growth and inflation are positive, which is greeted as good news during contractions. However, the indication that growth and inflation is increasing further, raising the possibility the economy

[1] See Dangl and Halling, 2009; Rapach, Strauss, and Zhou, 2009; Henkel, Martin, and Nardari, 2010. The existence of countercyclical risk premium is one explanation for this (e.g. Campbell and Cochrane, 1999; Gomes, Kogan, and Yogo, 2009; and Henkel, Martin, and Nardari, 2010).

is overheating, is seen as bad news during expansions. Our results therefore offer an insight into the question posed by US Federal Reserve Chairman Bernanke in 2008 "what signal should we take from recent changes in commodity prices about the strength of global demand or about expectations of future growth and inflation?"

Industrial metals seem a natural candidate for return predictors that generate state dependant predictability due to asymmetric information responses to their price movements. Industrial metals are often discussed in the financial news media as being important leading indicators of the economy and equity market. Increasing industrial metal prices are cited as being a positive sign when the economy is depressed. For instance:

"*Some analysts saw encouraging signs in the rise in copper since the start of the year. Its past correlation with industrial demand supported hopes that the economy had started to make small steps towards recovery and healthy inflation - rather than sliding into a protracted, severe period of falling prices and shrinking output.*"[2]

However, in expansions, rising industrial metal prices are frequently seen as signaling an overheating economy which is widely viewed as bad news. For example, Sandra Pianalto, President of the Federal Reserve Bank of Cleveland (2006) says:

"*Understanding why the prices of commodities, like copper, increase or decrease is one of the many pieces of the puzzle that we as policymakers try to fit together to help us figure out how the economy and inflation will perform in the future…. the elevated inflation numbers concerned me, and indeed they still do.*"

[2] http://www.marketwatch.com/story/dr-coppers-forecasting-ability-tested-year

In contrast to other commodities, industrial metals seem to be relatively unaffected by confounding factors.[3]

Our paper ties together three strands of the literature. The first is the work of McQueen and Roley (1993) and Boyd, Hu, and Jagannathan (2005), who show the same macroeconomic announcement can mean different things for the stock market in different economic states. For example, Boyd, Hu, and Jagannathan (2005) show an increase in unemployment is seen as good for the stock market in expansions as it is interpreted as indicating less chance of interest rate increases. However, increasing unemployment in contractions is seen as a negative signal indicating future profits and dividends are likely to be lower. Andersen, Bollerslev, Diebold, and Vega (2007) show this differential reaction to US macroeconomic news announcements across the business cycle also exists in British and German stock, bond and foreign exchange markets. More recently, Gilbert (2010) finds the link between macroeconomic news announcement day returns and future revisions differs between recessions and expansions.

The second literature area our paper is related to is that of gradual information diffusion. Hong and Stein's (1999) theoretical model suggests return predictability can result from information gradually being reflected in returns. This prediction has been confirmed empirically. Hong, Torous, and Valkanov (2007) find certain industries lead the broader stock market, while Driesprong, Jacobsen and Maat (2008) show information contained in oil price changes takes time to diffuse into the stock market.

[3] Energy prices may be influenced by political uncertainty and seasonalities in demand, agricultural commodities tend to be seasonal and precious metals also serve as safe haven.

The third strand of the literature is the recent work on state dependant return predictability. It has long been common for researchers to split their sample into sub-periods as a check for parameter stability, but there has only recently been the acknowledgement that changing predictability relations maybe the norm rather than the exception. Dangl and Halling (2009) document evidence of much stronger predictability in a range of variables in contractions. Henkel, Martin, and Nardari (2010) also find predictability is stronger in contractions, which they attribute to "counter-cyclical risk premia." However, they find no predictability in expansions. In other related work, Rapach, Strauss, and Zhou (2009) show US equity returns lead international equity returns and this effect is stronger in contractions.

While we follow this literature and allow the predictability relations to vary in expansions and contractions our work differs because we consider an alternative source for return predictability - the same news meaning opposite things in different states of the world. If we do not separate out expansion and contraction states we find no evidence of industrial metals leading the stock market. However, when we allow for different effects in expansion and contraction states of the economy this conclusion is reversed. We find strong and significant predictability results in line with our hypothesis. Increasing industrial metal prices predict higher future stock market returns during contractions and lower stock market returns during expansions. This is not just a US phenomena. Increasing industrial metal prices are seen as better news in contractions in the majority of European Union member countries. State dependant predictability appears to be linked to asymmetric reactions to the same news. Industrial metal price signal an increase in economic activity and inflation in both states of the economy but these increases are seen as positive for the stock market in contractions and negative in expansions. The predictability we document has a consistent sign across all five industrial metals. However, as expected, the two most important industrial metals to the global economy (aluminum and copper) provide the strongest signal.

Industrial metal returns predict a wide range of economic series but their equity market predictive power is not solely related to this. Rather, they contain predictive power beyond these economic series. This raises the possibility that industrial metals better reflect the state of the economy than economic statistics. An alternative explanation is that they have predictive ability that is not related to changes in the economy. The predictive power of industrial metals is very strong and can be used to generate out-of-sample economic profits. Sharpe ratios from a simple trading rule are substantially higher than those for a buy-and-hold strategy. Moreover, we find out-of-sample adjusted R^2s of up to 20%, which is a stark contrast to the mostly negative out-of-sample adjusted R^2s Goyal and Welch (2008) report for a range of well-known predictors.

2. Data and Method

2.1. Data

We include each of the five industrial metals that comprise the industrial metals segment of the Goldman Sachs Commodity Index (GSCI). This index includes the 24 commodities that are the most important to the global economy and weights them accordingly. These weights vary through time, but, as at June 28, 2010, copper had the largest weight of the industrial metals, followed by aluminum.

We obtain the Goldman Sachs aluminum, copper, nickel, lead, and zinc series from Thomson Reuters Datastream. These commence in 1991, 1977, 1995, 1977, and 1991 respectively. We also test the Goldman Sachs industrial metal index, which starts in 1977. We focus on futures data because these are more liquid and receive more attention in the media. The US equity market proxy is the S&P 500 price index sourced from Datastream. The European country equity market series (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain) are also sourced from Datastream. The MSCI country index is used in each instance. We use two proxies for the US business cycle phases of contraction and expansion. The first is NBER business cycle data[4] and the second is the Chicago Fed National Activity Index (CFNAI).[5] We follow the convention and define a period as a contraction period when the CFNAI-MA3 is less than -0.7 and an expansion period when the CFNAI-MA3 is greater than -0.7. The European Business Cycle data are from the "Euro Area Business Cycle Dating Committee"[6]. Summary statistics for the entire period and for NBER expansions and contractions are presented in Appendix 1.

The economic series include: Consumer Price Index: All Items, Consumer Price Index: All Items Less Food & Energy, University of Michigan: Consumer Sentiment, ISM Manufacturing: PMI Composite Index, Industrial Production Index, Capacity Utilization: Total Industry, Total Nonfarm Payrolls: All Employees, Civilian Unemployment Rate, Housing Starts: Total: New Privately Owned Housing Units Started, Personal Consumption Expenditures, and Retail Sales. All series are sourced from the Federal Reserve Bank of St. Louis, with the exception of Producers Price index which we obtain from the Bureau of Labor Statistics.

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[4] http://www.nber.org/cycles.html
[5] http://www.chicagofed.org/webpages/publications/cfnai/
[6] http://www.cepr.org/data/dating/

2.2. Methodology

The methodology combines the standard return predictability approach with the business cycle framework of Boyd, Hu, and Jagannathan (2005). The regression specification is given in equation 1:

$$R_t = \alpha_t + \beta_1 D_{t-1} IM_{t-1} + \beta_2 (1 - D_{t-1}) IM_{t-1} + \varepsilon_t \qquad (1)$$

Where:

R_t is the return on the equity market in month *t*.

IM_{t-1} is the return on the industrial metal in month *t-1*.

$D_{t-1}$is a dummy variable that equals 1 if the economy is expanding and 0 if it is contracting.

This regression is estimated separately for the five industrial metals and the industrial metal index. β_1 and β_2 represent the stock return reaction to a change in industrial metal price in expansions and contractions respectively. We use the F-Test to determine if β_1 and β_2 are statistically significantly different.

3. Results

The Table 1 results show a researcher testing the predictive ability of movements in the industrial metal index for equity market returns using all available data (1977 – 2010) and the simple predictive regression $R_t = \alpha_t + \beta_t IM_{t-1} + \varepsilon_t$ would conclude industrial metals have no predictive ability. A similar conclusion would be reached if data for the 1977 – 1990 period were used. However, a researcher using the most recent decade of data (2001 – 2010) would conclude industrial metals have strong positive predictive power. To the contrary, a researcher testing the relation at the beginning of last decade using the most recent ten years of data (1990-2000) would conclude increases in the price of industrial metals predict negative equity returns the following month.

[Insert Table 1 Here]

Could the inconsistent predictive ability of industrial metal price changes be related to different states of the economy? We address this question in Table 2. We assign each month as a contraction or expansion. Firstly, we use the designation of the NBER business cycle dating committee. Secondly, we use the Chicago Fed National Activity Index (CFNAI) and define a period of contraction (expansion) as a period when the CFNAI-MA3 is less (greater) than -0.7. We run the regression specified in equation 1 and then use the Wald test to determine if there is a difference between the slope coefficient in expansions and contractions. This approach is followed for the industrial metal index and each of the industrial metals separately.

The final column in Table 2 shows the difference in slope coefficient between expansions and contractions $(\beta_1 - \beta_2)$ is negative and statistically significant for the industrial metal index and each of the industrial metals. The slope coefficient is lower in expansions than contractions in each instance. Increases in the price of each of the industrial metals and the industrial metal index predict increases in the equity market in the following month in contractions. Alternatively, increases in price of the three metals that are most important to the global economy (aluminum, copper, and nickel) and the industrial metal index predict equity market declines the following month in the based on NBER and CFNAI business cycle and based on CFNAI expansion and contraction definitions respectively. It is not surprising the results are stronger for aluminum and copper than the other three industrial metals. The Goldman Sachs Commodity Index (GSCI) allocated weights to commodities based on their importance to the global economy. In June 2010 for aluminum and copper each had weights that are over three times larger than those for lead, nickel, or zinc.

[Insert Table 2 Here]

As mentioned in the introduction, there are frequently articles in the financial press which suggest that industrial metal price changes provide important information about the health of the economy. For instance:

"… *copper has a PhD in economics. Because copper is used in everything from electrical wiring to water pipes, it is seen as a good measure of the economy. If demand for copper falls, then it's believed the economy is slowing*."[7]

The fact that some financial and economic series lead other series has also been documented in the literature. Zarnowitz and Moore (1981, p. 61) note: "series that represent early stages of production and investment processes … lead series that represent late stages .... Under uncertainty, less binding decisions are taken first."

We investigate whether movements in the industrial metal index and each of the individual industrial metals predict a range of economic series using the regression: $ES_t = \alpha_t + \beta_t IM_{t-1} + \varepsilon_t$, where ES_t is the change in the economic series in month *t*. The results

[7] http://www.whocrashedtheeconomy.com/?p=34

presented in Table 3 suggest increases in the industrial metal index indicate an increase in growth and inflation and a decrease in unemployment in the next month. When the industrial metal index increases Capacity Utilization, Industrial Production, ISM Manufacturing, Personal Consumption Expenditures (PCE), and the Producer Price Index (PPI) all increase, while Civilian Unemployment decreases. Aluminum price changes predict Capacity Utilization, Industrial Production, and the Producer Price Index. Copper returns predict Capacity Utilization, Civilian Unemployment, Industrial Production, ISM Manufacturing, and the Producer Price Index. Nickel price changes predict Capacity Utilization, Civilian Unemployment, the Consumers Price Index (CPI), Housing Starts, Industrial Production, ISM Manufacturing, and the Producer Price Index. Zinc returns predict Consumer Confidence.

[Insert Table 3 Here]

Since it is clear that industrial metal price movements are related to changes in economic variables it is possible that industrial metal returns do not contain any information beyond that contained in the economic series. We investigate this by regressing each of the industrial metal return series on the all the economic series. We then take the residuals from these regressions and check whether these residuals can predict the equity market. Predictability from these residuals will indicate information from industrial metals returns beyond that contained in economic series predict equity returns. The results presented in Table 4 relate to NBER expansions and contraction. The results show the difference in coefficient between expansions and contractions is negative and statistically significant for all commodities other than lead. The IM Index and copper residuals negatively predict stock returns in expansions and positive predict stock returns in contractions. These results suggest one of two things. Either industrial metal returns contain information about the economy that is not reflected in economic series or industrial metal returns have predictive power due to some non-economic reason.

[Insert Table 4 Here]

We next analyze whether the difference in the predictive relationship of industrial metals for stock returns between expansions and contractions hold outside the US. In Table 5 we present results for 12 European Union countries. The business cycle data from the Euro Area Business Cycle Dating Committee is estimated to for the Europe region as a whole. The economies of European Union countries are synchronized but is it likely they do not all enter into recessions at exactly the same time so these results are likely to be weaker than their US equivalents. The Table 5 results show seven of the 12 countries and equally weighted average European equity market result have a lower coefficient in expansions then contractions. The differential predictive power of industrial metals is not just a US phenomenon. The Table 5 results are based on the industrial metal index, but aluminum and copper results are qualitatively similar.

[Insert Table 5 Here]

The next question we address is whether investors can earn out-of-sample risk-adjusted returns from a trading rule based on the signals of industrial metals. We are careful to ensure that investors have all necessary information to implement the trading rule in real time so we use the Chicago Fed National Activity Index (CFNAI) reading that investors have access to as an indication of whether the economy is expanding or contracting each month. Our trading rule is very simple. It signals an investment in the equity market for the next month if the industrial metal return predicts a return higher than the risk-free rate, otherwise it signals an investment in the risk-free asset for the month. We apply this trading rule in the 5-year out-of-sample period from 2005 to 2010.

We measure the out-of-sample performance of the trading rule using three approaches. We calculate the Sharpe Ratio for each trading rule and compare these to the buy-and-hold Sharpe Ratio. We also apply the Manipulation-Proof Performance Measure (MPPM) from Ingersoll, Spiegel, Goetzmann, and Welch (2007) to each trading rule. Unlike the Sharpe Ratio, this is not based on the assumption that returns are normally distributed. Our results relate to a risk-aversion coefficient of three. The final technique we apply is the out-of-sample R^2 approach of Goyal and Welch (2008). The results presented in Table 6 indicate trading rules based on industrial metal returns are highly economically significant. While the equity market has declined in this period, the returns to all trading rules, with the exception of those based on nickel, generate positive returns. These are as large as 0.73% per month or over 8% per year. The Sharpe Ratios from the trading rules (nickel excluded) are considerable larger than the buy-and-hold Sharpe ratio. The out-of-sample adjusted R^2 of the industrial metal, aluminum, copper, and zinc are all in excess of 12% and are as large as 20%. This indicates just how strong the predicative ability is and is in stark contrast to Goyal and Welch (2008) who find a range of popular predictors have negative out-of-sample adjusted R^2s

[Insert Table 6 Here]

4. Conclusions

It is now known that return predictability often varies across the business cycle. We show the same news conveying different information is one explanation for this. Industrial metal (aluminum, copper, lead, nickel, and zinc) returns predict stock returns. Increases in industrial metal prices are good news for the stock market in contractions. However, increasing industrial metal prices are bad news in expansions. In contractions, any sign that growth is returning is welcomed by the equity market. However, in expansions the indication that growth is strengthening and inflation is building signals that the risk of the economy overheating is increasing, which is bad news for equities.

A researcher who selects a sample period that includes both expansions and contractions will incorrectly conclude there is no relation between industrial metal movements and stock returns. Alternatively, if a period that is dominated by recessions (expansions) is chosen a researcher will conclude there is always a strong positive (negative) relation between industrial metal price changes and stock returns.

It is clear that a portion of the predictive power of industrial metals is related to economic variables. Increases in industrial metal prices predict increased capacity utilization, lower unemployment, increased industrial production and a range of other economic series. However, the predictive power of industrial metals remains after these economic factors are controlled for. This suggests either industrial metal price movements reflect changes in the economy that are not picked up by these variables or their predictive ability is due to some other reason.

The predictive power of industrial metals is not limited to the US. The differential predictions of industrial metal price changes in different states of the economy are present in European Union countries to. The predictions are strong. An out-of-sample trading rule shows strong predictive ability. Trading rule Sharpe Ratios are considerably larger than buy-and-hold Sharpe Ratios and out-of-sample adjusted R^2s are as large as 20%.

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Table 1: Overall and Sub-Period Equity Market Predictability

	α_t	t-statistic	β_t	t-statistic	Adj. R^2	N
All Data (1977-2010)	0.007	**2.771**	0.010	0.252	-0.002	399
1977-1990	0.009	**2.568**	-0.023	-0.713	-0.004	166
1991-2000	0.013	**4.321**	-0.185	**-2.281**	0.037	120
2001-2010	-0.003	-0.615	0.187	**2.162**	0.067	113

The Goldman Sachs Industrial metal index and S&P 500 data are sourced from Thomson Reuters Datastream. The predictive regression $R_t = \alpha_t + \beta_t IM_{t-1} + \varepsilon_t$ is run, where R_t is the S&P 500 monthly return and $IM_{t-1}$is the industrial metal return. t-statistics that are statistically significant at the 10% level or more are highlighted in bold.

Table 2: Equity Market Predictability Across the Business Cycle

	Expansion			Contraction				
	β_1	t-statistic	N	β_2	t-statistic	N	$\beta_1 - \beta_2$	F-test
Panel A: NBER								
IM index	-0.051	-1.586	332	0.217	**1.993**	67	-0.2683	**5.605**
Aluminum	-0.152	**-3.010**	193	0.319	**2.416**	38	-0.4710	**10.398**
Copper	-0.045	**-1.614**	332	0.188	**2.554**	67	-0.2333	**8.879**
Lead	-0.027	-0.703	146	0.120	**1.880**	37	-0.1468	**3.601**
Nickel	-0.045	**-1.756**	170	0.110	**1.741**	37	-0.1557	**5.517**
Zinc	-0.003	-0.079	193	0.264	**2.765**	38	-0.2678	**6.235**
Panel B: CFNAI								
IM index	-0.054	**-1.762**	334	0.312	**3.257**	63	-0.3657	**13.459**
Aluminum	-0.166	**-3.482**	194	0.363	**3.177**	36	-0.5287	**18.409**
Copper	-0.046	**-1.769**	334	0.255	**5.041**	63	-0.3010	**28.735**
Lead	-0.033	-0.972	151	0.145	**2.348**	31	-0.1783	**6.197**
Nickel	-0.043	**-1.735**	175	0.123	**1.758**	31	-0.1659	**5.287**
Zinc	-0.013	-0.302	194	0.342	**4.166**	36	-0.3541	**14.450**

The Goldman Sachs Industrial metal index, aluminum, copper, lead, nickel, zinc and S&P 500 data are sourced from Thomson Reuters Datastream. The regression $R_t = \alpha_t + \beta_1 D_{t-1} IM_{t-1} + \beta_2 (1 - D_{t-1}) IM_{t-1} + \varepsilon_t$ is run for each industrial metal series. R_t is the return on the equity market in month t, IM_{t-1} is the return on the industrial metal in month *t-1*, $D_{t-1}$is a dummy variable that equals 1 if the economy is expanding and 0 if it is contracting. Expansion and contraction in the economy is separately measured using NBER and Chicago Fed National Activity Index (CFNAI) data. We use the F-Test to determine if β_1 and β_2 are statistically significantly different. t-statistics and F-statistics that are statistically significant at the 10% level or more are highlighted in bold.

Table 3: Industrial Metals Predicting Economic Series

	IM Index		Aluminum		Copper		Lead		Nickel		Zinc	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat
Capacity Utilization	0.017	**2.985**	0.032	**2.473**	0.015	**3.090**	0.012	1.492	0.012	**3.219**	0.010	1.572
Civilian Unemployment	-0.060	**-2.531**	-0.076	-1.567	-0.051	**-2.435**	-0.009	-0.304	-0.046	**-2.097**	-0.022	-0.855
Consumer Confidence	0.054	1.565	0.038	0.601	0.046	1.493	0.057	1.317	0.051	1.336	0.087	**1.655**
CPI All	0.007	1.339	0.012	1.348	0.007	1.385	0.002	0.292	0.009	**1.883**	0.006	0.889
CPI Less Food Energy	-0.001	-0.235	-0.001	-0.305	-0.001	-0.386	0.002	1.310	0.001	0.560	-0.002	-0.847
Housing Starts	0.011	0.138	0.112	1.236	0.019	0.274	0.097	1.259	0.104	**2.135**	0.070	1.066
Industrial Production	0.014	**2.476**	0.029	**2.165**	0.013	**2.428**	0.009	1.019	0.010	**2.821**	0.008	1.262
ISM Manufacturing	0.101	**2.493**	0.095	1.384	0.092	**2.700**	0.115	**2.664**	0.065	**2.107**	0.024	0.603
Non-Farm Payrolls	-0.001	-0.125	-0.006	-0.467	0.002	0.454	0.008	1.292	0.000	-0.059	0.007	1.197
PCE	0.008	**1.783**	0.012	1.312	0.006	1.358	0.005	0.827	0.005	1.219	0.004	0.771
PPI	0.035	**2.493**	0.060	**2.208**	0.034	**2.592**	0.009	0.465	0.032	**2.324**	0.025	1.440

The Goldman Sachs Industrial metal index, aluminum, copper, lead, nickel, zinc and S&P 500 data are sourced from Thomson Reuters Datastream. All economic series are sourced from the Federal Reserve Bank of St. Louis, with the exception of Producers Price index (PPI) which we obtain from the Bureau of Labor Statistics. The regression: $ES_t = \alpha_t + \beta_t IM_{t-1} + \varepsilon_t$ is estimated in each instance. ES_t is the monthly change in the economic series. t-statistics that are statistically significant at the 10% level or more are highlighted in bold.

Table 4: Equity Market Predictability After Controlling for Economic Series Predictability

	Expansion			Contraction				
	β_1	t-statistic	N	β_2	t-statistic	N	$\beta_1 - \beta_2$	F-test
IM index	-0.055	**-1.653**	320	0.232	**1.909**	67	-0.287	**5.156**
Aluminum	-0.160	**-3.037**	193	0.271	1.526	38	-0.431	**5.278**
Copper	-0.047	**-1.653**	320	0.221	**2.422**	67	-0.268	**7.846**
Lead	-0.015	-0.442	146	0.116	1.458	37	-0.132	2.147
Nickel	-0.041	-1.568	170	0.108	1.597	37	-0.148	**4.282**
Zinc	-0.002	-0.051	193	0.276	**2.281**	38	-0.279	**4.574**

The Goldman Sachs Industrial metal index, aluminum, copper, lead, nickel, zinc and S&P 500 data are sourced from Thomson Reuters Datastream. All economic series are sourced from the Federal Reserve Bank of St. Louis, with the exception of Producers Price index (PPI) which we obtain from the Bureau of Labor Statistics. Each industrial metal series is regressed on all economic series (contemporaneously) and the residuals are used to predict equity market returns in contractions and expansions based on the NBER business cycle.

Table 5: European Equity Market Predictability Across the Business Cycle

		Expansion			Contraction			
	β_1	t-statistic	N	β_2	t-statistic	N	$\beta_1 - \beta_2$	F-test
Austria	0.015	0.256	304	0.324	**2.031**	95	-0.309	**3.332**
Belgium	-0.038	-0.778	304	0.208	1.357	95	-0.246	2.351
Finland	-0.055	-0.999	270	0.120	0.510	71	-0.174	0.521
France	-0.125	**-2.042**	304	0.231	**2.407**	95	-0.356	**9.492**
Germany	-0.108	**-2.041**	304	0.200	**1.968**	95	-0.307	**7.140**
Greece	0.130	0.853	207	0.418	**2.084**	62	-0.287	1.279
Ireland	-0.038	-0.503	207	0.446	**2.682**	62	-0.484	**7.045**
Italy	-0.068	-1.256	304	0.220	**1.800**	95	-0.288	**4.582**
Luxembourg	0.023	0.265	138	0.347	1.167	33	-0.325	1.116
Netherlands	-0.016	-0.502	304	0.206	**2.097**	95	-0.222	**4.595**
Portugal	0.132	1.522	207	0.204	**2.065**	62	-0.072	0.287
Spain	-0.005	-0.108	304	0.214	**2.693**	95	-0.220	**5.297**
Average Equity Market	-0.022	-0.608	304	0.225	**1.996**	95	-0.247	**4.314**

The Goldman Sachs Industrial metal index, aluminum, copper, lead, nickel, zinc and equity index data are sourced from Thomson Reuters Datastream. The regression $R_t = \alpha_t + \beta_1 D_{t-1} IM_{t-1} + \beta_2 (1 - D_{t-1}) IM_{t-1} + \varepsilon_t$ is run for each industrial metal series. R_t is the return on the equity market in month *t*, IM_{t-1} is the return on the industrial metal in month *t-1*, $D_{t-1}$is a dummy variable that equals 1 if the economy is expanding and 0 if it is contracting. Expansion and contraction in is measured using Euro Area Business Cycle Dating Committee data. We use the F-Test to determine if β_1 and β_2 are statistically significantly different. t-statistics and F-statistics that are statistically significant at the 10% level or more are highlighted in bold.

Table 6: Out-of-Sample Economic Significance

	IM index	Aluminum	Copper	Lead	Nickel	Zinc	Buy-and-Hold
Panel A: Sharpe Ratios							
Mean	0.728%	0.667%	0.470%	0.539%	-0.243%	0.660%	-0.031%
Standard Deviation	3.627%	3.490%	3.878%	3.529%	4.395%	3.560%	4.811%
Sharpe Ratio	0.140	0.128	0.065	0.091	-0.105	0.124	-0.051
Panel B: MPPM							
MPPM	3.75%	3.19%	0.29%	1.59%	-9.24%	3.03%	-7.36%
Panel C: Out-of-sample Adjusted R^2							
c1	-0.014	-0.005	-0.009	-0.002	0.001	-0.006	
t(c1)	-2.420	-0.890	-1.807	-0.249	0.084	-1.002	
c2	1.762	1.064	1.236	0.233	-0.160	0.778	
t(c2)	4.979	4.672	4.749	0.491	-0.266	3.547	
N	60	60	60	60	60	60	
OoS R^2	21.7%	17.7%	18.1%	0.6%	0.1%	13.9%	
OoS adj R^2	20.4%	16.3%	16.7%	-1.1%	-1.6%	12.4%	
95% bootstrap critical value OoS R^2	6.02%	6.39%	6.28%	5.87%	6.34%	6.15%	
95% bootstrap critical value OoS adj R^2	4.40%	4.77%	4.66%	4.24%	4.72%	4.53%	

The Goldman Sachs Industrial metal index, aluminum, copper, lead, nickel, zinc and S&P 500 data are sourced from Thomson Reuters Datastream. A trading rule that signals a long equity market position or a t-bill position the following month based on the industrial metal return is test. Sharpe Ratios are presented in Panel A. The Manipulation-Proof Performance Measure (MPPM) of Ingersoll, Spiegel, Goetzmann, and Welch (2007) results are in Panel B. Panel C contains results for the out-of-sample R^2 approach of Goyal and Welch (2008). All results relate to a 5-year (2006 – 2010) period.

Appendix 1: Data Summary Statistics

	Mean	Median	Max	Min	SD	Skewness	Kurtosis	N
Panel A: All Data								
IM index	0.009	0.006	0.384	-0.282	0.071	0.543	6.981	400
Aluminum	-0.001	-0.006	0.148	-0.183	0.055	-0.153	3.775	232
Copper	0.009	0.008	0.325	-0.439	0.079	-0.328	7.125	400
Lead	0.011	0.010	0.270	-0.274	0.086	-0.021	4.132	184
Nickel	0.014	0.010	0.352	-0.275	0.104	0.160	3.385	208
Zinc	0.004	-0.003	0.281	-0.342	0.073	-0.027	5.615	232
S&P 500	0.006	0.009	0.163	-0.218	0.044	-0.446	4.905	557
Panel B: NBER Expansions								
IM index	0.013	0.007	0.384	-0.245	0.067	1.073	7.458	333
Aluminum	0.002	-0.005	0.117	-0.181	0.047	-0.046	3.495	193
Copper	0.013	0.009	0.325	-0.281	0.073	0.411	5.098	333
Lead	0.014	0.011	0.270	-0.165	0.073	0.481	3.867	147
Nickel	0.017	0.011	0.352	-0.275	0.098	0.389	3.951	171
Zinc	0.006	-0.003	0.281	-0.170	0.067	0.682	4.641	193
S&P 500	0.007	0.009	0.132	-0.218	0.039	-0.542	5.743	463
Panel C: NBER Contractions								
IM index	-0.009	-0.016	0.151	-0.282	0.083	-0.661	4.446	67
Aluminum	-0.011	-0.013	0.148	-0.183	0.085	0.040	2.378	39
Copper	-0.009	-0.006	0.155	-0.439	0.100	-1.502	7.666	67
Lead	-0.003	0.005	0.252	-0.274	0.126	-0.205	2.677	37
Nickel	0.000	-0.005	0.192	-0.241	0.132	-0.151	1.872	37
Zinc	-0.009	-0.013	0.161	-0.342	0.097	-1.030	4.922	39
S&P 500	-0.002	-0.002	0.163	-0.169	0.061	-0.049	2.834	94

Summary statistics for entire data period and NBER expansions and contractions.