

THE EFFECT OF US ECONOMIC INDICATORS ON COPPER PRICES: A QUANTITATIVE ANALYSIS

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Abstract: *Economic Indicators have major role in the prices of the commodities. A quantitative analysis was done to construct a model to predict the future prices of the commodities. Nineteen economic indicators were considered for analysis based on CME rating. The analysis was done on base metals and the results of copper are presented here. In addition to effect of economic indicators the effect of the business cycles also analysed. Secondary data was collected from different official sources and past two business cycles data was considered for analysis. A regression model was constructed by using SPSS to predict the future prices of copper. The effect of Exports of goods and services, Unemployment rate and Consumer credit outstanding is more on the copper prices followed by Construction Spending, Industrial Production Capacity Utilisation, Consumer Sentiment Index and Retail sales. To analyse business cycle effect two different models were considered one with all business cycles combined together and the other one with the recent business cycle. The effect of some economic indicators is different in different business cycles.*

Key words: Economic indicators, Copper Price, Business Cycle, Regression Analysis

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Introduction

An economic indicator is a statistic about the economic performance of a country. Economic indicators allow analysis of the present economic performance and predictions of future performance. Economic indicators are the vital barometers that tell us what the economy is up to and, more importantly, in what direction it is likely to go in the future. These indicators describe the economic backdrop that will ultimately affect earnings, interest rates, and inflation. They can also influence the future cost of loans, the security of our jobs, and our overall standard of living. Even executives of various businesses are under pressure to monitor the economic indicators more closely. Knowledge of economic conditions enables executives to make decisions with greater confidence on whether to buy more equipment, increase inventories, hire workers, or raise fresh capital (Bernard, 2005). The release of economic indicators also affects the prices of the commodities. Many people eagerly anticipate the release of the indicators as they have large impact on equity and commodity markets.

Literature Review

Previous literature on the impact of macroeconomic announcements has mostly focused on bond and currency markets, with fairly clear evidence that macroeconomic news has significant price and volatility effects. Rossi (1998) finds that certain key economic announcements cause U.K government bond yield changes of between 2–6 basis points, including beyond the trading day. Fleming and Remelona (1999) find that the arrival of public information has a large effect on prices and subsequent trading activity, particularly during periods in which uncertainty (as measured by implied volatility) is high. Balduzzi, Elton, and Green (2001) indicate that a wide variety of economic announcements affect U.S. Treasury bond prices, with labour market, inflation, and durable goods orders data having the largest impact. Commodities are not financial assets, but these results are relevant for our study given the relationship between commodity prices and some financial asset valuations. Frankel (2008) argues that interest rates can have a significant effect on commodity prices and Roache (2008) provides supporting empirical evidence. The strongest and most consistent relationship, however, is between the U.S. economic indicators and commodity prices, and there is a building consensus that macroeconomic news does affect commodity prices. Andersen et al (2002) explore the relationship between macroeconomic news and the U.S. dollar exchange rate against six major currencies. They confirm macroeconomic news generally has a statistically significant correlation with intra-day movements of the U.S.

dollar, with “bad” news for example, data indicating weaker-than-expected growth having a larger impact than “good” news. Galati and Ho (2003) found similar results using daily data. Ehrmann and Fratzscher (2005) focused on the euro-dollar exchange rate and found that U.S. news tended to have more of an effect on the exchange rate than German news. Activity indicators such as GDP and labor market data had a particularly large and significant effect, with the news impact increasing during times of high market uncertainty.

Common themes have emerged from the literature focused on commodities and announcements. The number and significance of macroeconomic announcements on commodity prices is lower than that for U.S. Treasury bonds, exchange rates, and equity markets. However, a number of key U.S. indicators, including inflation, GDP, and employment statistics, repeatedly show the ability to move some commodity prices; in general, energy products have tended to be less sensitive, while copper prices has been most sensitive. Nonferrous metals other than copper also appear sensitive to news related to supply and demand. In particular, some studies indicate that announcement of economic indicators data have tended to cause price declines (Cai, Cheung, and Wong 2001). Other studies have found that metal prices sensitivity to news varies through time, with Hess, Huang, and Niessen (2008) presenting evidence that it is dependent upon the state of the economy, with sensitivity increasing during recessions. In their recent paper Shaun K. Roache and Marco Rossi (2009) argued that activity indicators such as GDP and labour market data had a particularly large and significant effect, with the news impact increasing during times of high market uncertainty. In addition to these economic indicators literature also explained how the monetary policy of a country affects the commodity prices in the market.

Objectives & Methodology

The main objective of the study is to find the effect of the US economic indicators on copper prices. If there is any impact of the economic indicators on the copper prices then to establish a model to predict the future prices of copper based on the economic indicators data. Some economic indicators lead commodity prices, some lags and others are coincident with the commodity prices. Prior knowledge of this will help in predicting the future price of the commodity.

The present study focuses on how the economic indicators affecting the prices of copper. Nineteen economic indicators namely Construction Spending, Retail Sales, Balance

of Trade, Exports of Goods and Services, Imports of Goods and Services, Disposable Personal Income, Government unemployment insurance benefits, Consumer Price Index, Consumer Credit Outstanding, Consumer Confidence Index, Consumer Sentiment Index, Manufacturers' Shipments, Industrial Production Capacity Utilisation (%), ISM purchasing Managers Index (PMI), Unemployment rate, New privately owned housing units completed, New privately owned housing units permits, New privately owned housing units started, New privately owned housing units under construction was selected to examine the effect on copper prices. These nineteen indicators were selected based on Chicago Mercantile Exchange economic indicators grading, published in their white paper on economic indicators. Multiple regression models were used to predict the future prices. The regression was done by using SPSS software. The graphs between the variables were plotted after normalizing the data for better comparison.

Selection of Independent Variables

There are many economic indicators which Federal Government releases every month. But out of this very few affects the prices of base metal prices. We have selected 19 economic indicators based on literature survey and CME ranking of economic indicators. The independent variables were selected such that the specification error was minimized. Specification error occurs when irrelevant variables were included or when the relevant variables were excluded. Although the inclusion of irrelevant variables does not bias the results of the other variables, it does impact the regression variate. But the exclusion of relevant variables can seriously bias the results and negatively affect the interpretation of them. So all the indicators related to construction was considered as construction has some major effect on the base metal prices.

Selection of estimation Technique

The most popular sequential approach, stepwise estimation method is used for regression. This approach enables to examine the contribution of each independent variable to the regression model. In this model all the insignificant variables will be eliminated automatically and only significant variables remains in the model. This technique maximizes the predictive accuracy of the model (Joseph F. Hair et all 2007).

Assessing Multicollinearity

A key issue in interpreting the regression variate is the correlation among the independent variables. This problem is one of data, not of model specification. The ideal situation would be to have a number of independent variables highly correlated with dependent variable. To assess multicollinearity, we need a measure expressing the degree to which each independent variable is explained by the set of other independent variables. In simple terms, each independent variable becomes a dependent variable and is regressed against the remaining independent variables. The two most common measures for assessing both pairwise and multiple-variable collinearity are tolerance and its inverse, Variance Inflation Factor.

Tolerance is defined as the amount of variability of the selected independent variable not explained by other independent variables. Variance Inflation Factor is calculated simply as the inverse of the tolerance value. Theory suggests that that the tolerance value of 0.1 and VIF value of 10 is acceptable for a model to predict future values. When the value of VIF is more than 10 then we have to remove one of those two independent variables and have to create another model. In the present case we are dealing with the economic indicators, which have high correlation among themselves. Each economic indicator will depend upon other, so the model is very much prone to multicollinearity. In the present case we neglected the problem of multicollinearity. The reason is the difference in the date of release of each and every indicator. Some indicator data is released every week where as others every month. If we want to predict the future value of commodity by just using the economic indicators which was released that week, we need to consider all the weekly indicators only. If we consider multicollinearity we may remove those indicators and the prediction will be less accurate.

Limitations of the study

There are many indicators on which this study have focused. The degree to which the marketplace focuses on one or another indicator is subject to change over time and as a function of monetary and fiscal policy. So the calculated effect may not be same over the period. The market generally anticipates the level of significant economic indicators and acts accordingly in advance of the actual release of the data. Frequently, a forecast figure is reported that indicates the general expectation regarding the level of future release. But many times forecasted figure differs from the actual figure. The “forecast error” or the “surprise”

that may be most important in causing the marketplace to react by bidding market prices upwards or offering them downwards (John W. Labuszewski et al 2007). In the present study only actual release historical data was considered. In the present study only US economic indicators was considered to predict the commodity prices but there might be some slight effect of German Consumer Price Index or Japan Industrial production. The effect of these foreign countries indicators was neglected. This study may not be useful in predicting the base metal prices on day to day basis. It may be useful for monthly predictions and predicting the trend of the prices only.

Results and Discussions

The world price of copper nearly trebled between December 2008 and the summer of 2011, one of the most remarkable booms in commodity markets in many years. Much of the steep rise in price has been due to demand-side factors. World demand for copper has been rising much faster than the growth in market supply that result from new discoveries of copper and increased extraction rates of known reserves. In the recent past, the effect of china's demand was more on copper prices. According to a recent study from geologists at Yale University, new discoveries of copper have raised global reserves by just 0.63 per cent a year since 1925 but usage (final demand) has risen at 3.3 per cent per annum. And now demand is growing strongly on the back of phenomenal growth in China, India and other emerging market economies. Because copper is malleable and ductile, there is a huge industrial demand for copper. Like most metals the demand for it is derived in part from the final demand for products that use copper as an important component or raw material. Nearly 50 per cent of the demand for copper comes from the construction industry, and 17 per cent is from the electrical sector. The demand for copper is also more from is the automobile industry. The average new car contains 27.6kg of copper. And hybrid cars which incorporate electric motors in conjunction with combustion engines could lead to further rises in copper demand. A typical electric hybrid car might use around 2 times the current usage of copper in extra cabling and windings for electric motors.

Recent data suggests that the incremental growth in world demand for copper has come almost exclusively from China and other Asian economies. HSBC analysts calculate that the compound annual growth in copper consumption from North America has fallen by 3 per cent and by 1.8 per cent from Western Europe and 2 per cent from Japan. In contrast, demand from Asian countries other than Japan has increased by 8.6 per cent each year whilst in China the growth has been a staggering 15 per cent per year. There has also been a

noticeable speculative demand for copper as investment funds around the world have started to track commodity prices. In addition to supply and demand there are other factors which will affect the copper prices. These other factors mainly include economic Indicators. The prices in CME (Chicago Mercantile Exchange) and other exchanges like MCX (Multi Commodity Exchange) are majorly affected by these economic indicators. Regression model was constructed to find the effect of economic indicators on copper prices. The regression was done by using stepwise regression method which eliminates insignificant variables automatically. The model was given as follows;

$$Y = -19389 + 0.006*(X1) + 0.029*(X2) + 0.071*(X3) - 0.006(X4) - 29.579*(X5) + 160.97(X6) + 580.8*(X7)$$

- | | |
|------------------------------------|---|
| X1 = Construction Spending | X5 = Consumer Sentiment Index |
| X2 = Retail Sales | X6 = Industrial Production Capacity Utilisation (%) |
| X3 = Exports of Goods and Services | X7 = Unemployment Rate |
| X4 = Consumer Credit Outstanding | |

The effect of Exports of goods and services, Unemployment rate and Consumer credit outstanding is more on the copper prices followed by Construction Spending, Industrial Production Capacity Utilisation (%), Consumer Sentiment Index and Retail sales (t values were given in SPPSS output). The economic indicators which had negative relation with the copper prices are Consumer Credit Outstanding and Consumer Sentiment Index. But the keen observation of these factors shows that the effect is inconsistent in different business cycles. The relations that economic indicators had with copper prices were different in business cycles 1991-2001 and 2001-2008. But the observation of data also reveals that the relation is same in 2001-08 and the present business cycle. So the regression model by considering the data after 2001 will give better result. The regression model was constructed by considering data after 2001. The regression model is as follows;

$$Y = -35316 + 0.047*(X1) + 0.045*(X2) + 0.027*(X3) + 227.32(X4) - 0.007*(X5) + 65.485(X6) - 1197.1*(X7)$$

- | | |
|---|--|
| X1 = Retail Sales | X5 = Consumer Credit Outstanding |
| X2 = Balance Of Trade (In Millions) | X6 = ISM purchasing Managers Index (PMI) |
| X3 = Government unemployment insurance benefits | X7 = Unemployment Rate |
| X4 = Consumer Price Index | |

More significant variables being Consumer Price Index, Consumer Credit Outstanding and Unemployment rate are the more significant variables which affect the copper prices. Let us calculate the effect of business cycles in predicting the future price. The model was predicted by considering the historical data till May 2011, which is available by the time of model prediction. Now consider the indicators data for the month June to check the accuracy of the prediction. For combined business cycles, 1991-2011

$$Y = -19389 + 0.006*(X1) + 0.029*(X2) + 0.071*(X3) - 0.006(X4) - 29.579*(X5) + 160.97(X6) + 580.8*(X7)$$

Values for June 2011

X1 = Construction Spending (772300 million dollars)

X4 = Consumer Credit Outstanding (2433034 million dollars)

X2 = Retail Sales (392131 million dollars)

X5 = Consumer Sentiment Index (59.5)

X3 = Exports of Goods and Services (175,500 million dollars)

X6 = Industrial Production Capacity Utilisation (%) (76.7)

X7 = Unemployment Rate (9.2)

$$Y = -19389 + 0.006*772300 + 0.029*392131 + 0.071*175500 - 0.006*2433034 + 29.59*59.5 + 160.97*76.7 + 580.8*9.2 = 10408.7$$

Considering the business cycle 2001-2008 and 2008-till date; it can be re-written as follows;

$$Y = -35316 + 0.047*(X1) + 0.045*(X2) + 0.027*(X3) + 227.32 (X4) - 0.007*(X5) + 65.485 (X6) - 1197.1*(X7)$$

X1 = Retail Sales (392131 million dollars)

X5 = Consumer Credit Outstanding (2433034 million dollars)

X2 = Balance Of Trade (In Millions) (-50150)

X6 = ISM purchasing Managers Index (PMI) = 50.9

X3 = Government unemployment insurance benefits (98200)

X7 = Unemployment Rate = 9.2

X4 = Consumer Price Index = 225.72

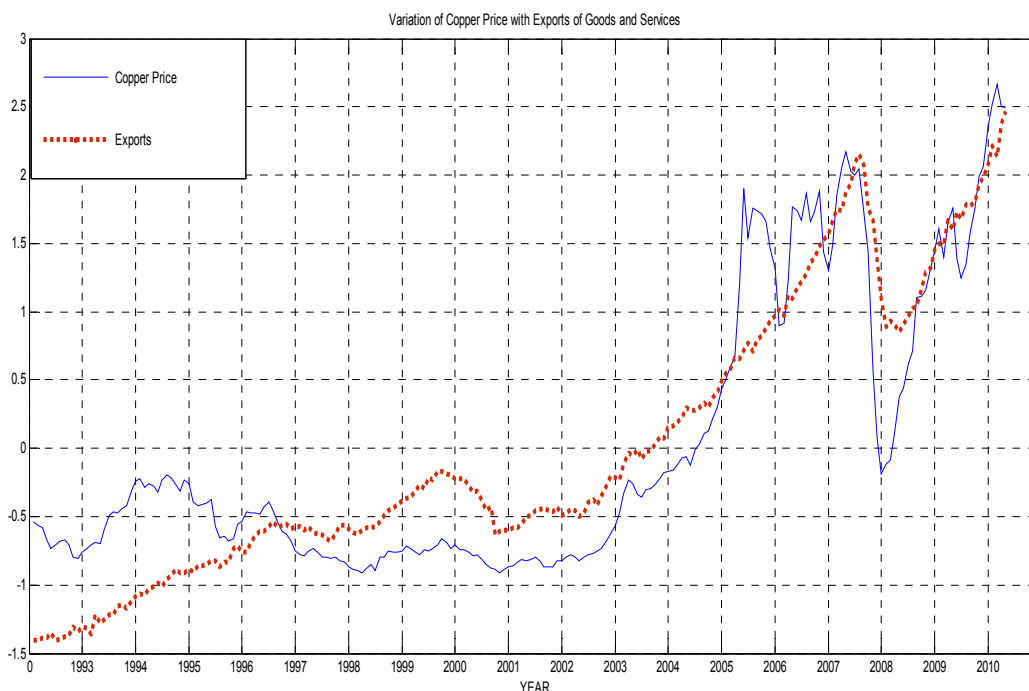
$$Y = -35316 + 0.047*(392131) + 0.045*(-50150) + 0.027*(98700) + 227.32 (225.72) - 0.007*(2433034) + 65.485 (50.9) - 1197.1*(9.2) = 10114$$

The actual price of copper at the end of June 2011 is 9405 dollars per ton. The predicted figure with considering business cycle effect is much closer than the value without considering business cycle effect. Let us see how the various economic indicators affecting copper prices. The indicators, which has major effect on copper prices only discussed here.

Exports of Goods and Services

Developed countries like US copper consumption has been steadily decreasing over the decade from 3 million metric tonnes in 1998 to 1750 million metric tonnes in 2010.

Exhibit1: Variation of Copper Price with Exports of Goods and Services



Demand has been increasing from the emerging markets such as China and India in last decade because of the major expansion and structural changes being done from the infrastructure to life style of the people. Refined copper consumption of US has declined from 21% in 1999 to 9% of the total world consumption. In the last nine years, copper consumption in the U.S declined by around 38% to 17, 99,000 short tons in 2009 due to weak economic conditions. U.S exports jumped from 26,000 short tons in 2001 to 83,000 short tons in 2009 mainly to China, the largest consumer of copper. After the economic recovery in the US markets, Fed reserve has planned to purchase \$600 billion worth of bonds from June 2011 to improve the economic growth. The demand for copper is expected to rise further. In United States, the mine production is viable but the refineries are in shortage and cannot meet the demand of the refined copper. In this situation they have to export the Copper ore to other leading refineries such as China & Japan.

After the end of recession in March 1991 the exports of US has increased sharply. In the year 1993 exports shown almost negative correlation with copper prices in 1994 it showed positive correlation where exports is lagging by two months to the copper price. In the business cycle 1991-2001 exports and copper price hardly followed any proper trend. But once the economy started recovering in October 2001 the exports started increasing. From this period onwards exports leading copper prices by one month. The leading trend continued for almost five years but the copper price was reduced drastically in August 2006. Again from June 2008 the exports and copper price has good correlation. Once the imports of china started increasing copper price increased. The major changes occurred in copper price is mainly due to China copper imports.

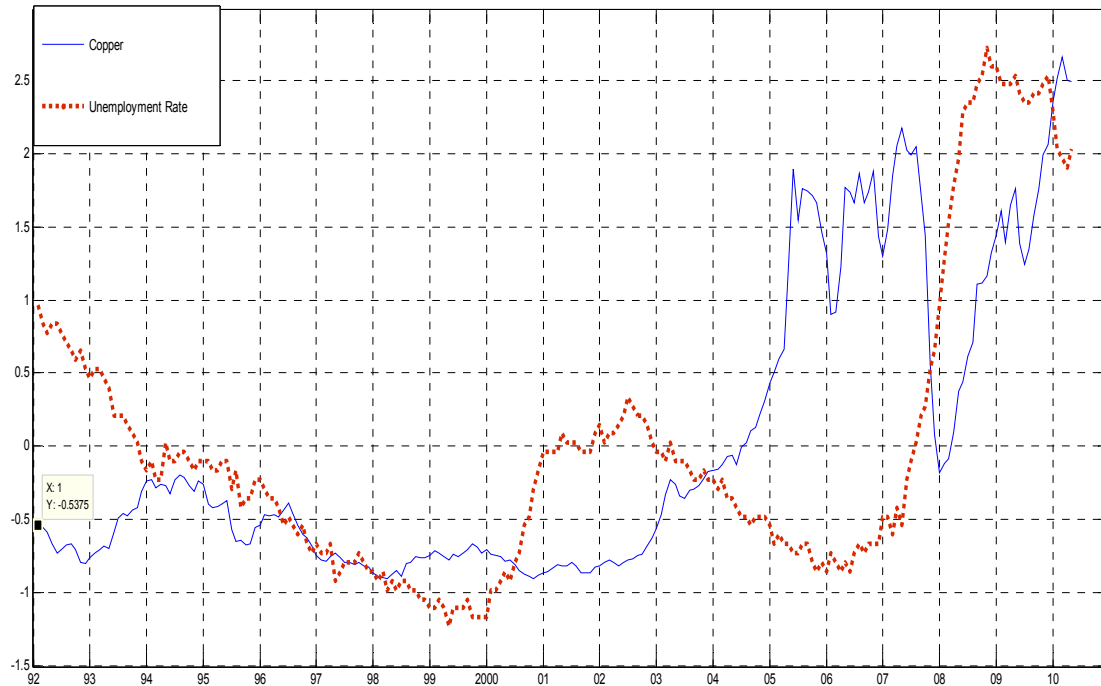
Unemployment Rate

Many economists often refer to the unemployment rate as a lagging indicator, which means it responds slowly to changes in the economy. As a result, they say, there is little one can derive from it about the future. However, that's not quite the case. But the unemployment rate alone itself is of no use in forecasting an economic recovery. Joblessness can remain high as long as two years after a recession ends because most employers are reluctant to add to their payrolls unless they're convinced the economy is genuinely on a solid growth path. Another reason for the slow rebound in job creation is that companies could have increased their operating efficiency. Improvements in technology, Usage of computerized equipment, better inventory management, and greater foreign outsourcing of production, employers can more easily raise output without hiring back U.S. workers in the numbers they once did. Where the unemployment rate can serve as a leading indicator is by warning of an impending downturn in economic activity.

Since the early 1980s, the increased use of technology and electronic networking has allowed firms to respond much faster than in the past to meet the changes in the demand for goods and services. At the same time companies also acting equally fast in reducing the costs by altering number of employees. Because labour is the largest expense to companies, layoffs are now occurring months before the onset of a recession. In the recent recession (Dec 2007-June 2009), the jobless rate began to climb five months before business activity turned down. And when the 2001 recession started, the unemployment rate bottomed out a year earlier. Thus, this indicator is capable of acting as an early warning system that the economy may be in trouble. One last point about the unemployment rate on average, about 150,000 new people of working age enter the labour force every month simply because of the nation's population

growth and from students who graduate. This means that the economy needs to create that many jobs each month on average just to keep the unemployment rate from rising. Most economist seem to agree that to produce that many new positions every month, the economy must over time expand by at least a 3–4% annual rate. Should growth fall below that pace, fewer jobs are created, and the unemployment rate will climb higher.

Exhibit2: Variation of Copper Price with Unemployment Rate



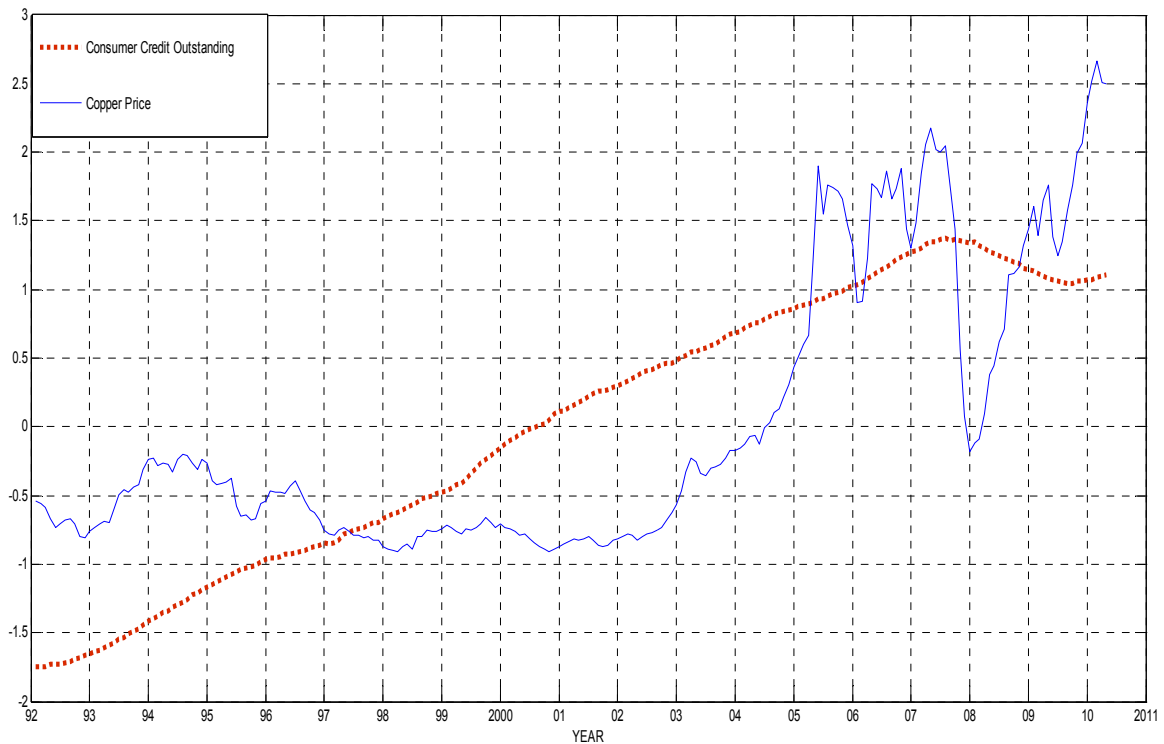
As it was discussed earlier it is very difficult to predict the direct relation of commodity prices with unemployment alone. Unemployment rate decreased once the economy was recovered from 1991 recession till 2001 recession but the price of copper had shown some fluctuations in this period. Unemployment has delayed effect on the prices.

Consumer Credit Outstanding

The consumer instalment debt release usually evokes little more than a yawn from the investment community. For one, it comes out quite late, nearly two months after the fact. By then, numerous other reports on consumer outlays for the same month have already come out. Moreover, the release itself arrives mid-afternoon, just as traders are looking to close their orders for the day. So it shouldn't be surprising if these professional investors find it hard to get worked up about news on consumer credit. Nevertheless, it would be a mistake to dismiss this report, for it has lots of useful information that can add to our understanding of the

financial health of consumers and of the future course of the economy. By definition, consumer instalment debt is virtually any debt taken on by individuals that is not secured by real estate. There are essentially two type's debts. One is revolving credit, with which most everyone is familiar. They include credit cards issued by banks, retail stores, and gasoline companies. Whether you pay all your credit card balance at once without incurring interest charges or spread the payments out for months with finance charges, it is all considered revolving credit. However, credit card usage makes up only 40% of all consumer instalment debt. The rest is non-revolving credit. This consists of outright loans to finance the purchase of autos, boats, mobile homes, vacations, home improvement, and education. It also includes the refinancing of existing debt. Consumer instalment credit does not include any loan that is collateralized by real estate, so home mortgages and home equity loans are not counted in this series. Motor vehicle leases are also excluded.

Exhibit3: Variation of Copper Price with Consumer Credit Outstanding

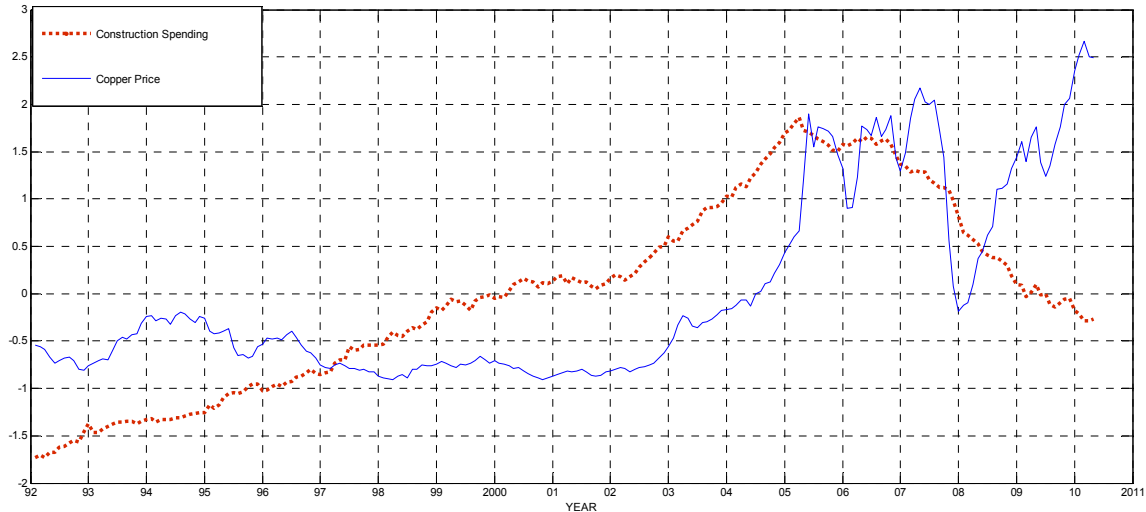


Consumer credit outstanding has negative correlation with copper prices in the business cycle 1991-2001. We can't get any direct relation between copper prices and consumer credit outstanding but this economic indicator is very important along with other indicators. This is another economic indicator which acted differently in two business cycles.

Construction Spending

Construction spending is one of the most important indicators which affect copper prices.

Exhibit4: Variation of Copper Price with Construction Spending

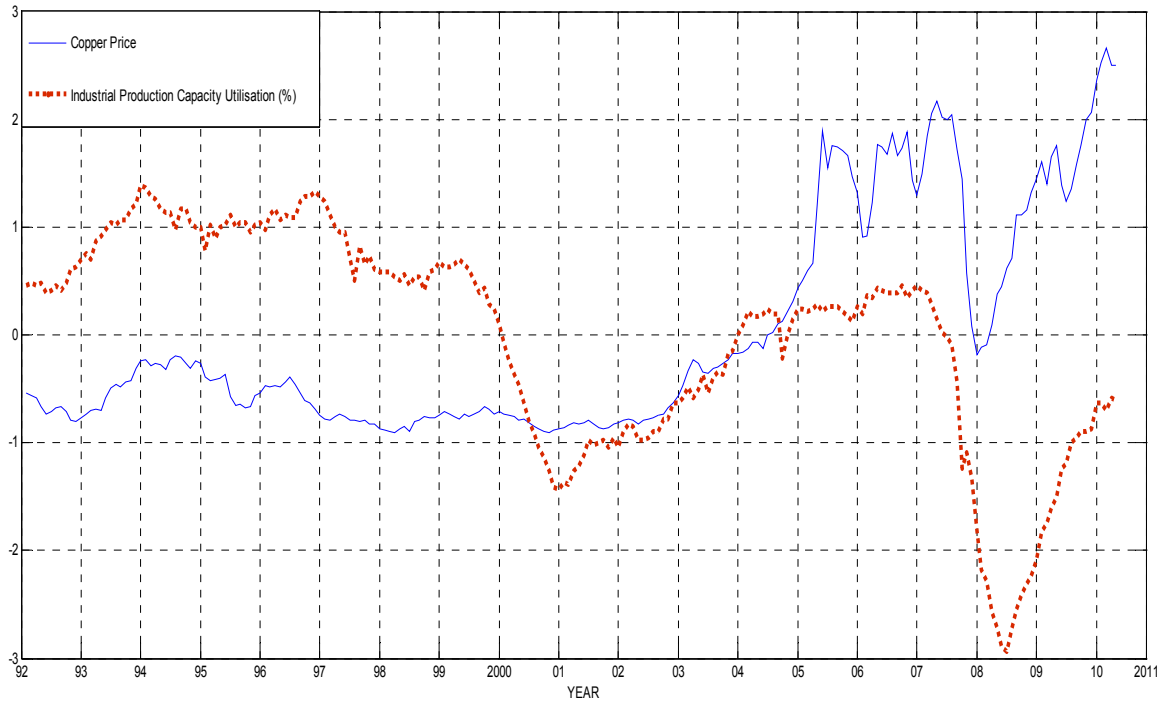


The reason is copper is very important metal used in construction. Almost around 50% total copper used in construction. Construction spending showed different effect on copper priced in different business cycles. In the business cycle 1991-2001 it has shown negative correlation where as in the business cycle 2001-2008 it has shown positive correlation. Again in the new business cycle the trend was reversed. We will get better results when we take one business cycle alone.

Industrial Production Capacity Utilisation

Industrial production is not one of those high-profile indicators known to roil the equity market. Strong production is generally considered to be supportive of stock prices because it signifies more economic growth and better corporate profits. The only concern for stock investors is if higher production leads to excessively tight capacity and higher prices. Should the latter scenario emerge, stocks might react negatively to a jump in industrial output.

Exhibit5: Variation of Copper Price with Industrial Production Capacity Utilisation

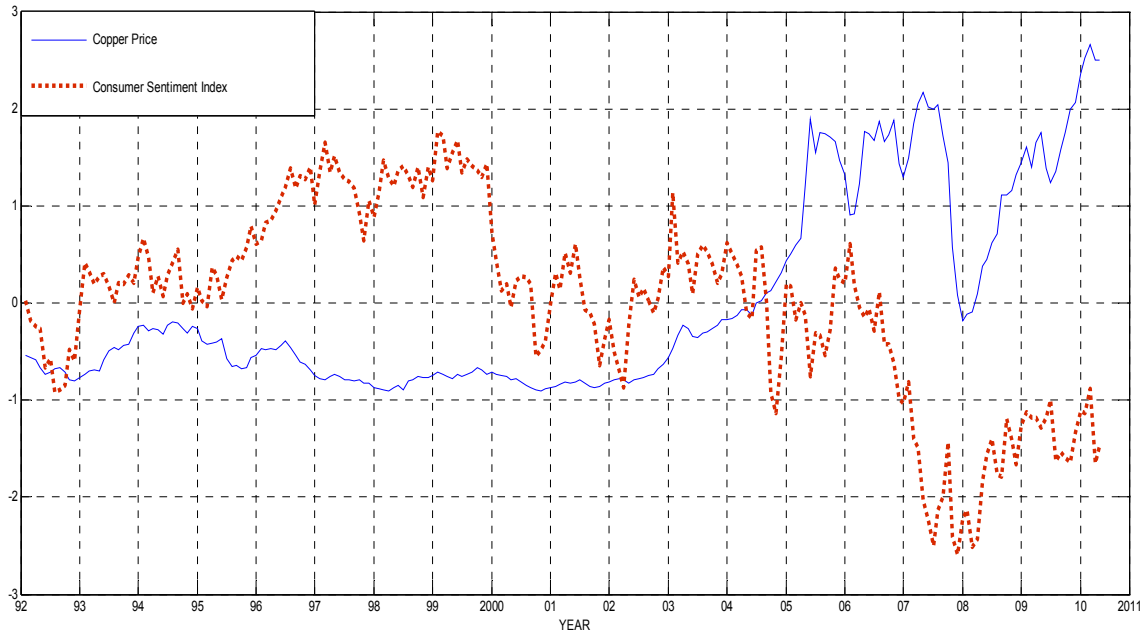


There is a good correlation between Industrial production and capacity utilization and copper prices. Industrial production capacity utilization is more affected in recession periods when compared to copper prices. It acted as coincident indicator till 2000 but once the recession started it acted as leading. After recession 2001 also it acted as leading indicator.

Consumer Sentiment Index

The main Index of Consumer Sentiment is based on the results of two subset indices: the Index of Current Economic Conditions, which explores consumer thinking about their current finances and buying plans, and the Index of Consumer Expectations, which is designed to gauge the outlook of their finances and buying plans over the coming one and five-year periods.

Exhibit6: Variation of Copper Price with Consumer Sentiment Index

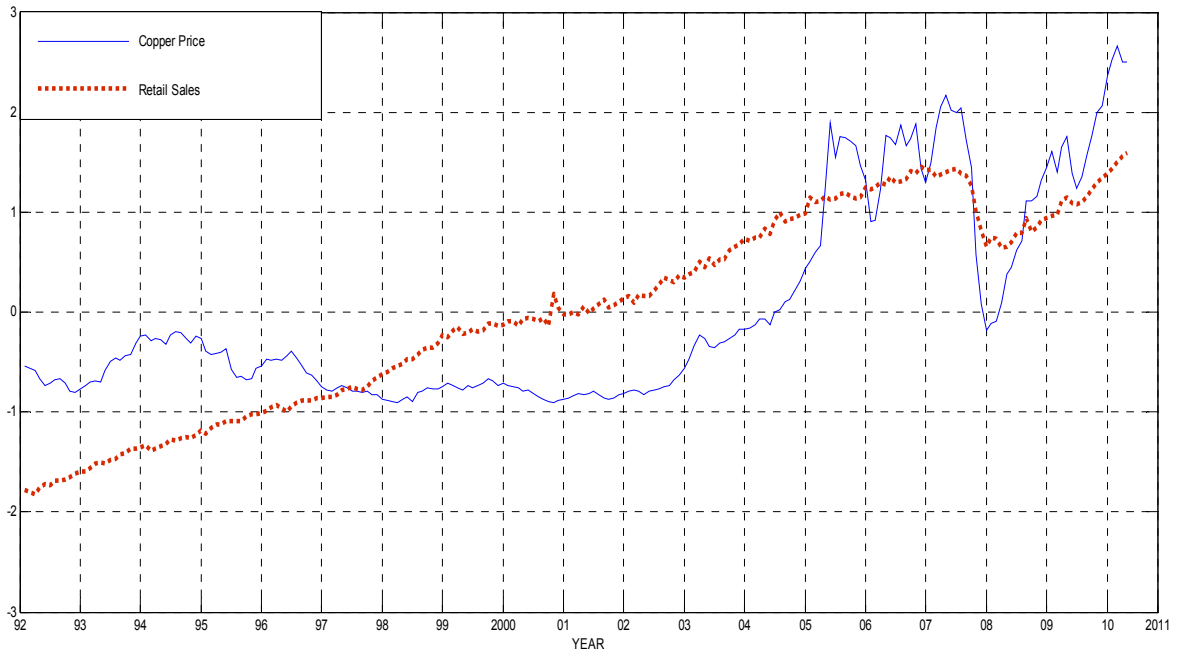


This index reveals the sentiments of the people. This data was published by The University of Michigan twice in month. The actual data is revealed only to the subscribers. By this data we estimate the sales of houses and automobiles with a good accuracy. Since houses and automobile sales are major factors which affects copper consumption the consumer sentiment has good effect on copper prices.

Retail Sales

There's a risk in relying too much on the advance estimates of retail sales because they are based on a relatively small sampling.

Exhibit7: Variation of Copper Price with Retail Sales



A more accurate sense of the underlying trend in consumer spending patterns can be discerned by monitoring sales on a three-month moving average basis or by looking at the last three months' worth of data and comparing it with the same three-month period the year before. There is good correlation between retail sales and copper in the business cycles 2001-2008 and the present one. This indicator was almost coincident.

Conclusion

The effect of economic indicators on copper prices is different in different business cycles. The economic indicator which is showing positive effect on copper prices in one business cycle (let say 1991-2001) may not have same effect on the next business cycle (2001-2008). So it important to study these economic indicators for each and every business cycle separately. Exports have major effect on the Copper prices followed by unemployment rate and consumer credit outstanding. The major part of US copper exports goes to China, which is the largest consumer of the red metal. The other economic which affect copper prices are Construction Spending, Industrial Production Capacity Utilisation (%), and Consumer Sentiment Index and Retail sales.

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Data Resources

Most recent GDP report:

- www.bea.doc.gov/bea/rels.htm

Industrial Production and Capacity Utilization:

- www.federalreserve.gov/releases/g17/current

Chicago’s Purchasing Managers’ Report (NAPM):

- www.napm-chicago.org

Manufacturing activity from the Institute for Supply Management (ISM):

- www.ism.ws/ISMReport/index.cfm

Dates and lengths of past recessions and expansions (business cycle data):

- www.nber.org/cycles.html/

Personal Income and Spending:

- www.bea.doc.gov/bea/newsrel/pinewsrelease.html

Retail Sales:

- www.census.gov/svsd/www/advtable.html

Consumer Sentiment by the University of Michigan:

- www.sca.isr.umich.edu/main.php

Consumer Confidence by the Conference Board:

- www.conference-board.org/economics/consumerConfidence.cfm

Employment Situation Report:

- <http://stats.bls.gov/news.release/empsit.toc.htm>