The Role of Financial Speculation on Markets for Industrial Metals*

Eva Pichler
Michael Böheim
Matthias Firgo

Vienna
September 2012

*) We like to thank Christian Helmenstein and Raimund Alt for cooperation in formulating the "policy recommendations". All errors are, of course, our own.

Content

Zusammenfassung

Seit dem Jahr 2003 zeigt sich bei den Preisen der meisten Industriemetalle ein signifikanter Aufwärtstrend, nachdem zuvor über einen Zeitraum von mehr als 15 Jahren die Preise real gesunken waren. Unmittelbar nach dem großen Konjunktureinbruch begannen 2009 die Preise neuerlich zu steigen, diesmal vor allem verursacht durch das starke Wachstum in China. Zu diesem Trend gesellt sich eine ausgeprägte, in anderen Wirtschaftssektoren nicht vorhandene Preisvolatilität, die grundsätzlich durch die strukturellen Charakteristika der Metallmärkte mit unelastischem Angebot und schwankender Nachfrage homogener Güter verursacht ist. fließt immer mehr Geld zu Spekulationszwecken in die Rohstoffmärkte. Auslöser hierfür war eine bahnbrechende Arbeit von Rouwenhorst und Gorton (2006). Sie zeigte, dass das Risiko von Portfolien durch Diversifikation in Rohstoffe gesenkt werden könnte, da diese sich antizyklisch gegenüber Aktienkursen verhielten. In der Folge entstanden zahlreiche Fonds, welche die Entwicklung einzelner Rohstoffe oder Rohstoffindices abbilden, in den letzten Jahren nahm auch die Zahl der Fonds zu, die an der Preisentwicklung partizipieren, indem sie physische Lager halten.

Beide Faktoren sind im Fall der metallischen Rohstoffe („Industriemetalle“) für die metallverarbeitende Industrie mit hohen Kosten verbunden. Durch hohe Volatilität werden Absicherungsgeschäfte („Hedging“) der nicht primär spekulativ orientierten Marktteilnehmer mit zunehmenden Risikoprämien teuer. Darüber hinaus belasten die generell steigenden Inputpreise die Gewinne der metallverarbeitenden Industrie langfristig.

Immer mehr Stimmen wurden laut, die vermuten, dass die spekulativen Einflüsse sowohl das Preisniveau als auch die Volatilität weiter erhöhen. Da Spekulation – im Gegensatz zu den meisten anderen Fundamentaldaten der Industriemetallmärkte – im Prinzip einer Regulierung unterworfen werden kann, kommt ihr besondere wirtschaftspolitische Bedeutung zu.

Der Fokus der vorliegenden Arbeit liegt auf zwei Arten von Spekulation. Die erste betrifft das Handeln auf Futures Märkten, auf welchen Termingeschäfte abgeschlossen werden, physische Lieferung in den meisten Fällen jedoch nicht erfolgt und in diesem Sinne keine reale Nachfrage nach dem derivativen Instrument zugrunde liegenden Produkt („Underlying“) entsteht. Daneben verfolgen wir die in der jüngeren Vergangenheit stark zunehmende Bedeutung von Lagerhaltung auf Industriemetallmärkten, welche durch die seit 2009 weltweit verfolgte Politik des „billigen“ Geldes ausgelöst wurde. Sie spiegelt zumindest zum Teil die wachsende Rolle rohstoffbasierter Fonds, aber auch anderer Formen spekulativer Lagerhaltung, welche durch die vorherrschende Geldpolitik stark verbilligt wurde, da der Zinssatz die wichtigste Kostenkomponente der Lagerhaltung darstellt. Diese Form der Spekulation generiert im Gegensatz zum Handeln mit Futures direkt Nachfrage an den Spotmärkten.

In der Literatur wurden zahlreiche Ansätze entwickelt, die den Einfluss von Spekulation auf das Preisverhalten untersuchen. Auf der einen Seite steht Friedmans

klassische Hypothese, dass Spekulanten durch die Zufuhr von zusätzlicher Liquidität in den Markt zu einer Stabilisierung der Preise beitragen. Im Gegensatz dazu belegen spieltheoretische Modelle, dass Märkte durch Spekulation destabilisiert und die Varianz der Preise erhöht werden kann.

Bezüglich des Zusammenhangs von Spekulation und Preisen wurden verschiedene Modelle entwickelt, alle möglichen Aussagen sind argumentierbar: Einerseits führt Spekulation Liquidität in den Markt, was die Preise senken sollte, andererseits eröffnet Futures Spekulation die Möglichkeit, Marktmacht strategisch auszubauen, was das Gegenteil bewirkt. Empirische Arbeiten sind daher erforderlich, um die relative Bedeutung verschiedener Argumente beurteilen zu können.

Die empirischen Befunde sind allerdings nicht eindeutig – einige Studien finden keinen Einfluss der Spekulation auf Preise und deren Varianz, andere stellen Preisblasen fest, wobei sich in verschiedenen Märkten, unterschiedlichen Zeiträumen und bei anderen Fragestellungen verschiedene Muster zeigen. Bei Agrarmärkten und Rohöl konnte der Einfluss der Spekulation in empirischen Arbeiten nicht definitiv nachgewiesen werden, bei Industriemetallen liegen gemischte Ergebnisse vor.

Die vorliegende Arbeit analysiert fünf an der *London Metal Exchange (LME)* gehandelte Industriemetalle (Aluminium, Kupfer, Nickel, Zinn und Zink) im Zeitraum 2003 bis Ende 2011. Aufgrund der fehlenden Verfügbarkeit von Tagesdaten der kontrollierenden Fundamentalvariablen stützen sich die zentralen Regressionsanalysen auf Monatsdaten. Zusätzlich werden zwei extreme Situationen (am Nickel- und Zinnmarkt) über einen Zeitraum von jeweils drei Jahren auf Basis von Tagesdaten untersucht.

Unsere empirischen Resultate zeigen unterschiedliche Effekte der Spekulation auf die Preise und deren Volatilität. Hoch signifikant lässt sich die These zurückweisen, dass Spekulation das Preisniveau (sowohl im Spot- als auch im Futures Markt) erhöht. In den Märkten für Aluminium, Nickel, Zinn und Zink sind die Einflüsse sowohl minimal als auch insignifikant, bei Kupfer finden wir einen signifikanten, aber geringen preissenkenden Einfluss der Spekulation, was auf eine liquiditätszuführende Funktion der Futures Märkte hinweisen dürfte. Im Gegensatz dazu ist in allen Märkten und in sämtlichen Spezifikationen der Einfluss der weltweiten Industrieproduktion auf die Preise ausgeprägt und hoch signifikant. In den Aluminium- und Kupfermärkten findet sich ferner erwartungsgemäß ein deutlicher (wenngleich in Relation zur Industrieproduktion stark abfallender) Effekt des Ölpreises (als wichtiger Input der Produktion) auf das Preisniveau. Die Hypothese, wonach Spekulation zu einem Anstieg der Spot- bzw. Futurespreise führt, kann anhand der untersuchten Daten nicht bestätigt werden. Im Gegensatz dazu wird die These, wonach Spekulation durch ihre Liquiditätszuführende Wirkung die Preise senkt, nicht auf allen Märkten zurückgewiesen.

In Bezug auf die Preisvolatilität finden wir, dass das Ausmaß der Futures Spekulation die Volatilität bei Aluminium und Kupfer erhöht, was impliziert, dass die Absicherungskosten der nicht spekulationsorientierten Marktteilnehmer durch die Futures Spekulation steigen. Die Spezifikation unseres Modells erlaubt (über die Logarithmierung der Daten), die geschätzten Koeffizienten als Elastizitäten zu interpretieren. Bei Aluminium ist eine sowohl signifikante als auch quantitativ beträchtliche Verstärkung der Preisvariation feststellbar. Ähnlich destabilisierende Effekte finden sich im Kupfermarkt. Eine 1%-ige Erhöhung des Spekulationsvolumens induzierte eine 2,9% - 5,2%-ige (Aluminium) bzw. 1,0% - 1,8%-ige (Kupfer) Erhöhung der Preisvolatilität, die als Standardabweichung der täglichen relativen Preisänderungen eines Monats definiert ist. Bei Nickel, Zinn und Zink lässt sich ein Einfluss der Futures Spekulation auf die Volatilität der Preise nicht nachweisen. Deutlich zeigt sich auf allen Märkten (mit teilweiser Ausnahme des Aluminiummarktes), dass die Variable Industrieproduktion die Volatilität senkt – was für die starke Informationsverarbeitung der Preisgestaltung auf Börsen spricht. Die Friedman'sche Hypothese, wonach Spekulation zu einer Senkung der Preisdispersion beiträgt, wird von den vorliegenden Daten nicht gestützt.

Die wichtigsten Resultate dieser Arbeit betreffen den Zinssatz bzw. die Rolle der Lagerhaltung, die sich wiederum zum Großteil ebenfalls auf die Zinsentwicklung zurückzuführen lassen. Zinseffekte treten in diesem Sinn sowohl direkt als auch indirekt in Erscheinung. Da die expansive Geldpolitik seit 2009 den Preis des Geldes weltweit auf historisch niedrige Niveaus (mit seit Jahren negativen Realzinsen) brachte, sind diese Resultate besonders ausgeprägt.

Zunächst zeigt sich, dass Zinsen einen direkt Preissenkenden Effekt ausüben. Signifikante Effekte finden sich im Zinn- und Zinkmarkt, die Größenordnung der Effekte ist allerdings in Relation zum Einfluss der internationalen Industrieproduktion gering. In den anderen Märkten fehlen signifikante Zusammenhänge, obgleich der negative Zusammenhang überall angedeutet ist. Dies bestätigt die bereits 1931 geäußerte Vermutung Hotellings, dass die Preise nicht vermehrbarer Ressourcen – dazu zählen letztlich auch alle Industriemetalle – negativ mit dem Zinssatz zusammenhängen. Auf der einen Seite haben Produzenten bei niedrigen Zinsen weniger Anreize, den Rohstoff rascher abzubauen, auf der anderen Seite wird Lagerhaltung billiger. Der erste Faktor reduziert das Angebot, der zweite erhöht die Nachfrage, beides wirkt preissteigernd.

Über die Lagerhaltung wird noch ein zweiter indirekter Wirkungskanal der niedrigen Zinspolitik sichtbar, dieser wirkt über die spekulative Komponente der Lagerhaltung. Betrachtet man den gesamten Untersuchungszeitraum (2003-2011), haben höhere (LME registrierte) Lager einen preisdämpfenden Effekt. Dieser ist hoch signifikant zumindest in den Märkten für Nickel, Zinn und Zink. Dieser Befund entspricht der traditionellen Sicht, wonach die Veränderung der gemeldeten Lagerbestände ein Signal für die Knappheit am Markt bildet. Übersteigt die Nachfrage das Angebot, steigt der Preis, gleichzeitig bauen Marktteilnehmer ihre Lagerbestände ab. Da die

Veränderung der Lager in den LME Warenhäusern täglich publiziert wird, diente sie für die Marktteilnehmer lange als wertvolle Orientierungsgröße.

Betrachtet man jedoch die Periode des „billigen Geldes“ ab 2009, verschwindet dieser Zusammenhang vollständig und die Situation kehrt sich (auf allen betrachteten Märkten) in das genaue Gegenteil. Ab nun hat eine erhöhte Lagerhaltung einen preistreibenden Effekt (bzw. der negative Preiseffekt wird abgeschwächt). Für Aluminium und Kupfer wird ein über den Gesamtzeitraum nicht statistisch signifikanter Einfluss der Lager auf die Preise in einen hoch signifikanten positiven Einfluss gedreht, auf dem Nickel-Markt wird der über den restlichen Zeitraum beobachtete preisdämpfende Effekt höher Lagerbestände ausgeschaltet. Auf den Märkten für Zinn und Zink können ab 2009 keine signifikanten Unterschiede in den Effekten der Lagerhaltung im Vergleich zu den Jahren davor ausgemacht werden. Auch wenn die geschätzten Elastizitäten dieses Zusammenhangs quantitativ gering erscheinen mögen, hat der teils enorme Lageraufbau insgesamt erhebliche preistreibende Effekte. Multipliziert man die Koeffizienten mit dem Lagerzuwachs im Zeitraum 2009/10, erhält man für diese Periode einen preistreibenden Effekt des Lageraufbaus für Aluminium von knapp 3%, bei Kupfer von knapp 11% (!).

Wir argumentieren, dass zwei Faktoren für diese Befunde verantwortlich sind. Erstens ging nach einer Preisblase im Nickelmarkt 2007 die Informationsfunktion der Veränderung der LME-Lager zumindest weitgehend verloren, die Markttransparenz wurde reduziert. Zunächst hatte die Mehrheit der Marktteilnehmer fälschlicherweise auf verstärkte Marktverknappungen geschlossen, als die Lager rasch zu schrumpfen begannen. Erst nach Monaten stellte sich heraus, dass zumeist nur eine Verschiebung von Lagerbeständen in andere, nicht an der LME registrierte, Lager stattgefunden hatte. Seither werden Lagerveränderungen in den Märkten mit Vorbehalten beurteilt.

Wichtiger ist vermutlich der zweite Einflussfaktor. Die Niedrigzinspolitik begünstigt das Halten von Lagern für alle Marktteilnehmer, insbesondere auch das Entstehen großer rohstoffbasierter Spekulationsfonds. Diese treten – im Gegensatz zum Handel mit Futures Kontrakten – auf den Spotmärkten direkt in Erscheinung. Als Resultat dessen stellt sich eine positive Korrelation zwischen Lagerhaltung und Preisen ein.

Wir betonen, dass Banken und Finanzinstitutionen dadurch gegenüber anderen Marktteilnehmern einen erheblichen, wirtschaftlich nicht zu rechtfertigenden Vorteil erhalten. Die expansive Geldpolitik bewirkt (genau das ist ihr Ziel), dass sich Banken bei den Zentralbanken günstig zu refinanzieren vermögen. Die zugrundeliegende Intention der Zentralbanken liegt darin, den Kreditfluss in die Realwirtschaft aufrechtzuerhalten. Aufgrund der herrschenden Regulierungsregime (Basel II bzw. III) sowie des geschwächten Vertrauens im Interbankenmarkt können die Banken diese günstigen Konditionen jedoch immer weniger an ihre Kunden bei der Kreditvergabe weitergeben. Dies führt dazu, dass das ‚innovative‘ Investmentbanking Geschäft

(„Spekulation“) ertragreicher ist als das klassische Kommerzbankengeschäft (Kreditvergabe an Unternehmen).

Für Banken wird es besonders attraktiv, rohstoffbasierte Spekulation zu betreiben – auch in speziellen Fall der Industriemetalle. Es ist in diesem Zusammenhang auch kein Zufall, dass Großbanken in jüngster Vergangenheit begannen, Lagerhäuser in großem Stil aufzukaufen (was die Grenzkosten der Lagerhaltung senkt und unter Umständen auch die Beobachtbarkeit der Lagerhaltung durch die Banken erschwert). In der Folge treiben sie in einer Phase geringer Zinsen und langsameren Outputwachstums die Preise auf Kosten der Nachfrager in die Höhe. Da Industriemetalle ein wichtiger Rohstoff für die verarbeitende Industrie sind, transformieren sich die Preissteigerungen bei Industriemetallen letztendlich in gestiegene Güterpreise. Frankel (2011)bezeichnete die zinssensitiven Preise von Rohstoffen entsprechend als „Vorboten der Inflation“.

Die Handlungsempfehlungen, die sich an diese Arbeit anschließen, sind zahlreich. Zunächst argumentieren wir, dass eine mögliche Limitierung der Futures Spekulation nur mit großer Vorsicht und unter Berücksichtigung sämtlicher Vor- und Nachteile geschehen dürfte, da die Gefahr des Entzugs von Marktliquidität nicht unterschätzt werden sollte. Zweitens weisen wir darauf hin, dass die Markttransparenz an der LME weit hinter dem US-amerikanischen Standard hinterherhinkt. Die Publikation präziserer Daten wäre für Marktstruktur und Marktergebnis vorteilhaft. In diesem Zusammenhang sind u.a. sowohl verbesserte Information über die weltweite Lagerung von Industriemetallen als auch die spezifische Rolle von Banken als Eigentümer von Industriemetallen und Lagerhäusern zu berücksichtigen. Eine weitere Handlungsempfehlung betrifft die Weiterentwicklung optimaler Lagerstrategien für die metallverarbeitende Industrie. Wir denken auch eine mögliche Subvention privater oder gemeinsamer Lagerstätten sowie eine Erhöhung der Recycling Raten an.

<u>Österreichische Maschinen- und Metallverarbeitende industrie</u>

Die österreichische Maschinen- und Metallverarbeitende Industrie besteht aus industriellen Unternehmen, die aktiv im Stahlbau, bei Metallkonstruktionen, im Anlage- und Maschinenbau tätig sind. Über 150,000 oft hochqualifizierte Personen sind in mehr als 1.200 mittelständischen Unternehmen beschäftigt. Die Branche erzeugt innovative Produkte und investiert intensiv in F&E. Im Jahr 2010 erbrachten diese Unternehmen einen Produktionswert von 33 Mrd. Euro.

Metallwaren umfassen z.B. Produkte wie Metallkonstruktionen, Schlösser und Beschläge aus unedlen Metallen, Werkzeuge oder Mechanik. Der Bereich Maschinenbau umfasst Produkte wie etwa Hebezeuge und Fördermittel, Land- und Forstwirtschaftliche Maschinen, Bergwerk- Bau- und Baustoffmaschinen etc.

Der Metallverbrauch der österreichischen Wirtschaft betrug im Jahr 2010 8,3 Mio. Tonnen, wovon etwa 82% auf Eisen und Stahl entfallen. Die wichtigsten Nichteisenmetalle waren Aluminium, Blei, Zinn, Zink und Kupfer.

Executive Summary

After a long period of declining prices of most industrial metals, prices started to rise substantially in 2003. During the recession of 2008 the price level fell sharply, but a rebound set in quickly in 2009. Moreover, price volatility in these markets is pronounced and substantially higher than in other industrial sectors. This is mainly due to the characteristics of the industrial metals markets, where inelastic supply, unstable demand and heterogeneous goods come together.

In addition, more and more money has flown into the market for speculative reasons. This development has been triggered by a paper of *Gorton and Rouwenhorst* (2006) demonstrating that investors are able to reduce portfolio risk by diversifying into raw materials as the returns to these types of assets are negatively correlated to equity returns. Quickly, large banks established funds that replicated the price of single resources or resource based indices. During recent years, also funds that gain from price movements in commodity markets by holding stocks of the physical asset have been founded. The increasing importance of speculative trading gave rise to presumptions that speculation might both increase the level as well as the volatility of prices.

In the case of industrial metals, both factors lead to rising costs for firms in the industry. Most important, hedging becomes more expensive with increased volatility as higher risk premiums have to be paid. Moreover, increasing input prices dampen profits directly. The present study looks at the impact of speculation on the price level and its volatility in five important industrial metals markets. We use data until the end of 2011 to be able to investigate even the most recent market developments.

In particular, we are dealing with two types of speculation. The first one, *futures speculation*, is more common and involves the trading of contracts of different maturities, physical delivery, however, is either excluded or not intended ex ante in most cases. Second, we investigate the role of (physical) stockholding, which is exerting a direct effect on spot markets *(spot market speculation)*. Indeed, stocks have been built up substantially in recent years since monetary policy has flooded markets with 'cheap money'. The interest rate being the most important cost factor of holding inventories, stock related speculation has become more attractive for all types of market participants. The same holds true for physically based funds, too. The increasing magnitude of stocks in most industrial metal markets at least partly mirrors strongly increased activities of exchange traded commodity funds (ETCs), which in contrast to (ordinary) exchange traded funds (ETFs) hold the underlying(s) in physical form.

In the economics literature, a variety of strands have developed to understand the impact of speculation on prices and volatility. On the one hand, the classical Friedman hypothesis claims that speculators as a class must dampen price volatility, because otherwise they would lose money as a class. In contrast, game theoretical approaches have shown that this need not be necessarily true, since price bubbles can arise. Empirical evidence is unequivocal, too. Results partly differ from market to

market, and from time period to time period. Also the underlying research questions seem to play a role. In total, empirical evidence of an impact of speculation on prices and volatility in agricultural and the raw oil market is rather weak, whereas in industry metals markets, more significant results have been obtained.

The present paper investigates price behaviour of industrial metals that are traded at the *London Metal Exchange (LME)* (aluminium, copper, nickel, tin and zinc) between 2003-2011. Most recent data are exploited to understand developments since 2009, in particular the impact of loose monetary policy on prices for industrial metals.

For our econometric model, we use monthly data as information about controlling variables is available only for this time scale. Two extreme situations (in the nickel market 2006-08 and in the tin market 2008-10) are investigated by using daily data, however.

We focus on the impact of speculation on both prices and price volatility. Concerning the former, no evidence of a systematic impact of futures trading on spot or futures prices could be found. In the markets for aluminium, nickel, tin and zinc, speculation affects prices both in a minimal and insignificant way. For copper, data suggest that speculation lowers prices significantly, but the quantitative size of the effect remains small. In contrast, there is strong evidence that in all markets and in all types of specifications of the model, OECD industry production strongly and significantly increases prices. Further, as one might expect, in the aluminium and copper industries, metal prices are also sensitive with respect to the price of oil, but the magnitude of the effects remains small in relation to the impact of industry output. To conclude, our data do not support the hypothesis that a higher level of futures speculation leads to higher market prices.

Turning to the impact of speculation on price volatility (measured by the standard deviation of the relative day-to-day changes in prices during a month), we find that futures speculation increases price volatility of aluminium and copper. We conclude that futures speculation is driving up hedging costs of risk-averse market participants. The estimated coefficients of our models can be interpreted as elasticities. The strongest effects are present in the markets for aluminium and copper: An increase in the volume of speculation by 1% leads to an increase of 2.9% to 5.2% in aluminium prices, and 1.0% to 1.8% in copper prices, respectively. In the markets for nickel, tin and zinc, no direct impact of speculation on prices can be proven. On the other hand, there is a significant and large negative effect of industry production on volatility in all markets (with the partial exception of aluminium), suggesting that news about industry output are transferred into prices quickly at stock exchanges. In any case, Friedman's hypothesis that speculation contributes to stabilize prices is not supported by the present data set, but destabilizing speculation seems to be at work.

The most important results of this paper concern the rate of interest and its impact on prices, both directly and indirectly via stock inventories, the optimal holding of which is a function of the borrowing costs of money. Since about 2009, loose monetary policy has brought down real interest rates to negative levels, and they are likely to stay there for many more years. So it is interesting to look for the impact of monetary policy on metal prices.

At first, the evidence shows that lower interest rates tend to increase prices (and vice versa). We find significant but small effects in the market for tin and zinc, while in other markets results are insignificant (if weak, even insignificant effects can be found, they all turn out to be negative). Hence, Hotelling's (1931) hypothesis that the price of a scare resource (finally, all industrial metals are fixed in supply) is negatively related to the rate of interest is not rejected. On the one hand, producers´ incentives to exploit raw material deposits are reduced (so that underground inventories are exploited a lower rate). On the other hand it becomes cheaper for all types of market participants to hold inventories when interest rates are low. The first factor reduces supply, the second increases demand, both work together to drive up prices.

Secondly, lower interest rates contribute to increase prices via enhanced speculation with stocks, too. Regarding the whole period under investigation (2003-2011), we find that higher stocks (at LME registered warehouses; from now on: LME-stocks) go together with lower prices. These results are significant at least in the markets for nickel, tin and zinc. This evidence is consistent with the traditional view that LME-registered stocks send market signals to traders: If supply exceeds demand, stocks are built up, and prices decline. Changes in stocks being published daily at the LME, this has been a reliable indicator for traders for a long time.

If we only investigate the years of 'cheap money' supply 2009/10, we find that this relationship vanishes completely, and the situation is turned into its opposite in all industrial metal markets. Firstly, low interest rates contribute to higher inventories. These inventories, however, are not associated with lower, but higher prices. In the markets for aluminium and copper, LME-stocks have no significant impact on prices in the period 2003-2008, but from 2009 on a significant positive impact can be detected. In the nickel market, the negative effect of stocks on prices in the pre 2009 period is reduced to zero in the post 2008 period. For the metals tin and zinc, we do not find a significant difference between these two sub-periods. Even though the quantitative effect of stocks from 2009 on seems to be limited by the size of the coefficient, the large increase in stocks may have contributed significantly to an increase of metal prices. Multiplying the respective regression coefficients with the growth of inventories during the years 2009/10, stocks might have contributed to a price increase of nearly 3% for aluminium and nearly 11% for copper.

According to our interpretations, two factors are driving these results. Firstly, after the price peak in the nickel market in 2007, the information function of LME-stocks was weakened and market transparency was deteriorated. LME-Stocks began to decline sharply, and most market participants interpreted this as a sign of increased market tightness. Only months later traders had learned that a substantial part of stocks had only been reallocated from LME registered warehouses to other warehouses. Since this time, agents have become more cautious in interpreting daily changes of LME-stocks, and market transparency has decreased.

Secondly, with low interest rates, holding stocks has become cheaper. This has inter alia enhanced physically based speculation by ETCs. Building up these funds directly creates demand at spot markets and is driving up prices immediately.

We stress the role of banks and financial institutions in this setting vis á vis other market participants. In particular, they profit from a competitive advantage which is not due to superior management but due to market conditions. Expansionary monetary policy has decreased the borrowing costs for banks, but due to Basel II/III and the poor state of confidence in the interbank market, banks are not able to pass over these conditions to firms. As a result, they have exclusively access to cheaper money, leading to lower costs and systematic rents in commodity based speculation vis á vis other market participants.

For this reason, a new business field has been opened up for banks who now engage in buying large stocks of physical commodities. In the context of industrial metals, it is little surprising that financial institutions have also started to buy warehouses systematically (which further decreases the marginal costs of holding stocks).

As a consequence, prices of commodities tend to rise even in the face of low "fundamental" demand. This should not be viewed as a beneficial smoothing of prices over the cycle, but as a systematic erosion of the price mechanism. Industrial metals are an important input in many industries, so that higher prices are transferred into higher consumer prices at last. In this context, *Frankel* (2008) speaks of commodity prices as "harbingers" of inflation.

According to our point of view, banks get access to low rates of interest by national banks in order to accomplish better borrowing conditions for the private sector, not in order to speculate, which results in biased prices of commodities and high excess burdens in the markets.

Our policy recommendations imply a variety of subjects. Firstly, we argue that futures speculation might be limited by regulation. This, however, must be based on careful considerations of the various pros and cons, given that the danger of reducing market liquidity should not be underestimated. Secondly, market transparency at the LME is poor as compared to US standards. We suggest that providing more precise data to the public could improve both market structure and market outcome. In this respect, it would i.a. be important to know more about worldwide warehouses for industry metals and the role of banks, in particular as owners of stocks and warehouses. A further policy recommendation concerns the development of "cost averaging" strategies for optimal stockholdings of industry metal consuming firms. We also think about "competition neutral" coordinated procurement in order to subsidy shared (or private) warehouse capacities to reduce hedging costs as well as potentials for improving recycling rates.

The Autrian Machinery and Metal Ware Industries

The Austrian machinery and metal ware industries consist of industrial enterprises active in mechanical and plant engineering, steel construction and metal ware production. Over 150,000 people are employed in more than 1,200 mainly medium-sized companies. In 2010 this branch accounted for a total production value of 33 billion Euros. Firms invest heavily in F&E in order to produce highly competitive innovative products.

Metal ware, for example, includes product groups like metal structures, locks and hinges made of base metal, tools and mechanisms. Machinery covers products like lifting and handling equipment, agricultural and forestry machinery, mining, construction and quarrying machinery etc.

In 2010 the metal consumption in Austria was about 8.3 mill. tons, where the proportion of iron and steel was about 82% and the proportion of non-ferrum metals was about 18%. Among the latter the most important metals were aluminium, lead, zinc, tin und copper.

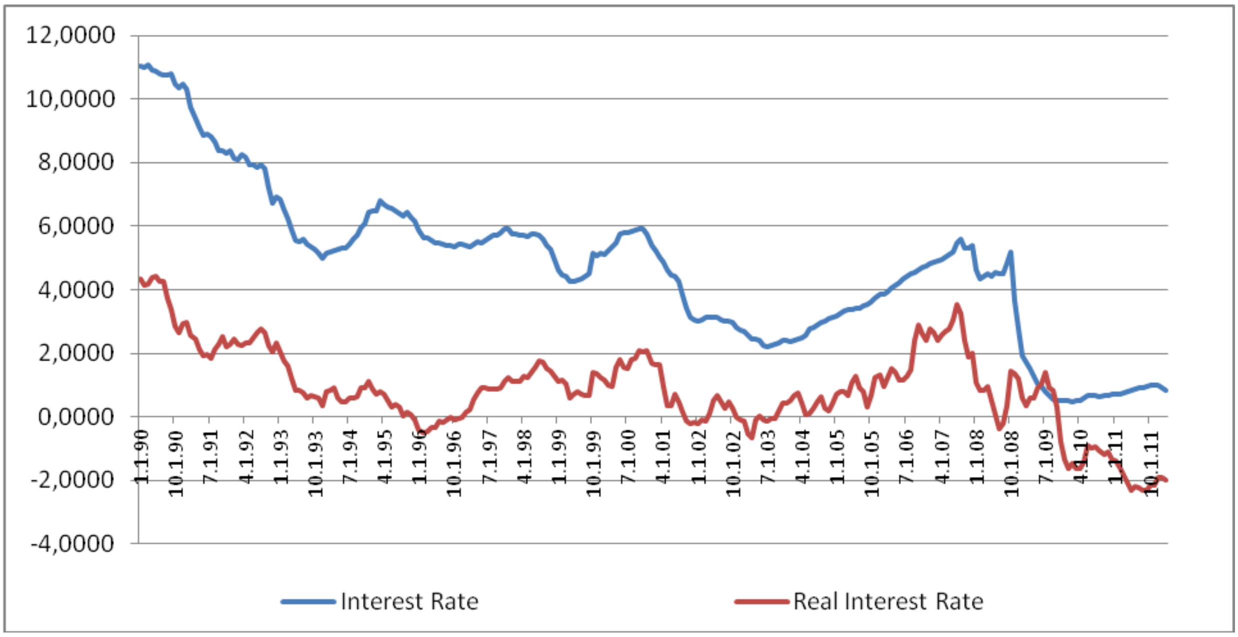
1. Introduction

Economic and finance models have made clear that speculation has many faces. Producers, consumers and "market outsiders" are involved, often it is difficult to tear apart whether a transaction is performed either to hedge or to speculate. We focus on two forms of speculation when formulating our hypotheses.

First, we ask whether futures market trading has an impact on the level and volatility of prices. This type of speculation is measured by volumes of contracts. The indicator has been used in other studies (e.g. Slade 2006). While its explanatory power might be limited from a theoretical point of view, it captures a variety of motives to speculate. We test the impact of futures trading on both prices and price volatility by controlling for market fundamentals and LME-stocks. We do not, however, assign a certain sign to this relationship as theoretical models for both directions have been proposed.

Second, we look at the role of inventories LME-stocks) as an instrument of speculation. We argue that while stocks of industrial metals have always been an instrument of speculation, the significance of this tool has, however, changed since a few years as central banks have begun to flood markets with cheap money. This period has approximately started in 2009. The nominal interest rate (OECD weighted average) fall below 1%, and real interest rates became substantially negative. (Figure1).

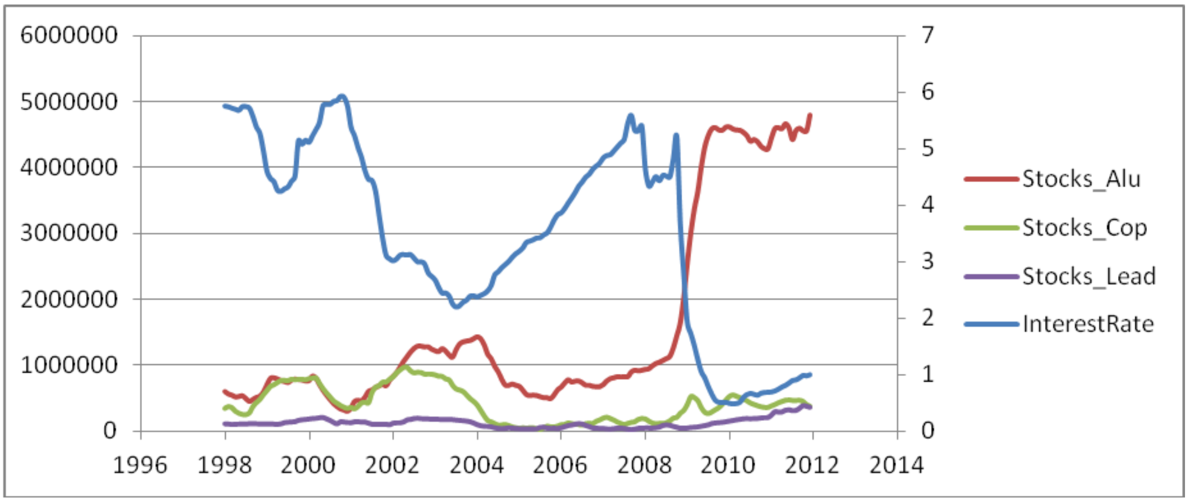
Figure 1: Nominal and real interest rates, OECD-average, 1990-2012

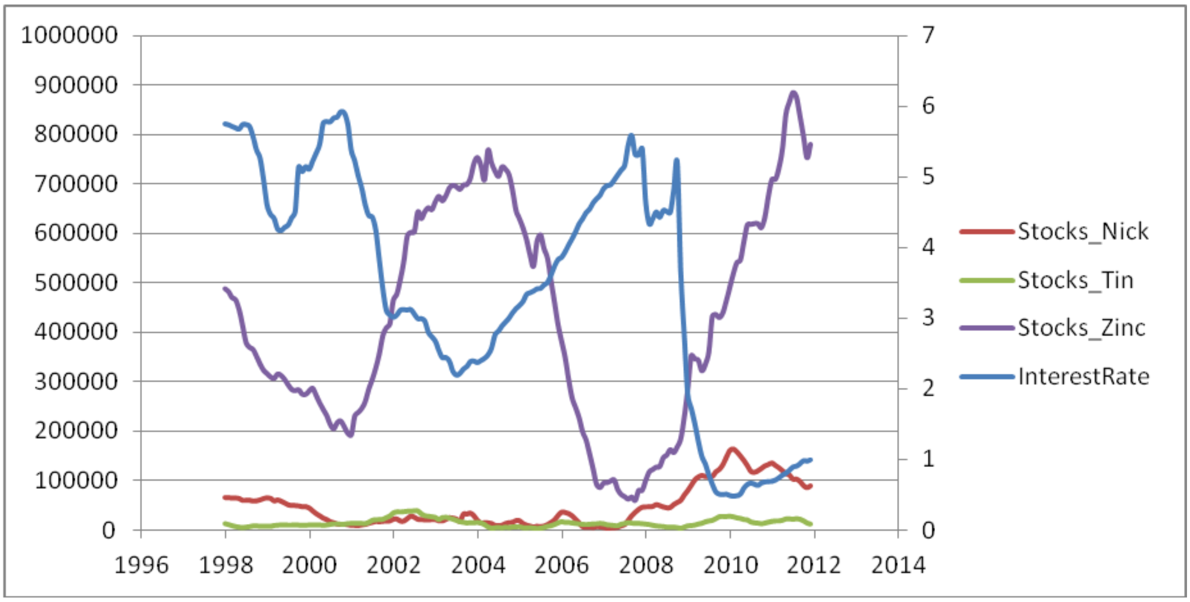


Source: OECD, own illustration.

For the rate of interest being the most important cost factor when holding inventories of industrial metals, it is not surprising that stocks are high when interest rates are low and vice versa. Figure 2 reveals that this relationship can be found in most markets.

Figure 2a, 2b: LME-Stocks of Industrial Metals and Nominal Interest Rates, 1998-2012





Source: LME, OECD, own illustration.

Correlation between interest rates and LME-stocks (table1) is negative for all metals and pronounced with the exception for copper, where it is negative but weak.

Table 1: Correlation Coefficient between Interest Rates and LME-Stocks, 1998-2011

Aluminium	-0,90
Copper	-0,13
Zinc	-0,70
Tin	-0,45
Nickel	-0,65
Lead	-0,44

Source: LME, OECD, own calculations.

Of course, the incentive to increase the level of inventories when money becomes cheaper is present for all kinds of market participants, but we claim that this effect is strongest for banks and financial institutions for the following reason.

Banks have access to money at low rates of interest (in real terms, they have fallen to negative levels). In December 2011 and march 2012, the ECB offered credits for banks for 1% for three years. Banks have borrowed about one trillion Euro from the European Central Bank. However, a substantial share of this amount has not been used to provide commercial credits to firms, and to avoid financial constraints to the 'real' economy (as intended by the ECB). Instead the financial institutions started to deposit hundreds of millions of Euro at the ECB, where interest rates of only 0,25% were paid. In spring 2012, the ECB lowered nominal interest rates to zero. This implies that opportunity costs for financial institutions have fallen to a historical low level. This is not true, however, for other types of market participants, because banks have costs of providing credits: Due to Basel II and Basel III requirements, and due to low trust in the interbank market, the spread between finance costs for banks and other firms has grown. As a consequence, banks get an advantage in speculation with physical goods and earn high rents as they are enjoying a substantial cost advantage (which is not due to superior business performance).

Given this development, we not only focus on the impact of futures speculation on prices and volatility, but also of the role of LME-stocks.

2. 'Speculation' in the economics literature

Arguments Pro and Contra Speculation

The impact of speculation, in particular in futures markets, on prices and volatility has been investigated from a variety of viewpoints. In spite of the fact that many arguments have been discussed, in principle two opposite positions collide:

The first claims that speculation is beneficial for the functioning of markets. This argument is going back to Adam Smith and has been resumed by Milton Friedman (1953). Speculators lower price volatility, as they buy when prices are low and sell when they are high. Otherwise speculators as a class would be losing money systematically. According to this view, more speculation – in particular in futures markets – increases market liquidity and contributes to transfer information of private agents into prices quickly and efficiently. Further, "pure" speculators allow producers and consumers to sell the risk to less risk-averse market participants which are prepared to bear it at a lower price. Hence, speculation allows efficient risk-absorption in markets.

The second strand of arguments postulates that the opposite can be also true – at least under conditions of imperfectly competitive markets and imperfectly informed speculators, in particular, when "excessive" speculation is present: Speculation may contribute to destabilize prices and breed "bubbles" where prices rise or fall below their fundamental values. If "excessive" speculation imports uninformed traders into the market, they might drive prices away from their fundamental values. In this context, speculation has been blamed to cause huge social costs, in particular in agricultural markets, and more general, in all types of commodity markets. In a non-competitive market, speculation may provide a medium to "corner" the market by insider trading, a possibility that arises if markets are not too large. It has been discovered that also stocks, which are a tool to interfere in the spot market directly, may play an important role in these games. Accordingly, both spot and futures markets provide market circumstances that allow for strategic moves to drive prices away from their equilibrium level both in the spot and futures market.

In any case, beyond dispute is the huge increase of speculation in commodity markets that took place during the last two decades, a fact that became well known as "financialization" of commodity markets. Investments of this type have been driven by the rationale that commodities are a distinct "asset class", which allows to diversify a portfolio in a favorable way. If this asset class has a specific risk-premium that is not replicable by a combination of other assets, in particular stocks (see Scherer and He 2008), the risk-return characteristics of the portfolio where they are added improves.

During the next years, the literature has found that different markets seem be characterized by a different sensitivity with respect to speculation (see Irvin et al. 2009 and 2010, Krugman 2008). E.g. in the agricultural and the raw oil market, speculation seems to be of less important than in the industry metals markets. In what follows we concentrate on the latter.

Reacting quickly, investors and hedge funds have begun to invent commodity based assets during the 90ies. In principle, two types of investments can be distinguished. First, index funds replicate a particular commodity index or the price of a single commodity in the same way that equity tracking funds replicate and equity index. They do not engage in physical stocks, but only operate on futures markets, where they continuously buy futures that are revolved into new contracts before expiry, since delivery of the physical stock is not scheduled. Secondly, exchange-traded commodity funds (ETCs) have started to hold stocks of commodities in physical form. These investments directly affect commodities markets by creating new 'real' demand, mainly in spot markets.

At present, physically based stocks are becoming more popular for two reasons. At first, the stable '*backwardation*'[1] of commodity exchanges of the last decade has turned into a stable '*contango*'[2] situation. With a positive correlation between futures prices and their time horizon, revolving futures position has become more expensive, raising costs and lowering profitability of index funds. Second, and perhaps more important, loose monetary policy has brought down real interest rates to negative levels, so that opportunity costs of holding stocks have become nearly negligible. In particular, after the flooding of markets with money by the European Central Bank in two steps (about a trillion of Euro), private banks took loans for 1 percent for three years, and deposited a majority of the sum (about 600 Bill. Euro) at the ECB for 0,25% since they did not have a possibility to use the money. Hence, the nominal opportunity costs of banks, which are the main issuers of ETCs, went down to 0,25% (and to 0% in spring 2012). Not surprisingly, big investors have started to buy warehouses in order to further bring down the marginal costs of holding inventories. It is not by chance that all of these investors have access to cheap money by being affiliated to some bank or financial institution.

As a consequence, holding stocks has become more attractive for all types of market participants, in particular for commodity funds and speculators (Of course, also a producer´s decision not to extract today but to wait until tomorrow is based on the same type of consideration). Hence we suppose that low interest rates have contributed to raise commodity prices as well. At present, consumers are worried when banks like JP Morgan announce that they are going to build up additional commodity based funds. One might wonder what producers will say when interest rates finally will have to return to former levels in a few years. More important in this context, however, is that this type of inventory based investment lowers price volatility not in the short, but in the medium run: Even if it is thought to be beneficial if price volatility would be reduced by speculation (if this were the case indeed), this

[1] *Backwardation* is a market condition wherein the price of a forward or futures contract is trading below the expected spot price at contract maturity.

[2] *Contango* is a market condition wherein the price of a forward or futures contract is trading above the expected spot price at contract maturity.

insight does not carry over to a longer time horizon. It rather comes down to the breaking of the operation of price mechanisms in these markets. When demand is low, increasing inventories prohibit an adequate decline of prices, sending biased signals to both producers and consumers. In other words, setting the price of credits nearly equal zero seems to translate into biased prices in commodity markets. We argue that this might have been taken place in the observed commodity markets indeed.

A short literature survey

Before a discussion about the impact of speculation starts, it is not even straightforward to define the "speculator" and to separate market participants into "good" and "bad" guys (see Irvin and Sanders 2010) as sometimes desired. The often noted equality of market participants (producers and consumers) as hedgers and outside agents as speculators is all too simplistic. In the complex reality of resource markets, more or less all agents do have more intricate motivations than the purely risk-seeking speculators and the purely risk-averse hedgers of standard textbooks, but their behavior can be described as a continuum of risk-taking and avoiding (see e.g. Scott and Sanders 2010, Irvin, Sanders and Merrin 2009, Hieronymus 1977). Producers´ selling or buying on futures markets affects their marginal revenues and hence production decisions (see Allaz 1992). More general, producers´ decisions to extract more or less of a resource that is finally fixed in supply always involves some kind of speculative elements, as has already been worked out in the seminar work of Hotelling (1931)[3]. At commodity exchanges, speculators limit their risk by taking opposite positions in different markets in order to hedge their risks. In an early contribution, Benninga et. al. (1983) have shown that even agents that only seek to hedge will not automatically take the exact opposite position in spot and futures market, but will follow an optimal hedging strategy (i.e. take at least some risk), which is even independent of preferences in a wide class of cases. To sum up, as long as the future is *uncertain* (in fact, it seems to be "very" uncertain in metals markets because due to structural market features, prices are due to huge volatility[4], even risk-avoiding market participants have to face some risk, that can never fully be eliminated, as hedging and speculative motives are finally two sides of the same coin.

Concerning the question of whether speculation is beneficial or detrimental, many ideas have been presented.

A famous starting point goes back to Milton Friedman (1953), who argued that speculation should decrease price volatility. This position goes even back to Adam Smith (1789). Just rising prices by exerting additional demand is quite a risky strategy as sooner or later, one has to "bury the corps", i.e. sell off the stocks and realize

---

[3] See also Slade and Thille (1997) who fail to reject this hypothesis in an empirical test for metal markets as well as Krugman (2008) who applies the same argument for the oil market.

[4] See e.g. Slade (2006) who argues that the price variance in industrial metals is about four times higher than that of total output prices.

losses. Paul Krugman (2008) has taken up this argument when claiming that the high oil-price has not been a "bubble" in 2008 but is driven by fundamental factors. Futures markets have also been viewed as beneficial in the literature because of two important functions: First, they reduce risk by transferring it to agents that are less risk-averse and are ready to bear it at a lower price. Secondly, they improve the inflow of information from all sides into the market, so that prices get more efficient.

Accordingly, Cox (1976) and Danthine (1978) build models where new speculators arrive with new information and hence lower spot price volatility in the market. In Cox (1976), a kind of efficient market model is presented.

Irwin et.al. (2009), who are strongly defending the view that speculation is not detrimental for the functioning of markets, argue that there are well known historical patterns of attacks upon speculation during periods of extreme market volatility.

Yet the economics literature provides also arguments that speculation can have destabilizing effects, too. An important contribution goes back to Oliver Hart and David Kreps (1986). The authors have shown that even with rational agents that have identical preferences and access to information, speculation may destabilize prices. In their model, it takes very strong assumptions for speculation to stabilize prices, even in a weak sense. The reason for their dissenting results is that they do not assume that speculators buy at high prices and sell when they are low, but buy when they expect that chances of price appreciations are high, and sell when the contrary holds true, which may be causing path dependent trends and rational bubbles, driving prices away from their fundamental values. Furthermore, Hart (1977) makes clear that a sophisticated speculator can yield profits by exploiting forecast rules of naïve speculators.

Jeremy Stein´s contribution (1987) further explains a possible destabilizing effect of speculation. In his paper, the arrival of more speculators in a market may lead market insiders to change inferences of current prices by traders, and therefore may change for the worse the information content of current prices, resulting in price destabilization and welfare reductions.

According to the Keynes-Hicks theory of speculation, forward trading allows producers to shift risks towards less risk-averse traders (see e.g. Newberry and Stiglitz 1981). If risk is transferred to agents that are better able to bear it, valuable exchange possibilities will be taken advantage of, and both producers and consumers will benefit from these activities: This result more or less corresponds to the simple idea that risk is traded between agents that attach different costs to holding it.

An important strand of the finance literature is concerned with the impact of futures markets on prices. Here, mostly game-theoretic finance models are used to work out the link between the different markets. Allaz and Villa´s (1993) contribution models an oligopoly market with Cournot duopolists. They showed that even in the absence of uncertainty, the existence of forward markets will lower prices, which benefits consumers and hurts producers. In this approach, forward markets increase competitiveness in a kind of prisoners´ dilemma situation, so that each producer reacts with increased output to additional futures market sales activities of the other firm. When the number of forward trading periods prior to production tends to infinity, the outcome tends to the competitive solution.

Allaz (1992) presented another model where futures market can hurt competition, and noncompetitive producers are able to increase profits by participating in futures markets: E.g. if they are engaged long, this provides them with an incentive to produce less than in the absence of future trading, since their marginal revenue from higher prices increases. On the contrary, if producers also sell in the forward market, a precompetitive effect arises. Ferreira (2003) provides another model, where in an oligopoly with forward trading, an anti-competitive effect of forward trading may arise. A renegotiation-proof equilibrium above competitive prices can be established, which are driving prices beyond a level without a futures market.

Newbery (1984) adds to the discussion by working out the role of inventories and stocks. He compares the optimal rule for holding inventories for a competitive and a noncompetitive producer. The necessary first-order conditions equate the marginal costs of holding stocks to the marginal benefits, which differ according to market structure. In a competitive environment, they are based on prices, in cartelized or imperfect markets on marginal revenues. The author shows that with a stationary and linear demand function, storage and hence the degree of price stabilization increases with the firm´s market share. This paper makes clear that price stabilization due to stockholding, which is one possible form of speculation (since it cannot be kept apart from future price expectations), is not necessarily beneficial but, on the contrary, may be a sign of abuse of market power, increase profits and hurt consumer surplus. In Newbery 1990 he introduces a further argument as how storage might be used by firms in imperfectly competitive market where futures markets are present to exert market power. Also in this approach, storages are used to stabilize prices above the competitive equilibrium. Newbery argues that the existence of futures markets reduces risk, which encourages fringe firms to supply more output. In order to prevent this possibility, incumbents have an incentive to destabilize spot markets to prevent entry.

Much attention has been given to speculation in the context of commodity index funds and ECT´s (either in terms that speculate on the price of a commodity index by buying and steadily rolling over futures in the commodity markets. Irvin, Sanders and Merrin (2009) provide a summary of arguments why speculation has not been destabilizing in commodity markets. They warn to equate money inflows to the commodity futures markets with demand. Commodity futures markets are zero-sum games, and there is no limit to the number of futures market that can be created at a given point of time. Real price effects will only arise when new information arrives that causes agents to revise their estimates of physical supply and demand:

First, dealing with Stein´s (1987) argument claiming that the arrival of new speculators could exert a negative externality on insiders by leading them to revise their own estimations in a possible biased way, the authors argue that this is simple unlikely, since it requires a large number of sophisticated and experienced traders in commodity futures markets to reach the conclusion that index-fund investors possess valuable information that they themselves, as market insiders, would not possess (see Irvin, Sanders and Merrin 2009). In other words, if speculation by uninformed traders leads to deviations of the price from its fundamentals, informed traders should take contrary positions and drive prices back to the "real" values.

Secondly, the authors claim that index fund positions are active in financial transactions in futures markets, they do not take positions in the physical market by purchasing, delivering or hoarding the commodity. Futures contracts only rarely involve the actual delivery of the physical product and hence remain purely financial transactions. Hence, Irvin, Sanders and Merrin (2009) argue that index fund investors cannot raise both futures and spot prices. They should not be compared to past efforts to corner commodity markets, such as the Hunt brothers´ effort to manipulate the silver market in the 1970s.

Nonetheless, the works of Hart and Kreps (1986), Hart (1987), Newbury (1987) and Stein (1987) have provided evidence, that – at least in theory – futures markets can destabilize spot prices, in particular when dominant market participants or irrationally forecasting speculators are present in the market.

A further argument that index investment speculation may be destabilizing has been provided by Masters (2008). He points out that in contrast to "traditional" speculators, who provide liquidity in the market, index speculators buy futures and the steadily roll over their position by buying calendar spreads, since they are not interested in physical delivery. Therefore, they consume liquidity and do not provide benefit to futures markets, but rather contribute to increased price volatility.

Slade and Thille (2006), while not providing a theoretical model, stress that an observed positive correlation between the volume of speculation and price volatility does not necessarily prove that the further caused the latter. The correlation might be due to a third factor, in particular the arrival of new information.

Concerning the link between spot or forward price levels and the amount of speculation, all kind of predictions are produced by the models. Slade and Thille (2006) conclude, that prices should be lowered when producers engage in forward trading by holding short positions there (as they gain from buying at low prices in the futures markets, which gives an incentive to supply). On the other hand, if consumers hedge, demand is effected analogously, and higher prices should be expected. Hence, if producer hedging dominates, one might expect that higher volumes of futures trading should lower prices. A further fact that could lead to lower prices with speculation is that commodity exchanges with futures markets concentrate trade in one (physical) place, thus lowering transaction and information costs, which results in lower prices (Slade 2006).

To sum up, while a broad variety of models with respect to the impact of speculation on prices have been proposed by the literature, two main approaches can be distinguished. One argues that speculation is beneficial by lowering both prices and price volatility, the other one rejects this idea and on the contrary claims that speculation leads to a destabilization of markets and higher prices. Hence, testable hypotheses for empirical works are available 'in both directions'.

Figure 3a: Market stabilizing speculation

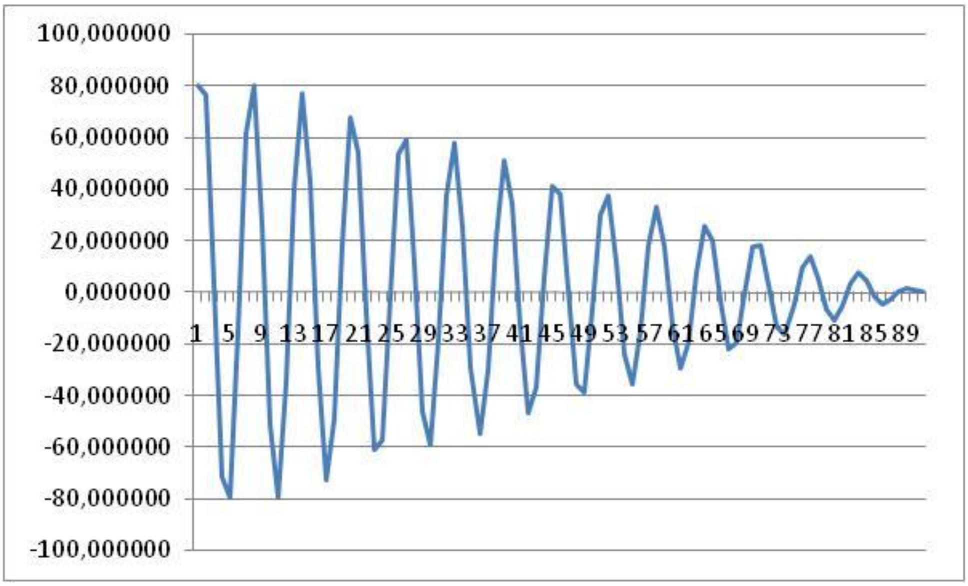
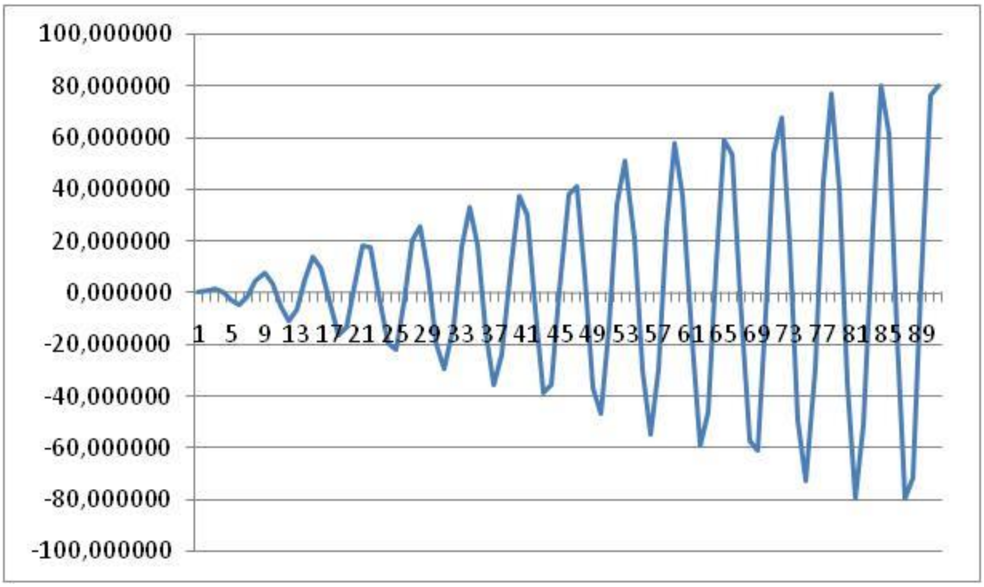


Figure. 3b: Market destabilizing speculation



Source: Illustration by the authors

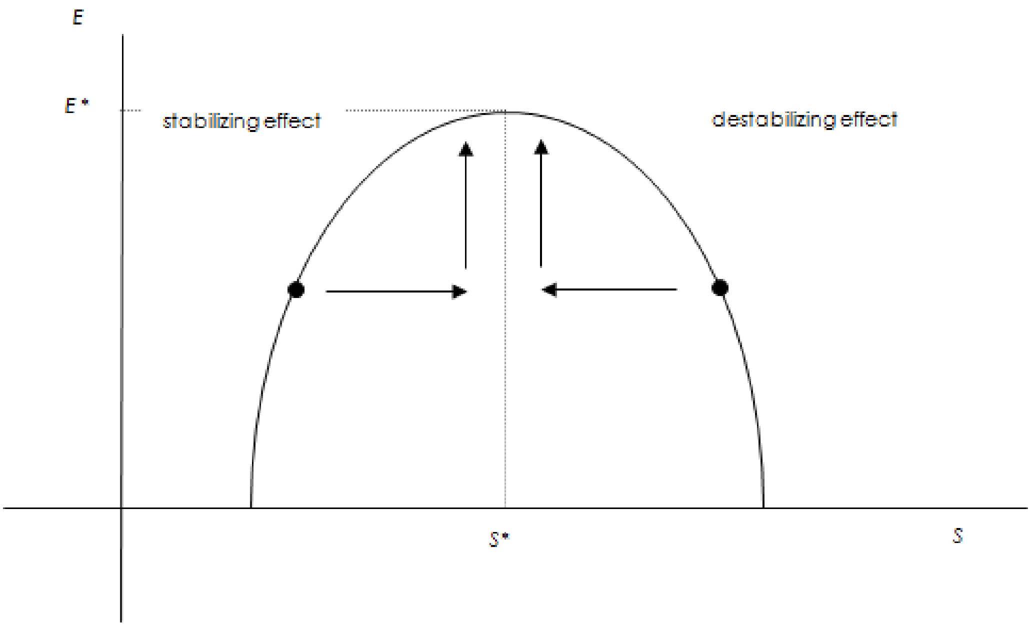
“Beneficial” vs. “excessive” Speculation

The activities of speculators bring additional liquidity, i.e. volume or turnover respectively, in the market. Thereby two main effects of ‘speculation’ on market efficiency can be distinguished, resulting in a dichotomy of ‘market stabilizing speculation’ on the one hand and ‘market destabilizing speculation’ on the other hand. (Figure 3a and 3b).

The question which effect will prevail depends on the efficiency status of the market ex ante the ‘speculative intervention’. If the market is below its efficiency optimum, speculation will have market stabilizing effects, while market destabilizing effects will occur if the efficiency optimum has already been passed.

The composite effect has a parabolic form resulting in an ‘inverse-U’ shape – which is well known in competition economics (cf. Aghion et. al. 2005) – of the relationship between speculation and market efficiency (Figure 4).

Figure 4: The relationship between speculation and market efficiency



Q: Illustration by the authors; S … speculation intensity, E… market efficiency

3. Speculation in the markets for industrial metals

Beyond the above reviewed general contributions to the topic several recent studies have investigated the role of speculation in more detail in the markets of core interest of our study, i.e. industrial metals.

Seminal papers have been presented by Slade (1991) as well as Slade and Thille (2006). In the former paper, Slade shows that the shift of market organization from price setting to commodity exchanges in the metals markets[5] has lead to more unstable prices. While this is not a direct test of the effects of speculation, the evidence is consistent with destabilizing speculation. Using panel data, she finds that price volatility is statistically significant and in a large manner determined by market structure or the existence of the commodity exchange, respectively. On the other hand, while market structure is found to be statistically significant as well, its impact is not proven to be as important.

The topic of the second paper (Slade and Thille 2006) is, inter alia to quantify the results of the first paper: The authors investigate how characteristics of product and forward markets affect levels of volatility and spot prices in six industrial metals market (from 1990-1999) by testing four groups of theories with panel data. They examine first how product market structure and futures trading affect the spot market, second they test for a relationship between product market structure and price volatility, and thirdly they investigate how information arrival affects price volatility and the volumes of trade. Their findings confirm the classical view that market structure does matter, thus rejecting the view that the existence of forward markets eliminates market power (Alaz and Villa, 1993). Further, concerning the relationship between market concentration and price volatility, they find that commodities that are produced in more concentrated markets tend to exhibit lower price variation. Supplementary, the link between lower prices and larger volumes of futures trading seems to be stronger in more concentrated markets, an observation that is congruent with the models of Allaz (1992) and Allaz and Villa (1993). An important finding concerns the impact of trading volume on spot price volatility. The authors find a strong and positive connection between the two. They argue that when the correlation is due to a third common factor, however, the significance of this relationship should disappear when instruments are used. As the relation virtually completely disappears upon the introduction of instruments, they conclude that the positive link between speculation and volatility is due to the arrival of new speculation. These findings are consistent with the hypothesis that speculation does not destabilize spot price volatility.

In the nickel market, a huge price peak was observed in 2007: Prices rose from about 10.000 US$ to about 50.000 $US per ton and fell sharply again within a few months. Posch (2011) investigated the role of speculation in this period. He found evidence that speculation, while not causing price trends, contributed to reinforce them. In

[5] Slade (1991) investigates the price behavior of aluminium, copper, lead, nickel, silver and zinc.

particular, during periods of substantial price changes, speculation further increased price volatility.

Market concentration

Using panel data, Slade and Thille (2006) found a positive impact of market concentration on industrial metal prices. In spite of these findings, we have decided not to use information concerning market concentration in our estimations for several reasons.

Using data of the Swedish Raw Materials Group, we have calculated two concentration measures for the major industrial metals. First, the Herfindahl-Hirschman index HHI measures the sum of firms´ squared market shares (multiplied by a factor 10.000). The C4 concentration index simply measured the cumulated market share of the 4 largest firms in the market). Quality of those data, however, is not sufficient for our purposes. During the last years, the metal production and consumption of China grew rapidly. Yet in most mines, production data have not been published. Therefore, total world production can only be roughly estimated. The difference between identified and estimated total world production grew significantly during recent years. E.g. in the aluminium industry, only about 60% of total world production could be identified, in the zinc market it was even less.

Therefore, one has to choose to calculate concentration measures on the basis of total world output or identified output. Using the latter, concentration ratios are overestimated, using the former, an underestimation would result, since big firms might have been omitted. Moreover, over- and underestimation do not remain constant over time but are growing (see Table 2). Since we focus on recent market performance, data are of limited value for our research questions.

Table 2: Share of Identified Production in Industrial Metal Markets, 2003-11

	Aluminium	Copper	Nickel	Lead	Tin	Zinc
2003	91,80%	95,90%	97,00%	71,40%	86,30%	89,70%
2004	89,40%	96,20%	98,50%	71,20%	86,10%	89,60%
2005	90,00%	96,40%	98,50%	70,10%	84,10%	88,90%
2006	90,00%	96,30%	96,10%	65,50%	85,40%	91,20%
2007	88,90%	94,60%	92,00%	58,10%	88,40%	89,30%
2008	80,80%	76,20%	91,40%	54,60%	80,20%	81,20%
2009	75,90%	75,70%	87,50%	50,80%	81,10%	66,00%
2010	71,00%	74,40%	89,40%	46,40%	76,90%	60,50%
2011	60,20%	71,40%	87,70%	40,90%	74,60%	59,00%

Source: Raw Materials Group (2012), own calculations.

We have nonetheless tried to incorporate concentration ratios in our estimations (see Table 3a and 3b for the HHI and C4). Using time series, we do not find any significant impact of HHI or C4s on prices although the HHIs were calculated on the basis of identified production (and were therefore overestimated). While this seems surprising at a first sight, it does not contradict predictions of industrial economics models: Most metal markets are only modestly concentrated, some seem to have rather competitive market structures. Though huge firms are operating in these industries, their market power seems to remain bounded in the world markets, which are of huge sizes as well. In addition, most big firms are operating in different markets at the same time, so that their output is not concentrated on one market in most cases. An exception is found in the nickel market, where concentration is highest. In the aluminium and zinc market concentration is lower, but it has intensified during the last years. It remains to be seen whether market power will affect prices in these industries in the time to come. In addition, the complex role of China calls for more attention of economic scholars yet.

Tab 3a: Herfindahl Hirschman Indices, 2003-2011

Basis: Identified Production

	Aluminium	Copper	Nickel	Lead	Tin	Zinc
2003	576	373	857	390	817,6	289,5
2004	559	374	892	380	593,6	233,4
2005	501	372	921	363	573,8	249,8
2006	463	398	934	344	610,3	262,0
2007	580	836	1.079	395	715,7	326,0
2008	678	542	1.262	379	655,9	554,2
2009	795	525	1.010	361	528,1	723,5
2010	780	491	986	342	416,5	663,5
2011	821	485	1.036	331	-	666,0

Source: Raw Materials Group (2012), own calculations.

Tab 3b: 4-Firm Concentration Indices, 2003-2011,

Basis: Identified Production

	Aluminium	Copper	Nickel	Lead	Tin	Zinc
2003	42,30%	30,10%	49,70%	31,10%	49,30%	27,70%
2004	41,50%	30,70%	51,00%	25,00%	42,90%	23,90%
2005	39,20%	31,00%	54,00%	27,30%	43,10%	24,40%
2006	37,10%	33,90%	53,60%	11,50%	44,20%	27,00%
2007	44,50%	46,90%	58,90%	n.a.	45,60%	30,10%
2008	48,30%	39,80%	64,30%	n.a.	45,00%	39,50%
2009	40,50%	38,50%	55,20%	n.a.	43,40%	44,80%
2010	52,40%	37,40%	54,70%	n.a.	34,40%	44,20%
2011	51,90%	36,90%	47,80%	n.a.		44,60%

Source: Raw Materials Group (2012), own calculations.

Industrial Metal Market: Stylized Facts

Industrial metal markets, though different in many aspects, have a variety of stylized facts in common. First, production is comparably capital-intensive and involves high sunk costs. If demand is low, firms cannot leave the market rapidly, if it is high, capacities are limited, and marginal costs jump to high levels when capacity constraints approach. Finally, many producers are located in developing countries that are very dependent on export incomes. These firms often do not have the flexibility to reduce production in times of low prices, and they lack the capacities to increase production when prices are high (see Slade and Thille 2006). These factors contribute to highly unstable prices, which are regularly observed.

The size of a market (see table4) is an important factor in whether and how speculation might affect prices. While in small markets it is easier to exert market power, this seems less likely in huge markets like e.g. the market for crude oil.

Tab 4: Estimated world production in kT, 2003-11

	Aluminium	Copper	Lead	Nickel	Tin	Zinc
2003	28.100	15.300	3.100	1.240	280	9.870
2004	29.900	15.850	3.100	1.250	320	10.350
2005	31.900	16.600	3.400	1.280	348	10.230
2006	33.900	17.350	3.500	1.355	352	10.700
2007	38.200	18.000	3.600	1.445	350	11.350
2008	39.800	18.450	3.800	1.380	332	11.650
2009	37.000	18.700	3.850	1.340	333	11.300
2010	41.000	19.200	4.200	1.350	359	12.800
2011	43.500	19.700	4.600	1.470	..	13.100

Source: Raw Materials Group (2012), own calculations.

Measured in quantities of extracted material, aluminium is by far the largest market followed by copper and zinc. We find that production has been growing quickly (apart from the years 2007-09), the strongest dynamics is found in aluminium and lead.

In this light it is not surprising that prices (see table5) rose sharply during the rapid growth period 2003-11: Mines have limited and partly declining capacities, it takes years and huge sunk investments to increase capacities. In addition, demand for individual metals can change substantially in the short run due to technical change, both by new applications, which open unknown markets, and newly invented substitution possibilities (e.g. copper by aluminium).

Tab 5: Industrial metals prices per T in US $, 2003-11

Year						
2003	**Aluminium USD/t**	**Kupfer USD/t**	**Blei US$/T**	**Nickel USD/t**	**Tin USD/t**	**Zinc USD/t**
2004	1.429	1.772	512	9.553	4.876	826
2005	1.711	2.859	883	13.850	8.504	1.045
2006	1.900	3.684	977	14.726	7.376	1.384
2007	2.571	6.720	1.291	24.226	8.788	3.284
2008	2.639	7.121	2.587	37.241	14.532	3.251
2009	2.580	6.989	2.099	21.208	18.576	1.882
2010	1.657	5.103	1.705	14.572	13.501	1.640
2011	2.174	7.553	2.149	21.852	20.465	2.161

Source: Raw Materials Group (2012), own calculations.

Of course, nominal prices are of little significance if inflation takes place. Deflating average yearly prices with the OECD price index, a modified picture arises.

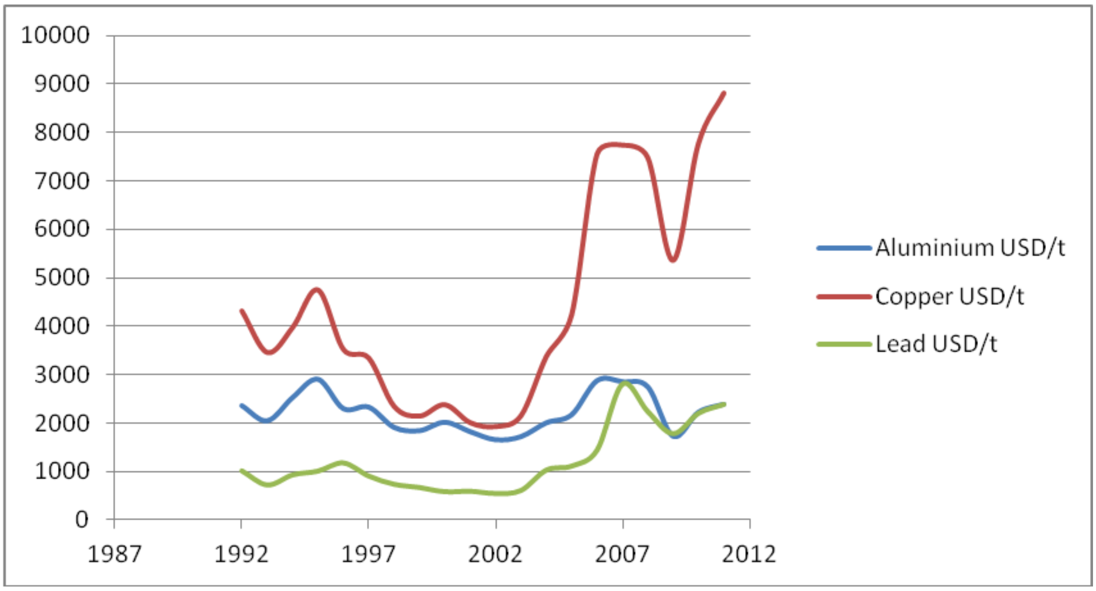
Real prices of all metals fell during the 1990ies (relatively to the basis year 1990), and a price rally started in 2003. Since then, heterogeneous developments of metal prices have been observed.

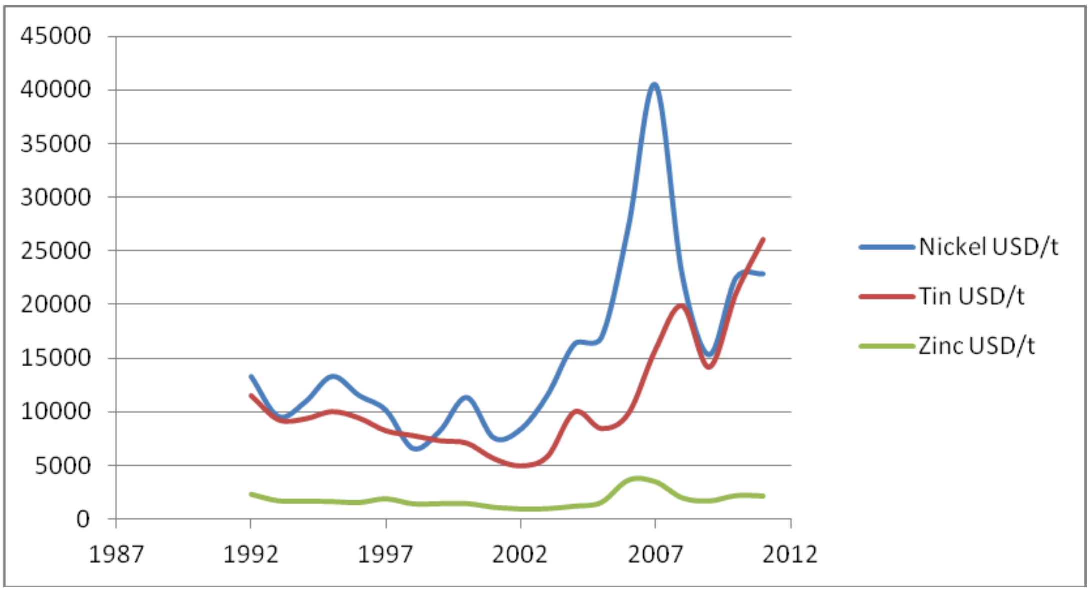
There is only one metal, zinc, where real prices do not show a long-run upward trend. Growth of capacities seems to have brought down prices to a long-run equilibrium level, indicating that constant returns to scale prevail in this industry. Lead is a borderline case where prices have increased only modestly over the two decades. Substantial real increases in real prices prevail in the aluminium industry, which mostly follows the oil price, and the copper industry. Real prices rose strongest for the metals tin and nickel.

Looking at figure 3b, the price peak in the nickel market seems to be an outstanding event. It has been investigated by Posch (2011), who diagnosed a substantial impact of speculation on prices though he stressed, that in principle, prices were determined mostly by market fundamentals. We also investigate this time period in the nickel market by using daily data 2006-08. According to our results, speculation added relatively little to the level and volatility of prices. However, a change in LME-stocks which was not due to supply-demand associated factors but perhaps due to speculation (later it became known that stocks were simply shifted from LME registered warehouses to non-registered warehouses) has driven prices far from equilibrium levels.

Economists analyzing the long-run development of metals prices have found that there is some evidence of cyclicality in prices, and price fluctuations are not purely random (Roberts 1994). In particular, phases of declining and low prices seem to last longer than phases of rising prices. Moreover, the long run trend of real prices was found to be constant over decades. In the light of prices that were steadily rising during the years 2003-07, Cuddington and Jerrett (2008) suggest that at present, we are in an early phase of a new "supercycle" for industrial metals which is primarily caused by urbanization and industrialization in China.

Figure 5a, 5b: Real prices of industrial metals, 1992-2011





Source: LME, OECD, own illustration.

In the time period considered, prices increased even faster than quantities, resulting in a huge market growth. The prices of copper more than quadrupled within of 8 years. After a similar rally, tin became the most expensive metal in the group. In 2011, the value of the copper market was about 174 bio. US$, the aluminium market amounted to about 104 billions. The smallest market for tin still accounted for about 8 bio. US$ (values for 2010). These figures still lack metal that is gained from scrap, which is substantial. E.g. for nickel, the recycling market is nearly as large as the market for newly excavated nickel.

During the period 2006-08, the price of nickel rose from about 10.000 US$ to nearly 50.000 US$ per ton. A similar sharp increase in prices can be observed in zinc during the period 2006-07. In 2009, a bottom was reached, and prices then started to grow again. Several papers have investigated the role of speculation in these periods.

Two smaller markets where speculation has been proven definitely are the silver and the cacao market. The former has a size of about 25bio.US$ (2010), the latter of about 12bio.US$ (2010, see World Cacao Foundation 2010). The size of these markets is roughly comparable to these of tin, lead and zinc. In the cacao industry, a single dealer managed to square the market three times between 1996 and 2002 by buying a physical amount of about 5-10% of total world production in hidden actions(see Werdinger et.al. 2010). In the silver market (see Gilbert 1997), an agent of a large Japanese firm managed to corner the whole market for an extended time period by driving up demand at the LME. This allowed his firm to get higher profits from silver, since the LME price acts as a reference price for the worldwide market. Finally, however, he ended up with huge losses when he was forced to sell the accumulated stocks at lower prices in the end.

In the crude oil market, which is substantially larger (roughly 4.000 bio.US$ in 2011, own estimations), the possibility that prices have been driven by speculation has been questioned by most scholars (see e.g. Krugman 2008, Fatouh et. al. 2012).

Industry metals are resources of fixed supply after all. Hence, on might suppose that scarcity of global supply might have been a determining factor for increasing prices. Table 5 depicts the long run availability as measured by statistical coverage of metals:

Tab 5: Statistical Coverage, Reserves and Resources of Industrial Metals (2004)

	Reserves (in mio. T)	**Resources (in mio. T)**	**Statistical coverage (resources) in years > 100**
Aluminium	n.a.	n.a.	n.a.
Copper	470	>2.300	32
Nickel	62	140	44
Tin	6,1	>11	23
Zinc	22	1.900	23
Lead	67	>1.500	21

Source: RWI 2008, Table1.1

Zinc and lead are amongst the metals with the shortest statistical coverage. Nonetheless, it is exactly these metals that have found to exhibit the flattest time paths. On the other hand, nickel, the price of which rose by far to the highest levels, has a statistical coverage which is twice as big as that of zinc or lead. For aluminium, the statistical coverage is high, since bauxite is available in abundance. Its price has been pegged to the price of oil, since production is highly energy consuming. In the case of copper, the RWI (2008) found that between 1975 and 2005, prices and statistical coverage were positively correlated. To conclude, though one might suggest that lower coverage should drive prices up (RWI 2008, p. 13), the data prove that this is not the case, and other factors are the driving factors behind prices.

We proceed to calculate output value to find that industrial metal markets are huge (table 6).

Table6: Market size of industrial metals 2003-11, in Bill. US $

Year	Alu	Copper	Lead	Nickel	Tin	Zinc
2003	40.155	27.112	1.587	11.846	1.365	8.153
2004	51.159	45.315	2.737	17.313	2.721	10.816
2005	60.610	61.154	3.322	18.849	2.567	14.158
2006	87.157	116.592	4.519	32.826	3.093	35.139
2007	100.810	128.178	9.313	53.813	5.086	36.899
2008	102.684	128.947	7.976	29.267	6.167	21.925
2009	61.309	95.426	6.564	19.526	4.496	18.532
2010	89.134	145.018	9.026	29.500	7.347	27.661
2011	104.444	173.557	11.017	33.572	n.a.	28.689

Source: Raw Materials Group (2012), own calculations.

4. Identification and Measurement of Speculation

Much has been written about the possibility to define, identify and measure speculation in metal markets. As argued above, speculation is not easily defined, and it is quite ambiguous to distinguish speculators from hedgers. Producers might be hedging, but also speculating in futures markets, consumers have both hedging and speculative motives as well. Even speculators regularly hedge by taking opposite positions in different markets. In sum, a strict separation of hedgers and speculators is rather futile.

The volume of speculation

In the present paper speculation is measured by two variables. On the one hand, volumes of futures contracts that are exchanged on the LME are used. This type of speculation takes place at futures markets only, physical delivery, though possible in principle, is rarely involved.

The LME does not publish volumes separately for futures markets of different time horizons (3, 15 and 27 months), but only the aggregate volume of trading. Though not being an optimal indicator for speculation from a theoretical point of view, they mirror the inflow of money derived from index fund investors, ETF and ETC´s.

Commodity based speculation has become more popular by the rise of physically based ETC´s. We do not know whether banks have started to hold physical inventories for speculative reasons, too. In any case, stocks have been growing significantly in most metal markets during the last years, at least partly reflecting additional demand from ETC speculation.

As argued above, the major cause is the low rate of interest, as it decreases the opportunity costs of holding inventories. Of course, in contrast to futures speculation, physically based investment funds raise demand in the spot market and hence affect prices directly. Hence we suspect that low interest rates affect prices in the industrial metals markets by increasing the incentive to speculate via holding stocks.

As it is well known, other transmission mechanisms between interest rates and prices of scarce resources are present as well. Calvo (2008) pointed out the impact of lax monetary policy on commodity prices. He warned that excess liquidity in several non-G7 countries lead to an explosion of commodity prices, which according to him is a harbinger of future inflation. His arguments follow from the impact of low interest rates in Hotelling´s (1937) approach for resources with fixed supply: In equilibrium, their price has to raise *pari passu* with the rate of interest. If the latter is low, the former must increase to insure that when the resource is finally used up, the expected price will equate the price at which the scarce resource can be substituted by other inputs. High resource prices will finally result in increased consumers prices, and inflation will increase.

In a similar spirit, Frankel (2008) has shown that monetary policy influences commodity prices: Accordingly, a monetary expansion raises the prices of resources, whether via increased inflation expectations, or via a decreased rate of interest, or both. Low interest rates enhance the demand for storable commodities, or decrease the supply, through a variety of channels. Extraction incentives get stronger, firms´ incentives to hold inventories grow, and speculators are encouraged to shift into commodity contracts and out of treasury bills (Frankel 2008, p. 295). In particular, ETCs which are based on physical raw materials fall under this class.

Therefore, since interest rates have been at historical low levels (and even negative) during recent years, we focus on the role of stocks and their possible impact on prices of non ferrous metals.

Futures speculation

The amount of futures exchanged on the LME is huge indeed. Figure 6 depicts the share of yearly traded LME futures in world production. In this figure, volumes are measured in tons as to ensure comparability with world production (in contrast, futures contracts are specified in lots). We find that on average, yearly production was traded nearly 30 times on futures markets at the LME. Looking at this figures we must not forget that the LME is not the only metal exchange worldwide (e.g. copper is traded in Chicago as well).

When considered in relation to market size, the intensity of futures speculation increased slightly during the period 1998-2011, which includes the period where prices were rising most rapidly.

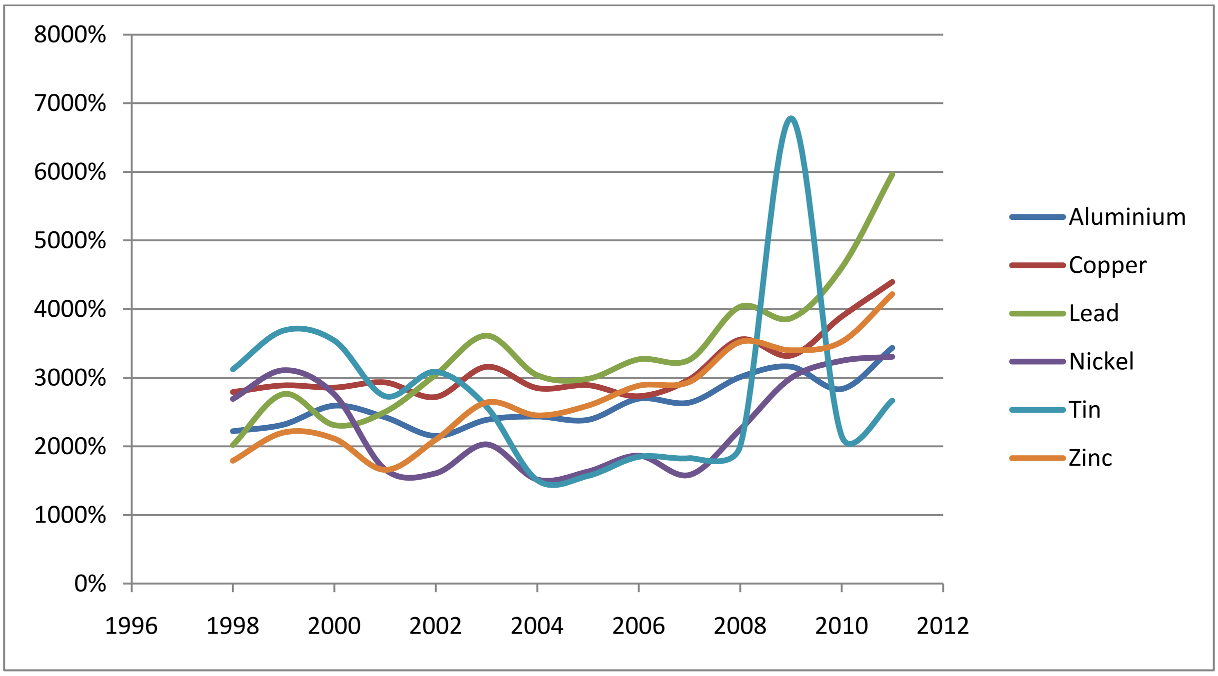
At a first sight, apart from the tin market, this is not necessarily a signal of "excessive" speculation. Since 2011, a rising trend seems to be observable in all metal markets captured by this work. In the tin market we find peak in 2009, which is even much more pronounced if we look at monthly data. In fact, volumes of futures contracts were higher than average mainly during the last three months of the year. We investigate this period more closely by looking at daily data below.

Apart from this, significant differences between the level of speculation seems to be present between industrial metals industries throughout the whole time period. Therefore, it seems difficult to define "normal" or "excessive" speculation independent of market characteristics. Without giving an economic interpretation, we note that there are indications that the amount of speculation and market concentration seem to be negatively related. In e.g. 2010, the correlation coefficient between volumes and the Herfindahl-Hirschman index was about -0,48. Further research is needed to get an interpretation of these finding.

Inventories

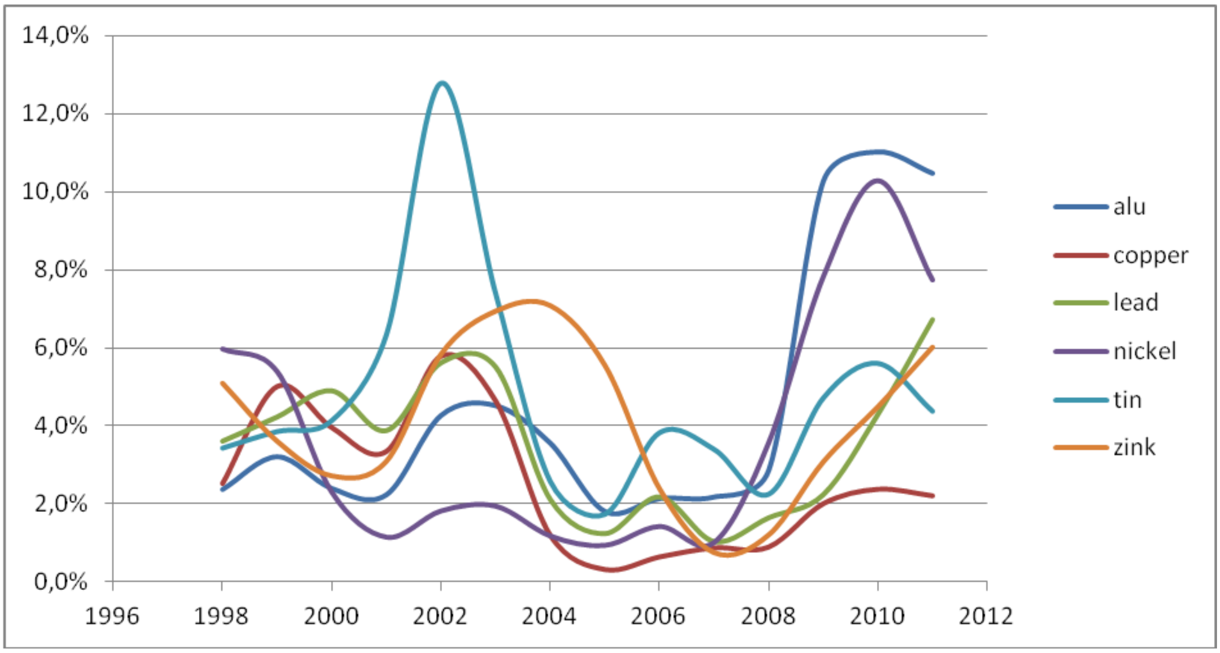
Since 2008, when the policy of low interest rates was started, LME-stocks rose to high levels. This is particularly pronounced in the aluminum and nickel industry and still significantly observable in the zinc, tin and lead industry. Only the latter had seen higher LME-stocks in relation to yearly production before. Copper seems to be an exception so far. According to a recent newspaper article, however, huge physically based ETC´s in the copper industry are going to be set up by JP Morgan and Blackrock (Die Presse 2012), so that copper inventories will jump up soon as well. Figure 7 shows the development of LME-stocks in the metals markets.

Figure 6: Share of the volumes of yearly futures trading at the LME in total world output, 2003-2011



Source: LME, own illustration.

Figure 7: Average monthly LME-stocks of industrial metals 1998-2011, as share of world production



Source: LME, own illustration.

Another factor that has favored physically based investment funds vis á vis index based funds, too. During recent years, a stable backwardation situation, where spot prices exceed futures prices in the stock exchange has given way to a contango situation, where the contrary holds. In this setting, index speculation becomes more expensive as funds are forced to roll over their maturing contracts permanently in order to prevent delivery of the physical good. When contracts with longer time horizons are more expensive than contracts that end sooner (which is per definition the case when contango prevails), rolling over becomes more costly, and the returns of index based funds are lowered.

5. A simple empirical model of speculation on markets for industrial metals

Data and Descriptive Statistics

In order to test our hypotheses we estimate the spot and futures prices and price volatilities for five major non-ferrous metals, namely aluminum, copper, nickel, tin, and zinc. While equivalent data for lead would be available in principle, we do not include this metal as lead is used as an instrument variable below. We obtain our financial data on these metals from the LME, while macroeconomic data on demand and cost variables come from the OECD Statistical Database (OECD, 2012). Our data set comprises the time period from January 2003 to December 2011.

The LME provides daily data on spot and futures prices, forward trading activities, and inventories (LME-stocks) for each of the five metals. The OECD data, however, are available monthly only. Therefore, we use monthly aggregates of the LME data. In constructing the variables used for our estimations we follow Slade and Thille (2006). However, in contrast to Slade and Thille (2006), we do not deflate our data on monetary variables because prices at the LME reflect world market prices and trade at the LME is global. Therefore, we fear that any index chosen as a deflator will lead to biased values for at least some parts of the market. Instead, a trend variable (*TREND*) and yearly fixed effects (denoted as f.e. in the regression output tables), respectively, are included into our model to control for time series behavior during the period observed. The following paragraphs describe the variables used. Each of the LME variables is constructed for aluminum, copper, nickel, tin, and zinc, respectively. All prices are denoted in US-dollars.

PRICE SPOT (*PRICE FUT*) is the monthly average of the daily cash settlement (daily three-month futures) price of the respective metal.

VOLA SPOT (*VOLA FUT*) is the standard deviation of the daily relative changes in the cash settlement (three-month futures) price in percent during the month observed.

TURNOVER is the monthly average of the daily sales of futures contracts, divided by the total yearly world production (*WORLD PROD*) of the metal, and multiplied by 100. While the unit of contract for futures at the LME is one lot, we convert the turnover volumes to metric tons. We do so in order to increase the comparability across metals because the size of one lot is not the same for all metals analyzed.[6] Data on the total yearly world production of metals are obtained from the Raw Materials Group (RMG).[7]

STOCK is the monthly average of daily LME-stocks, again for each metal divided by its total yearly world production (*WORLD PROD*), and multiplied by 100.

---

[6] While 1 lot is equal to 25 tons for Aluminum, Copper, and Zinc, it is the equivalent of 6 tons for Nickel and 5 tons for Tin.

[7] See www.rmg.se for company details.

In addition, to account for changes in demand and cost, we use three variables obtained from the OECD (2012).

IR is the average of three short term (3-month) interest rates, the European interbank offered rate (EURIBOR), the UK interbank loan rate (LIBOR), and the US certificates of deposit.

OIL is an oil price index (*2005=100*) which reflects the average price for the three main blends of crude oil (Brent, Dubai Fateh, and West Texas Intermediate).

IP is an index (*2005=100*) for the total industrial production (output) of the OECD countries.

Although market concentration measured by the Herfindahl-Hirschman Index (HHI) turns out to have a significant impact in many of the specifications on metal prices and price volatilities in Slade and Thille (2006), we do not include variables on market concentration provided by RMG in our estimations for three reasons. First, the RMG data fails to identify a substantial share of the yearly world production in terms of producers and ownership within the period covered in our sample. Second, based on the RMG data, market concentration is very low for all metals, with the maximum values in the HHI ranging from 424 (Zinc) to 1,054 (Nickel) during the period observed (see table 3a, 3b). Third, production data is provided yearly only, while we observe all other data monthly. As we do not estimate a panel including all metals but estimate equations for each metal individually, changes in the market concentration are perfectly captured by yearly time fixed effects.

The specification of the econometric model

For each of the five metals we estimate a simple linear model. We model individual models for each of the metals because we are interested in testing our hypotheses for each metal separately because among the various metals there are substantial differences (concerning e.g. market size, reactivity to business cycle).

The general model we are estimating for each metal is defined as

$$\begin{aligned} log(y_t) = \alpha + \beta_1\, log(TURNOVER_t) + \beta_2\, log(STOCK_t) + \beta_3\,(STOCK09/10) \\ +\gamma_1 log\,(IR_t) + \gamma_2 \log\,(OIL_t) + \gamma_3 log\,(IP_t) + \gamma_4\, TREND_t + \varepsilon_t, \end{aligned} \tag{1}$$

where y_t is the average price or price volatility in period *t*, α , $\beta_k\ (k = 1,2,3)$ and $\gamma_l\ (l = 1,2,3,4)$ are the parameters to be estimated, and ε is a random variable with zero mean. *STOCK09/10* is an interaction term with *STOCK09/10* = *(log(STOCK$_t$))(Y09+Y10)*, where *Y09* and *Y10* are dummy variables set equal to one for observations in the year 2009 and 2010, respectively, and zero otherwise. The inclusion of *STOCK09/10* allows us to separate the effects of the sharp increases of

LME-stocks observed in the 2009-2010 period on prices and price volatilities, which we argue are likely to be a result of loose monetary policy as argued above.

Econometric Model: Further technical explanations

Coefficients are to be interpreted as elasticities.

2SLS inefficient (see increase in standard errors and decrease in R^2) but consistent if endogeneity.

Specifications (1) , (2), (5), (6) in Table 9 to Table 13 restrict $\beta_3 = 0$, thus assuming no significant impact of STOCK09/10.

Interpretation of net effect of Stocks during 2009-10 period: STOCK + STOCK09/10.

STOCK09/10 not estimated with yearly fixed effects as in (5) and (6) because the effects would be captured by the dummies for 2009 and 2010.

Yearly fixed effects (f.e.) perfectly absorb changes in the market concentration as measured by the yearly RMG data.

Using the logs of the variables allows us to interpret coefficients as elasticities directly. To control for time series behavior, we further include a *TREND* or dummy variables for each year into equation (1). Slade and Thille (2006, p. 241-244) discuss several econometric issues related to their econometric model, which is similar to our model of equation (1).[8] Among these issues are the question of non-stationarity of (some of) the variables, potential endogeneity of some of the explanatory variables, the estimation of a static vs. a dynamic model, and the choice of an error covariance structure.

Assuming that all our variables are stationary, we estimate our model in log levels rather than in differences for two reasons. First, using differences instead of levels most likely decreases the explanatory power of our model substantially, which eventually may result in failure to empirically explore our hypotheses. Second, Slade and Thille (2006) emphasize the lack of agreement and controversial results in the literature on the issue of stationarity of commodity prices.

As for endogeneity, the variables *TURNOVER, STOCK* and the interaction term *STOCK09/10* are likely to be endogenous and applying ordinary least squares (OLS) may thus lead to biased estimates of β_k. Therefore, we also apply two-stage least

[8] Due to the fact that we are interested in the effects for each metal individually rather than in estimating a panel, the complexity of the issues discussed in Slade and Thille (2006) is reduced in our model.

square (2SLS) instrumental variable (IV) estimations of our model using the first lags of the respective variables as instruments in the first stage regressions.

With respect to the question of whether to estimate a static model as in equation (1) or a dynamic model, Slade and Thille (2006) argue that dynamic models estimating futures price typically use high frequency hourly or daily data and include short term lags only. Therefore, they conclude that dynamics are not likely to play an important role when applying monthly data.

Finally, to obtain consistent standard errors in the presence of both heteroscedasticity, which is likely to occur when estimating price levels, and/or autocorrelation in the residuals, we apply a Newey-West (1987) heteroscedasticity and autocorrelation consistent (HAC) estimator.

Empirical Results and economic interpretation

For each of the five metals analyzed the regression results of prices and price volatilities applying different specifications of OLS and 2SLS estimates is presented (table 8-13 below). We here only discuss the results on futures prices and futures price volatilities, but these results also apply *mutatis mutandis* to spot prices and spot price volatilities without any restrictions[9]. Compared to the futures markets the results of the spot markets exhibit hardly any differences in the size of the coefficients and the significance levels. However, our models tend to explain futures markets slightly better than spot markets in terms of their fit measured by the R^2.

Table 7: Summary of Central Results

		Aluminium	Copper	Nickel	Tin	Zinc
Turnover	Prices	0	-	0	0	0
	Volatility	+	+	0	0	+
Stocks 2003-2011	prices	0	0	-	-	-
	volatility	-	-	0	0	0
Stocks 2009-2010	prices	+	+	+	0	0
	volatility	+	0	0	0	+
Interest rate	prices	0	0	0	-	-
	volatility	0	+	+	+	+
Industry production	prices	+	+	+	+	+
	volatility	-	-	-	-	-

Summary statistics and the main econometric results of our estimations are summarized in Table 8 and Tables 9-13, respectively, below (further results for spot

[9] The regression output tables of spot prices and spot price volatilities are available in the appendix.

prices see Appendix). For the five industrial metals under investigation, Table 7 summarizes the most important results. The direction of relevant effects are indicated by "0" if insignificant, by "+" if positively, and by "–" if negatively significant. The results for prices and volatility both hold for spot and futures prices.

At first, results clearly show that futures speculation does not increase the level of prices. Coefficients are zero with the exception of copper, where they are significantly negative, but small. Hence the hypothesis that producers´ market power allows them to influence prices positively by using futures speculation is rejected for the data set under investigation.

In contrast, OECD-wide industrial production increases prices significantly throughout all markets, and the extent is large. As one might expect, also the oil price enters the determination of the aluminium price, and, to a lower degree, of the copper price. For other metals, no significant impact of the oil price on prices could be observed.

To sum up, international production seems to drive the price level of industry metals, and energy prices enter in the price determination for aluminium and copper. Futures speculation does not have a particular role though.

Concerning price volatility, a different picture is obtained. We do find a significant destabilizing effect of futures speculation on prices in the markets for aluminium, copper and zinc, so that speculation is exerting a negative effect on market participants that seek to hedge risks. In the nickel and tin markets, no empirical evidence for an impact of speculation on price volatility is present.

The results suggest that throughout all markets, international industry production lowers price volatility. We interpret this finding by the information content of production and the ability of markets to absorb this type of information quickly. The rate of interest, on the other hand, significantly contributes to more volatile prices in the markets for copper, nickel, tin and zinc. We come back to an interpretation of these findings below.

To conclude, the data suggest that futures speculation does destabilize prices, at least in the aluminium, copper and zinc markets. In particular, Friedman´s hypothesis that speculation is dampening price volatility is rejected in the present paper.

Next turning to the effects of the rate of interest, they are found both directly in the results for interest rates and indirectly in results for LME-stocks.

At first, interest rate tend to decrease prices directly (which we find for the tin and zinc market), but results remain weak. Second, lower interest rates result in higher LME-stocks holdings since the most important cost component declines.

Concerning the effect of LME-stocks, we find that over the whole period of investigation, higher LME-stocks lower prices in the nickel, tin and zinc markets (for aluminium and copper, evidence remains insignificant). This corresponds to the traditional view that LME-stocks were interpreted as indicator of supply and demand (see Slade and Thille 2006). Since 2009, however, this link has been completely reversed, and the impact of LME-stocks on prices has become positive in the aluminium, copper and nickel market (they are insignificant in the other markets).

We argue that two factors can explain these observations. Firstly, after the price peak in the nickel market in 2007, market participants had learned that stocks in LME registered warehouses only sent incomplete signals about market scarcity. Afterwards, the informational content of daily changes in LME-stock was eroded.

Second, the speculative demand for stocks in the spot market itself contributed to a positive correlation between prices and the level of stocks. We presume that it have been particularly banks and financial institutions that drove up the demand for LME-stocks in metals as – in sharp contrast to other market participants - their opportunity costs of holding inventories are near to zero.

Though the estimated coefficients seem to be low, this effect might have contributed to significant price effects as inventories have grown substantially since the period of cheap money has begun. Multiplying the growth of inventories in the period 2009/10 by the corresponding regression coefficient, we find that higher inventories might have caused a rise of prices in the aluminium market of 2,8% and in the copper market of 10,8%. For tin, nickel and zinc, no corresponding effects have been identified.

In any case, more information concerning the role of banks and financial institutions in the industrial metal markets, in particular as holders of inventories, are needed since the might have significant effects for firms and consumers.

Our results partially contradict the findings of Slade and Thille (2006) who (for the 1/1990 – 1/1999 period) find

- mainly significant negative impact of speculation on price levels,
- partly significant positive impact of LME-stocks on volatility (significance vanishes if commodity and/or time fixed effects are included),
- highly significant positive impact of industrial production on volatility.

Our research, however, cannot univocally confirm the conjecture that speculation does have a negative impact on price levels and/or volatility. A main factor is due to substantial changes in significance and direction of the effects when different time periods are observed. More in-depth investigations and research is necessary in this direction to discover the yet 'hidden' causes of this phenomenon.

Table 8: Summary Statistics for Industrial Metals

Variable	Obs	Units	Mean	Std. Dev.	Min	Max
Aluminum						
PRICE SPOT	108	USD	2118.17	485.34	1330.20	3071.24
PRICE FUT	108	USD	2138.61	492.46	1347.05	3122.35
VOLA SPOT	108	%	1.45	0.55	0.63	3.27
VOLA FUT	108	%	1.38	0.53	0.61	3.19
TURNOVER	108	%	11.01	1.81	7.55	16.72
STOCK	108	%	5.48	3.90	1.57	12.47
Copper						
PRICE SPOT	108	USD	5625.11	2462.12	1587.48	9867.60
PRICE FUT	108	USD	5587.05	2472.88	1600.08	9855.20
VOLA SPOT	108	%	1.84	0.78	0.84	5.86
VOLA FUT	108	%	1.79	0.81	0.81	6.01
TURNOVER	108	%	13.13	2.52	8.50	19.78
STOCK	108	%	1.65	1.28	0.17	5.56
Nickel						
PRICE SPOT	108	USD	20017.81	9125.60	7913.75	52179.05
PRICE FUT	108	USD	19800.50	8695.47	7927.75	49131.19
VOLA SPOT	108	%	2.45	0.97	0.98	7.43
VOLA FUT	108	%	2.37	0.94	1.04	7.59
TURNOVER	108	%	9.00	2.98	4.30	15.40
STOCK	108	%	4.04	3.55	0.25	12.18
Tin						
PRICE SPOT	108	USD	13634.67	7059.07	4435.68	32460.56
PRICE FUT	108	USD	13591.36	7075.35	4466.14	32477.78
VOLA SPOT	108	%	1.92	0.89	0.57	6.27
VOLA FUT	108	%	1.86	0.89	0.52	6.32
TURNOVER	96*	%	10.06	8.84	4.12	57.77
STOCK	96*	%	3.87	2.10	1.00	9.00
Zinc						
PRICE SPOT	108	USD	1962.09	901.25	754.65	4405.40
PRICE FUT	108	USD	1974.29	889.04	772.95	4320.50
VOLA SPOT	108	%	2.06	0.78	0.60	4.80
VOLA FUT	108	%	1.98	0.75	0.59	4.43
TURNOVER	108	%	12.42	2.55	7.69	18.81
STOCK	108	%	4.17	2.32	0.57	7.51
OECD Data						
IR	108	Index	2.77	1.63	0.48	5.59
OIL	108	Index	124.63	49.50	47.75	249.66
IP	108	Index	100.30	5.01	89.99	109.30

* RMG data on the 2011 world production of Tin is missing.

Table 9: Regression Results for Aluminium Futures

Aluminium Futures Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.022	0.063	0.041	0.396	-0.022	-0.147
	(-0.235)	(0.192)	(0.505)	(0.959)	(-0.351)	(-0.398)
STOCK	0.018	0.025	0.009	-0.009	-0.072	-0.062
	(0.374)	(0.493)	(0.199)	(-0.169)	(-1.053)	(-0.963)
STOCK09/10			0.038**	0.065*		
			(2.186)	(1.948)		
IR	0.014	0.014	0.009	-0.003	-0.093***	-0.087**
	(0.763)	(0.621)	(0.560)	(-0.126)	(-2.651)	(-2.448)
OIL	0.249***	0.253***	0.237***	0.227***	0.241***	0.232***
	(3.678)	(3.720)	(3.791)	(3.461)	(3.660)	(3.381)
IP	2.747***	2.814***	3.289***	3.876***	2.978***	3.023***
	(6.922)	(5.679)	(7.879)	(5.029)	(4.732)	(4.842)
TREND	-0.000	-0.001	-0.001	-0.003		
	(-0.039)	(-0.393)	(-1.062)	(-1.412)		
R^2	0.887	0.886	0.896	0.870	0.933	0.930
Adj. R^2	0.879	0.878	0.887	0.858	0.923	0.920

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.804***	2.967**	1.134***	5.236**	0.899***	4.501**
	(3.293)	(2.277)	(5.091)	(2.554)	(4.521)	(1.982)
STOCK	-0.320**	-0.427**	-0.380***	-0.699**	-0.120	-0.080
	(-2.553)	(-2.344)	(-3.023)	(-2.367)	(-0.458)	(-0.216)
STOCK09/10			0.043***	0.099***		
			(4.828)	(3.186)		
IR	0.039	-0.032	0.017	-0.146	-0.106	-0.192
	(0.731)	(-0.380)	(0.313)	(-1.270)	(-0.827)	(-1.027)
OIL	0.041	0.016	-0.060	-0.257	-0.365*	-0.095
	(0.213)	(0.067)	(-0.349)	(-0.744)	(-1.928)	(-0.265)
IP	-4.535***	-3.215	-1.718	4.101	1.105	0.205
	(-3.666)	(-1.635)	(-1.357)	(1.272)	(0.634)	(0.070)
TREND	0.010***	0.002	0.006*	-0.012		
	(3.550)	(0.296)	(1.859)	(-1.241)		
R^2	0.410	0.278	0.508	0.303	0.631	0.364
Adj. R^2	0.369	0.228	0.463	0.240	0.576	0.269

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

Table 10: Regression Results for Copper Futures

Copper Futures Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.611***	-1.050***	-0.522***	-0.781***	-0.139	-0.151
	(-4.975)	(-4.224)	(-4.394)	(-2.964)	(-1.493)	(-0.592)
STOCK	0.021	0.062*	0.016	0.043	0.021	0.058
	(0.779)	(1.921)	(0.632)	(1.430)	(0.489)	(1.008)
STOCK09/10			0.192***	0.209**		
			(2.980)	(2.442)		
IR	-0.007	-0.019	-0.006	-0.013	-0.071*	-0.069*
	(-0.334)	(-0.839)	(-0.313)	(-0.643)	(-1.807)	(-1.682)
OIL	0.405***	0.422***	0.423***	0.439***	0.493***	0.518***
	(2.945)	(2.939)	(3.264)	(3.288)	(5.278)	(5.240)
IP	3.642***	3.983***	4.292***	4.550***	4.888***	4.933***
	(5.662)	(5.578)	(6.006)	(5.926)	(7.200)	(7.030)
TREND	0.010***	0.011***	0.009***	0.009***		
	(5.686)	(5.970)	(4.797)	(4.390)		
R^2	0.939	0.929	0.945	0.941	0.974	0.974
Adj. R^2	0.935	0.924	0.940	0.936	0.970	0.970

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.709***	0.953**	0.747***	1.049*	1.046***	1.810***
	(2.760)	(2.275)	(2.729)	(1.906)	(4.275)	(2.852)
STOCK	-0.094*	-0.084	-0.095*	-0.090	-0.067	-0.030
	(-1.907)	(-1.417)	(-1.935)	(-1.403)	(-0.791)	(-0.212)
STOCK09/10			0.028	0.026		
			(0.690)	(0.454)		
IR	0.274***	0.288***	0.274***	0.290***	0.178***	0.157*
	(8.848)	(8.754)	(8.735)	(8.455)	(2.602)	(1.958)
OIL	-0.429**	-0.386**	-0.424**	-0.382**	-0.312*	-0.221
	(-2.317)	(-2.037)	(-2.267)	(-1.986)	(-1.854)	(-1.148)
IP	-5.596***	-5.876***	-5.309***	-5.657***	-6.072***	-5.666***
	(-5.334)	(-5.336)	(-4.617)	(-4.722)	(-4.106)	(-3.331)
TREND	0.016***	0.015***	0.015***	0.014***		
	(7.842)	(6.237)	(6.833)	(4.465)		
R^2	0.517	0.510	0.519	0.509	0.664	0.619
Adj. R^2	0.484	0.476	0.475	0.464	0.614	0.562

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

Table 11: Regression Results for Nickel Futures

Nickel Futures Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.027	-0.099	0.031	0.012	-0.005	-0.436
	(-0.246)	(-0.319)	(0.343)	(0.045)	(-0.059)	(-0.735)
STOCK	-0.186***	-0.174***	-0.209***	-0.205***	-0.207***	-0.160***
	(-3.612)	(-2.642)	(-5.042)	(-3.793)	(-6.854)	(-2.590)
STOCK09/10			0.179***	0.195***		
			(4.097)	(4.048)		
IR	-0.034	-0.037	-0.034	-0.034	-0.197***	-0.236***
	(-0.823)	(-0.774)	(-1.105)	(-0.982)	(-5.478)	(-3.437)
OIL	-0.063	-0.060	-0.080	-0.082	0.083	0.140
	(-0.317)	(-0.281)	(-0.506)	(-0.487)	(0.684)	(0.812)
IP	5.231***	5.230***	7.167***	7.352***	8.394***	8.092***
	(4.458)	(4.356)	(6.536)	(6.389)	(7.110)	(5.714)
TREND	0.009***	0.010***	0.006***	0.006***		
	(3.641)	(3.789)	(3.300)	(3.272)		
R^2	0.789	0.789	0.850	0.849	0.914	0.897
Adj. R^2	0.774	0.774	0.836	0.835	0.901	0.882
	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.032	0.320	-0.021	0.335	0.328	2.462*
	(-0.163)	(0.486)	(-0.109)	(0.502)	(1.505)	(1.825)
STOCK	0.023	0.004	0.018	-0.001	-0.043	-0.234
	(0.449)	(0.035)	(0.349)	(-0.012)	(-0.681)	(-1.208)
STOCK09/10			0.008	0.007		
			(0.785)	(0.542)		
IR	0.208***	0.234***	0.210***	0.235***	0.296***	0.494***
	(4.500)	(4.358)	(4.453)	(4.287)	(2.868)	(2.881)
OIL	-0.288	-0.346	-0.293	-0.350	-0.301	-0.623*
	(-1.390)	(-1.585)	(-1.391)	(-1.581)	(-1.469)	(-1.856)
IP	-4.072***	-3.732***	-3.752**	-3.467**	-3.631**	-1.914
	(-2.793)	(-2.596)	(-2.427)	(-2.219)	(-2.266)	(-0.647)
TREND	0.011***	0.010***	0.010***	0.009***		
	(4.007)	(3.195)	(3.562)	(2.772)		
R^2	0.272	0.248	0.275	0.251	0.465	0.246
Adj. R^2	0.222	0.196	0.209	0.183	0.385	0.134

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

Table 12: Regression Results for Tin Futures

Tin Futures Prices and Price Volatility						
PRICE	(1) OLS Trend	(2) 2SLS Trend	(3) OLS Trend	(4) 2SLS Trend	(5) OLS Year f.e.	(6) 2SLS Year f.e.
TURNOVER	0.028	0.062	0.032	0.094	-0.034	0.037
	(0.601)	(0.767)	(0.686)	(1.173)	(-0.867)	(0.437)
STOCK	-0.133***	-0.124*	-0.122**	-0.104	-0.183***	-0.209***
	(-2.700)	(-1.959)	(-2.263)	(-1.509)	(-5.467)	(-4.554)
STOCK09/10			-0.061	-0.161		
			(-0.576)	(-1.450)		
IR	-0.079***	-0.078***	-0.095***	-0.122***	-0.094***	-0.071*
	(-3.448)	(-3.093)	(-2.845)	(-3.599)	(-3.153)	(-1.876)
OIL	0.101	0.092	0.120	0.130	0.366***	0.360***
	(0.653)	(0.600)	(0.723)	(0.816)	(4.163)	(4.135)
IP	3.949***	4.168***	3.872***	4.146***	4.175***	4.010***
	(4.456)	(4.005)	(4.271)	(3.963)	(4.748)	(4.669)
TREND	0.012***	0.012***	0.013***	0.013***		
	(6.881)	(6.643)	(6.619)	(6.395)		
R^2	0.901	0.900	0.902	0.899	0.976	0.975
Adj. R^2	0.893	0.892	0.892	0.889	0.972	0.971

VOLA	(1) OLS Trend	(2) 2SLS Trend	(3) OLS Trend	(4) 2SLS Trend	(5) OLS Year f.e.	(6) 2SLS Year f.e.
TURNOVER	-0.034	-0.022	-0.013	0.078	0.293	0.297
	(-0.267)	(-0.097)	(-0.107)	(0.368)	(1.469)	(0.696)
STOCK	-0.151	-0.150	-0.133	-0.135	-0.068	-0.048
	(-1.584)	(-1.308)	(-1.232)	(-1.152)	(-0.558)	(-0.237)
STOCK09/10			-0.033	-0.067		
			(-0.675)	(-1.139)		
IR	0.180***	0.180***	0.150**	0.110	0.431***	0.440**
	(3.578)	(3.188)	(2.348)	(1.393)	(2.949)	(2.338)
OIL	-0.103	-0.107	-0.057	-0.041	-0.129	-0.133
	(-0.468)	(-0.460)	(-0.242)	(-0.166)	(-0.475)	(-0.482)
IP	-4.457**	-4.377*	-4.511**	-3.992*	-8.551***	-8.675***
	(-2.548)	(-1.849)	(-2.534)	(-1.718)	(-3.100)	(-3.140)
TREND	0.013***	0.013***	0.013***	0.014***		
	(4.438)	(4.231)	(4.482)	(4.438)		
R^2	0.348	0.347	0.350	0.345	0.433	0.433
Adj. R^2	0.297	0.296	0.283	0.277	0.336	0.336

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 96

Table 13: Regression Results for Zinc Futures

Zinc Futures Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.403	-1.131	-0.351	-1.034	-0.059	-0.970
	(-1.524)	(-1.611)	(-1.243)	(-1.213)	(-0.833)	(-1.386)
STOCK	-0.396***	-0.256***	-0.352***	-0.213	-0.420***	-0.153
	(-4.919)	(-2.826)	(-3.620)	(-1.586)	(-5.454)	(-0.849)
STOCK09/10			0.076	0.077		
			(1.099)	(0.501)		
IR	-0.169***	-0.084	-0.137*	-0.053	-0.270***	-0.196***
	(-2.721)	(-1.272)	(-1.912)	(-0.541)	(-5.608)	(-3.083)
OIL	0.109	0.104	0.084	0.076	0.116	0.171
	(0.449)	(0.469)	(0.351)	(0.335)	(1.078)	(1.245)
IP	5.477***	4.666***	5.728***	4.949***	5.450***	4.846***
	(5.413)	(4.693)	(5.430)	(4.125)	(6.400)	(3.965)
TREND	0.001	0.008	0.001	0.008		
	(0.289)	(1.468)	(0.333)	(1.435)		
R^2	0.783	0.742	0.786	0.749	0.958	0.914
Adj. R^2	0.768	0.724	0.767	0.729	0.952	0.901

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.153	0.559	0.321*	0.988	0.465***	2.718
	(0.839)	(0.944)	(1.831)	(1.522)	(2.893)	(1.613)
STOCK	-0.127*	-0.134*	0.012	0.049	-0.014	-0.519
	(-1.708)	(-1.660)	(0.159)	(0.504)	(-0.089)	(-1.041)
STOCK09/10			0.083***	0.115***		
			(3.480)	(2.957)		
IR	0.166***	0.163***	0.269***	0.300***	0.207***	0.074
	(3.033)	(2.802)	(4.996)	(4.138)	(2.731)	(0.470)
OIL	0.261	0.228	0.194	0.121	0.113	-0.074
	(1.443)	(1.211)	(1.116)	(0.661)	(0.738)	(-0.274)
IP	-4.689***	-4.472***	-4.094***	-3.521***	-4.012***	-1.910
	(-4.870)	(-4.285)	(-4.144)	(-3.089)	(-2.658)	(-0.702)
TREND	0.008**	0.006	0.008***	0.005		
	(2.542)	(1.258)	(3.085)	(1.218)		
R^2	0.578	0.561	0.618	0.576	0.710	0.351
Adj. R^2	0.549	0.531	0.583	0.537	0.667	0.254

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

6. Two Extreme Phases: Nickel Market 2006-08 and the Tin Market 2008-10

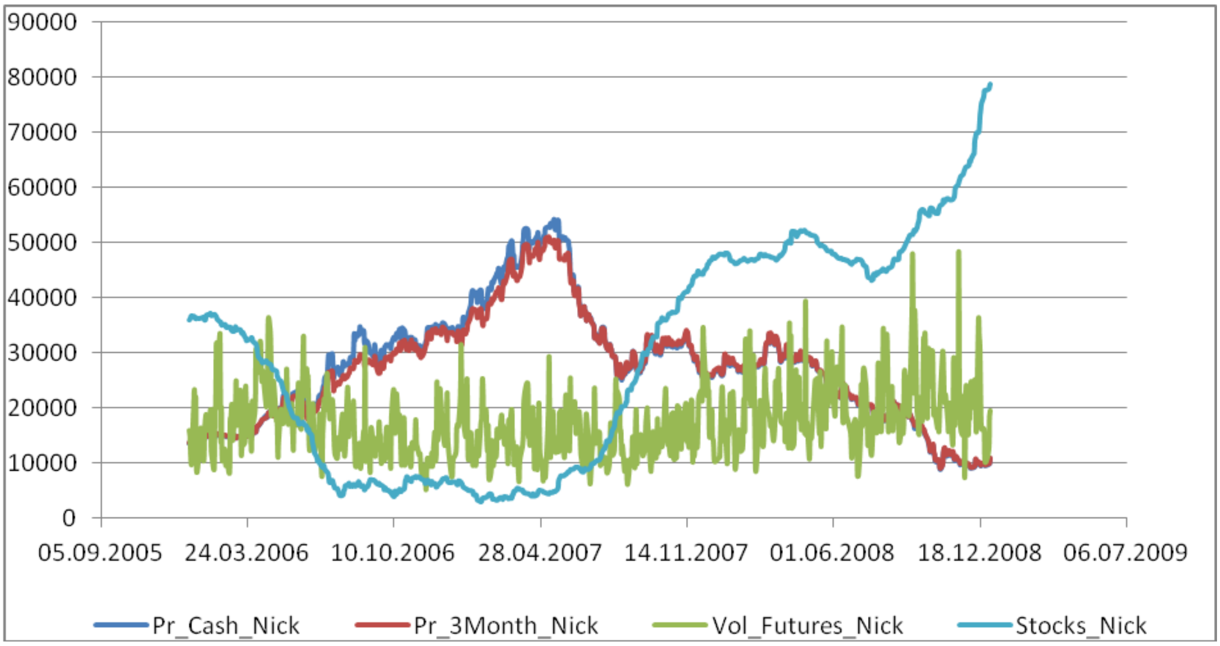
In the metal markets observed, two outstanding periods where prices and volumes behaved in an extreme matter are found. Both are investigated in more details by looking at daily data.

Nickel market 2006-08: Peak of prices

In 2006, prices of nickel set up to rise at enormous rates. Starting from a price per ton of about \$13.000, the price peaked at a level of about \$54.000 in may 1007 to decline quickly thereafter. E.g. Posch (2011) finds a significant impact of speculation on prices.

Figure 8 illustrates the behavior of prices, LME-stocks and speculation during this time span. We see that when prices soared quickly, the market was very tight, and backwardation dominated (i.e. spot prices were higher than futures prices, indicating short-run scarcity).

Figure 8: Nickel Market 2006-08



Source: LME, own illustration.

Using daily data between 2006-08, we run a regression by explaining nickel (spot)prices by nickel volumes and LME-stocks, nickel production, world industry production, oil price and the nominal rate of interest. Results are depicted below. They confirm the graphical impression given by figure8: The nickel spot price is not driven by speculation, as turnover turns out to be completely insignificant. Apart from the oil prices as an indicator of energy prices, all other variables are highly significant and have the expected sign. In particular, the negative impact of LME-stocks on prices is both significant and large.

We conclude that according to the evidence found in this paper, the main reason behind the price peak of nickel were falling inventories, and not futures speculation. Obviously, falling LME-stocks were wrongly perceived as a signal of a supply shortage. It is possible that speculative motives were the reason behind reallocating nickel stocks from LME registered warehouses to not registered warehouses, where the size of stocks gets published only with a delay of several months. Market participants in 2007 finally learned that the change in LME registered stocks only deliver incomplete information about supply-demand relations, which allowed prices to fall again quickly. This period also seems to have ended the function of s LME-tocks as a reliable indicator of scarcity. In other words, the market transparency has not improved as a consequence of these happenings.

Table 14: Summary Statistics: Nickel Market 2006-08 – PRICE LEVEL

R²	*0,81435273*			
Adj.R²	*0,81286953*			
	coefficient	*dtand.dev.*	*t-statistics*	*P-Value*
Constant	*-291.363,16*	*11.116,09*	*-26,21*	*0,00000*
No.interest rate	*-6.341,86*	*545,85*	*-11,62*	*0,00000*
oil price	*-4,38*	*6,99*	*-0,63*	*0,53106*
nickel world production	*1.749,71*	*110,56*	*15,83*	*0,00000*
world industry production	*0,12*	*0,01*	*19,71*	*0,00000*
turnover futures	*-11,73*	*67,03*	*-0,17*	*0,86118*
Stocks	*-4.399,57*	*175,36*	*-25,09*	*0,00000*

We further investigate the impact of futures trading on daily price volatility (as measured by the square of the change of daily spot prices). Only controlling for volumes and LME-stocks in this regression is a second best approach, so that results should be interpreted with care.

The results suggest that futures speculation significantly increased the volatility of prices during this phase. This finding is consistent with the results of monthly data regressions. Speculation has been destabilizing, but it has not contributed to higher prices according to the present results.

Table 15: Summary Statistics: Nickel Market 2006-08 – PRICE DISPERSION

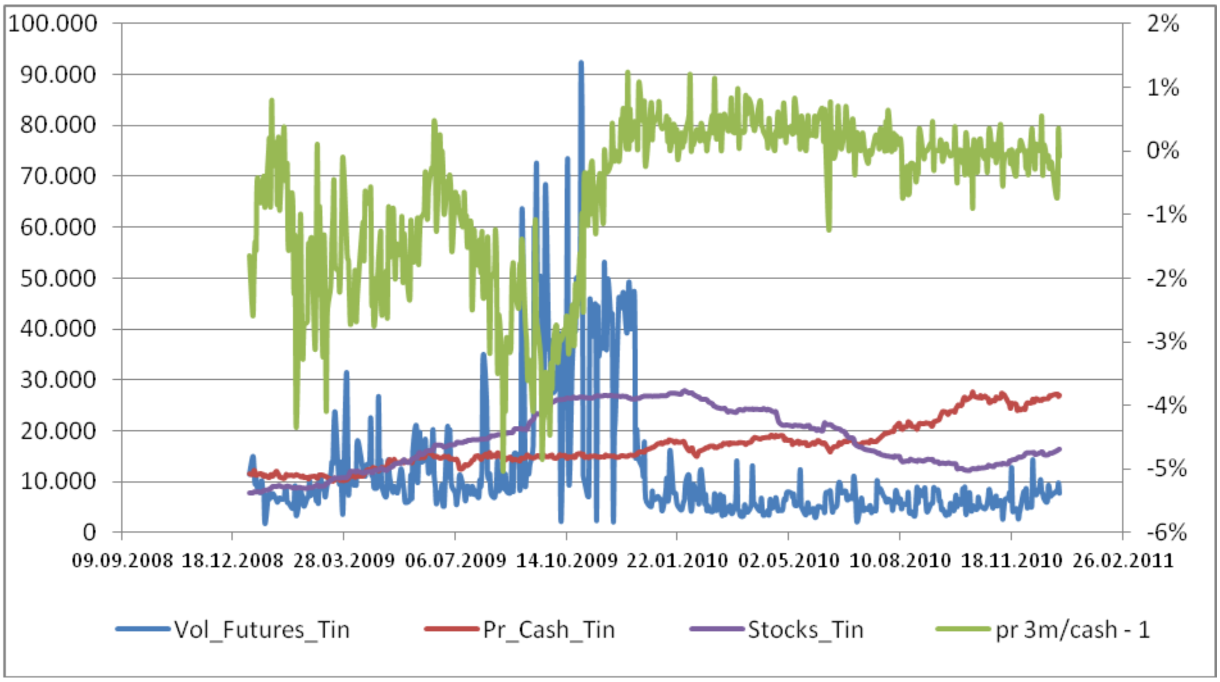
R²	0,052846916			
Adj. R²	0,050331237			
	coefficients	*Stand.dev.*	*t-statistics*	*P-value*
Intercept	854.420,34	144.320,72	5,92	0,00000
Turnover futures	41.228,63	19.501,00	2,11	0,03483
Stocks	-237.143,54	36.690,32	-6,46	0,00000

Tin-Market 2008-10: Peak of Speculation

In the tin market, the second example of extraordinary market behavior was observed. Here, the most significant peak of volumes of futures trading during the period 2003-2011 is found. In the last few months of 2009, futures trades soared to extreme levels. We turn to the question whether we can detect an impact of speculation on prices during this period.

Looking at figure 9 we would suggest that for some reason, traders expected prices to decline as higher levels of LME-stocks were built up: volumes soared, and futures prices fell relatively to cash prices. Since at the same time stocks incrased, one might conjecture a similar (though reversed) picture as in the nickel market 2007.

Figure 9: Tin market 2008-10



Source: LME, own illustration.

Running a regression of daily cash prices on volumes, LME-stocks, the rate of interest, world industry production, tin production and energy prices shows the following results: As one might expect, both interest rates and LME-stocks reduced prices significantly. Energy prices and output show expected signs and are significant. Futures speculation as measured by volumes of trade increase prices significantly, but the magnitude of the effect on prices remains low.

Hence during this interval, speculation contributed to higher prices. This finding is in contrast to the evidence that was obtained from analyzing monthly data over a longer time-horizon. A possible interpretation is that speculation prevented prices from falling when LME-stocks were built up.

Table 16: Summary Statistics: Tin Market 2008-10 – PRICE LEVEL

R^2	0,89			
Adj. R^2	0,89			
	coefficients	*Standard dev.*	*t-statistics*	*P-Value*
Constant	-32.342,75	2.105,91	-15,36	0,00000
Rate of interest	-2.880,01	83,28	-34,58	0,00000
OilPrice	74,06	2,42	30,61	0,00000
Production of total industry	425,60	29,96	14,21	0,00000
World_production_Tin	0,02	0,01	2,35	0,01905
Turnover_Futures_Tin	19,99	4,23	4,72	0,00709
Stock_Tin	-1.365,78	48,89	-27,94	0,00000

7. Policy recommendations

Any policy recommendations intended to limit the amount of speculation must be formulated with caution. Restricting the amount of futures volumes at exchanges bears the risk to exclude informed traders and to reduce the liquidity of the market. As a consequence, hedging might become more expensive, volatility could increase and market participants are worse off.

Grossman (1986) has shown that exchanges do have a strong incentive to prevent insider trading themselves, and to regulate speculation, as otherwise agents will leave the exchange in order to trade "over-the-counter", which will hurt profits and reduces liquidity. It is difficult for the government to get better access to information as how to regulate futures markets than exchanges themselves.

The big advantage of efficient exchanges is that a single price emerges which reflects all relevant information in the market. The more transparent and liquid markets are, the more informative will be the resulting prices for all market participants.

The present evidence shows that speculation, though not increasing prices, might destabilize markets by contributing to higher price volatility thereby imposing costs for market participants as hedging gets more expensive.

Consecutively various policy recommendations are presented based on the above insights. Nonetheless, it is important to keep in mind that these recommendations have to be formulated with considerable care. In particular, taking liquidity out of markets might have counterproductive effects of higher prices for hedgers.

Policy recommendations include measures at different levels:

Recommendations for regulators

There is some public concern that prices of metals are driven partly by the activities of financial speculators, which might lead to calls for regulation matters.

Recommendation 1:

> Limits on futures speculation are a mixed blessing. For this reason, any regulatory interventions in this respect should be based on careful considerations of the various pros and cons. Experiences of the CFTC in the US should be considered in this process.
>
> ***Competent authority: European Commission***

Recommendations for Futures markets

Market Structure:

Various types of traders are trading at futures market. In the U.S., for example, it is common practice to distinguish between commercial, non-commercial and "non-reportable" traders, while in Europe no distinction is made.

Recommendation 2a:

LME: Market transparency could be improved significantly by investing in the provision of data, the building-up of analytical capacity and the development of standardized reporting. The analysis of market data could be significantly improved, if commercial, non-commercial, "non-reportable" traders could be separated. In addition, commercial traders should be separated between producers and consumers. Furthermore, in order to identify financial speculators in the group of non-commercial traders, banks and financial institutions should be designated separately, at least as a group of traders.

Competent authority: European Commission, Financial Service Authority (FSS)

Recommendation 2b:

Warehouses: It would be important to have public information about the ownership structure of warehouses (both LME- and not LME registered warehouses). Further, some crude information about the ownership structure (producers; consumers; banks and financial institutions etc.) of stocks would be needed as well, and it would be important to know whether stocks are concentrated in the hands of a few players.

Competent authority: European Commission, Financial Service Authority (FSS), CFTC

Market Outcome

Data about market outcomes and market structure are an indispensable tool both for market participants and for researchers. This concerns both the London Metal Exchange and stocks in warehouses The availability and quality of futures markets data in Europe is relatively poor as compared to the U.S., where CFTC regulation holds. If appropriate data are not available, it is difficult e.g. for regulators, to recognize whether specific activities or price movements are unusual or not.

Recommendation 3a:

LME: Steps should be undertaken to improve the quality, details and dissemination of data concerning market results. In particular, it should be considered to make available historical data about prices on the internet to the public. Further, one should consider the publication of the volumes of futures contracts separately for different time horizons (since markets with longer time-horizons typically are less liquid, they react more sensitively, which should provide a clearer picture of the impact of trading). Furthermore, publicly available data about open interest would be extremely useful in order to analyze speculative behaviour.

Competent authority: European Commission, Financial Service Authority (FSS),

Recommendation 3b:

Stocks: inventories of industry metals serve an important information function in futures markets, in fact, they share important characteristics of "essential facilities". After the price peak in the nickel market in 2007, much of this information function has been lost as traders have learned that information in incomplete. Since then market transparency has deteriorated considerably. Therefore, the availability of stocks in both LME- and not LME-registered warehouses should be made public. Not LME-registered warehouses should be obliged to announce their stocks at least once a weak.

It has to be evaluated under what circumstances state regulation of warehouse capacity is necessary to guarantee *pari passu* access for all market participants.

Competent authority: European Commission, Financial Service Authority (FSS), CFTC

Recommendations for firms

An essential problem is the high volatility of metal prices. In order to reduce this risk metals firms should consider more actively the optimization of their procurement strategies. For example, spreading the costs for purchasing metals over a longer time horizon might be able to provide greater protection against price volatility.

Recommendation 4:

A traditional strategy which could be considered is "cost averaging" where quantities are systematically purchased at regular time intervals. This would result in procuring metals in smaller quantities at higher prices and larger quantities at lower prices. One might also think about more sophisticated approaches that take account of the specific characteristics of industrial metal cycles.

Competent authority: Helmenstein - Pichler

Austrian metal industry companies should consider opportunities in order to gain greater independence from and 'countervailing power' against metal exchanges and financial investors.

Recommendation 5:

One should engage in "competition neutral" coordinated procurement and/or the opportunity to subsidy investment in shared (or private) warehouse capacity to reduce hedging costs.

Competent authority: WKO, WKNOE, IV, Firms

The recycling of metal is viewed as a promising sustainable strategy. At an increasing rate metal is regained from scrap.

Recommendation 6:

Chances and potentials for improving current recycling rates have to be examined more intensively. The structure of the Austrian recycling market (including possible competition challenges) has to be analyzed for the relevant industrial metals, and a possible inclusion in the Austrian Recyling System ARA is to be considered. The implementation of best practice models ought to be discussed.

Competent authority: WKO, WKNOE, IV, Firms

In particular for small and medium-sized companies it becomes increasingly attractive and important to exchange information.

Recommendation 7:

One should consider the possibility of establishing a network on metal efficiency and recycling. This could act as a platform where information is provided and experiences are exchanged. Competition distorting effects have to be avoided from the beginning

Competent authority: WKO, WKNOE, IV,

Recommendations for policy-makers

By using cheap money banks are enabled to speculate in physical markets. This is especially critical for commodities markets which are important inputs for many other industries. This contributes to increase inflation in the whole economy. Furthermore, scarcity signals for the industrial metals markets are dispersed and biased signals are sent to both producers and consumers in these markets.

Recommendation 8:

Money which is provided to the banking sector by the central bank should be conditional to the obligation to finance business in the real economy instead of speculating in physical markets thereby driving up prices through generating ‘artificial’ demand. Corresponding transactions should be obliged to be subject to “enhanced risk weights” which make speculation relatively more costly.

Competent authority: European Commission

Appendix

Table 17: Aluminium Spot

Aluminium Spot Prices and Price Volatility						
PRICE	(1) OLS Trend	(2) 2SLS Trend	(3) OLS Trend	(4) 2SLS Trend	(5) OLS Year f.e.	(6) 2SLS Year f.e.
TURNOVER	-0.007	0.116	0.057	0.471	-0.005	-0.030
	(-0.070)	(0.341)	(0.681)	(1.094)	(-0.082)	(-0.078)
STOCK	0.004	0.009	-0.005	-0.027	-0.106	-0.094
	(0.084)	(0.172)	(-0.101)	(-0.512)	(-1.386)	(-1.330)
STOCK09/10			0.038**	0.070**		
			(2.133)	(1.961)		
IR	0.004	0.003	-0.000	-0.015	-0.108***	-0.104***
	(0.223)	(0.127)	(-0.019)	(-0.606)	(-2.729)	(-2.649)
OIL	0.237***	0.240***	0.225***	0.213***	0.236***	0.234***
	(3.184)	(3.231)	(3.266)	(2.997)	(3.295)	(3.194)
IP	2.919***	3.007***	3.463***	4.139***	3.080***	3.101***
	(6.979)	(5.695)	(7.728)	(5.011)	(4.592)	(4.637)
TREND	-0.000	-0.001	-0.001	-0.003		
	(-0.215)	(-0.602)	(-1.207)	(-1.572)		
R^2	0.879	0.875	0.888	0.852	0.925	0.925
Adj. R^2	0.872	0.866	0.878	0.839	0.914	0.914

VOLA	(1) OLS Trend	(2) 2SLS Trend	(3) OLS Trend	(4) 2SLS Trend	(5) OLS Year f.e.	(6) 2SLS Year f.e.
TURNOVER	0.827***	3.317**	1.166***	5.783***	0.946***	5.355**
	(3.553)	(2.412)	(5.463)	(2.585)	(4.687)	(1.985)
STOCK	-0.302**	-0.434**	-0.362***	-0.730**	-0.177	-0.142
	(-2.421)	(-2.313)	(-2.941)	(-2.321)	(-0.631)	(-0.338)
STOCK09/10			0.044***	0.108***		
			(4.914)	(3.190)		
IR	0.043	-0.041	0.021	-0.165	-0.151	-0.260
	(0.835)	(-0.476)	(0.393)	(-1.353)	(-1.094)	(-1.219)
OIL	-0.052	-0.084	-0.155	-0.381	-0.422**	-0.091
	(-0.245)	(-0.318)	(-0.838)	(-1.061)	(-2.161)	(-0.219)
IP	-4.054***	-2.547	-1.171	5.404	1.659	0.539
	(-3.179)	(-1.223)	(-0.908)	(1.572)	(0.969)	(0.160)
TREND	0.009***	0.000	0.005*	-0.015		
	(3.252)	(0.052)	(1.770)	(-1.363)		
R^2	0.372	0.236	0.482	0.282	0.584	0.298
Adj. R^2	0.328	0.183	0.435	0.217	0.322	0.193

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

\# of obs.: 108

Table 18: Copper Spot

Copper Spot Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.583***	-1.008***	-0.494***	-0.735***	-0.123	-0.121
	(-4.849)	(-4.072)	(-4.268)	(-2.823)	(-1.327)	(-0.470)
STOCK	-0.004	0.036	-0.009	0.016	0.001	0.038
	(-0.173)	(1.121)	(-0.392)	(0.560)	(0.012)	(0.656)
STOCK09/10			0.193***	0.212**		
			(3.009)	(2.491)		
IR	-0.013	-0.025	-0.012	-0.019	-0.074*	-0.072*
	(-0.641)	(-1.091)	(-0.651)	(-0.936)	(-1.895)	(-1.779)
OIL	0.415***	0.432***	0.434***	0.449***	0.507***	0.533***
	(3.054)	(3.048)	(3.395)	(3.423)	(5.332)	(5.308)
IP	3.641***	3.971***	4.294***	4.545***	4.829***	4.881***
	(5.738)	(5.630)	(6.116)	(6.007)	(7.048)	(6.908)
TREND	0.010***	0.011***	0.008***	0.008***		
	(5.457)	(5.754)	(4.569)	(4.163)		
R^2	0.939	0.930	0.945	0.942	0.973	0.973
Adj. R^2	0.935	0.925	0.940	0.937	0.969	0.969
	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.769***	0.945**	0.804***	1.029**	1.104***	1.736***
	(3.161)	(2.409)	(3.096)	(2.006)	(4.541)	(2.805)
STOCK	-0.127**	-0.110*	-0.128**	-0.115*	-0.106	-0.048
	(-2.508)	(-1.895)	(-2.528)	(-1.839)	(-1.139)	(-0.333)
STOCK09/10			0.026	0.023		
			(0.641)	(0.405)		
IR	0.264***	0.276***	0.264***	0.278***	0.154**	0.138*
	(8.539)	(8.326)	(8.443)	(8.070)	(2.389)	(1.852)
OIL	-0.440**	-0.394**	-0.435**	-0.390**	-0.278*	-0.186
	(-2.413)	(-2.120)	(-2.368)	(-2.077)	(-1.729)	(-1.019)
IP	-5.444***	-5.673***	-5.177***	-5.483***	-6.183***	-5.813***
	(-5.245)	(-5.179)	(-4.531)	(-4.619)	(-4.418)	(-3.654)
TREND	0.015***	0.014***	0.014***	0.013***		
	(7.253)	(5.911)	(6.374)	(4.364)		
R^2	0.498	0.493	0.500	0.492	0.647	0.612
Adj. R^2	0.463	0.458	0.455	0.446	0.594	0.554

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

Table 19: Nickel Spot

Nickel Spot Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.006	0.006	0.066	0.123	0.011	-0.314
	(0.049)	(0.020)	(0.714)	(0.446)	(0.120)	(-0.545)
STOCK	-0.220***	-0.216***	-0.244***	-0.249***	-0.242***	-0.204***
	(-4.161)	(-3.180)	(-5.784)	(-4.482)	(-7.799)	(-3.289)
STOCK09/10			0.185***	0.204***		
			(4.151)	(4.130)		
IR	-0.037	-0.036	-0.037	-0.033	-0.203***	-0.232***
	(-0.880)	(-0.725)	(-1.186)	(-0.913)	(-5.651)	(-3.608)
OIL	-0.059	-0.063	-0.077	-0.087	0.095	0.136
	(-0.290)	(-0.292)	(-0.474)	(-0.508)	(0.777)	(0.802)
IP	5.188***	5.220***	7.190***	7.443***	8.371***	8.160***
	(4.347)	(4.298)	(6.470)	(6.370)	(7.012)	(5.819)
TREND	0.010***	0.010***	0.006***	0.006***		
	(3.688)	(3.806)	(3.354)	(3.245)		
R^2	0.788	0.788	0.851	0.850	0.914	0.905
Adj. R^2	0.773	0.773	0.837	0.836	0.901	0.891

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.096	0.669	0.110	0.695	0.407*	2.882*
	(0.479)	(0.915)	(0.556)	(0.939)	(1.889)	(1.909)
STOCK	-0.034	-0.084	-0.040	-0.093	-0.093	-0.321
	(-0.535)	(-0.700)	(-0.634)	(-0.750)	(-1.193)	(-1.446)
STOCK09/10			0.011	0.011		
			(0.993)	(0.882)		
IR	0.223***	0.260***	0.225***	0.263***	0.310***	0.539***
	(4.883)	(4.835)	(4.794)	(4.701)	(3.056)	(2.783)
OIL	-0.218	-0.294	-0.225	-0.302	-0.217	-0.583
	(-1.031)	(-1.300)	(-1.040)	(-1.301)	(-0.999)	(-1.544)
IP	-4.621***	-4.227***	-4.202***	-3.775**	-4.576***	-2.620
	(-3.218)	(-3.052)	(-2.787)	(-2.530)	(-2.880)	(-0.816)
TREND	0.010***	0.009***	0.010***	0.008**		
	(3.742)	(2.674)	(3.224)	(2.200)		
R^2	0.287	0.230	0.293	0.234	0.461	0.231
Adj. R^2	0.238	0.177	0.229	0.164	0.381	0.116

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

Table 20: Tin Spot

Tin Spot Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.039	0.074	0.043	0.104	-0.028	0.039
	(0.850)	(0.896)	(0.908)	(1.270)	(-0.706)	(0.452)
STOCK	-0.148***	-0.139**	-0.140**	-0.121*	-0.198***	-0.222***
	(-2.903)	(-2.126)	(-2.474)	(-1.693)	(-5.846)	(-4.768)
STOCK09/10			-0.049	-0.149		
			(-0.452)	(-1.312)		
IR	-0.081***	-0.080***	-0.093***	-0.121***	-0.100***	-0.079**
	(-3.403)	(-3.051)	(-2.782)	(-3.488)	(-3.310)	(-2.027)
OIL	0.085	0.076	0.100	0.111	0.353***	0.348***
	(0.541)	(0.486)	(0.591)	(0.682)	(3.930)	(3.906)
IP	3.991***	4.213***	3.929***	4.192***	4.257***	4.098***
	(4.377)	(3.917)	(4.187)	(3.874)	(4.725)	(4.602)
TREND	0.012***	0.012***	0.013***	0.013***		
	(6.832)	(6.597)	(6.452)	(6.250)		
R^2	0.899	0.898	0.899	0.896	0.975	0.974
Adj. R^2	0.877	0.876	0.875	0.871	0.967	0.966

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.001	-0.009	0.022	0.094	0.289	0.246
	(-0.005)	(-0.042)	(0.178)	(0.464)	(1.465)	(0.584)
STOCK	-0.200*	-0.189	-0.180	-0.174	-0.149	-0.126
	(-1.871)	(-1.530)	(-1.479)	(-1.372)	(-1.202)	(-0.653)
STOCK09/10			-0.035	-0.070		
			(-0.737)	(-1.231)		
IR	0.167***	0.170***	0.134**	0.097	0.355**	0.344*
	(3.173)	(2.904)	(2.242)	(1.302)	(2.385)	(1.906)
OIL	-0.087	-0.080	-0.037	-0.011	-0.108	-0.106
	(-0.409)	(-0.353)	(-0.164)	(-0.047)	(-0.428)	(-0.407)
IP	-4.094**	-4.195*	-4.152**	-3.794	-7.606***	-7.544***
	(-2.245)	(-1.719)	(-2.223)	(-1.589)	(-3.070)	(-3.159)
TREND	0.012***	0.012***	0.013***	0.014***		
	(4.483)	(4.282)	(4.361)	(4.424)		
R^2	0.380	0.380	0.383	0.379	0.464	0.464
Adj. R^2	0.248	0.248	0.234	0.229	0.294	0.294

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

\# of obs.: 96

Table 21: Zinc Spot

Zinc Spot Prices and Price Volatility						
	(1)	(2)	(3)	(4)	(5)	(6)
PRICE	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	-0.409	-1.141	-0.357	-1.042	-0.052	-0.909
	(-1.512)	(-1.582)	(-1.235)	(-1.190)	(-0.721)	(-1.277)
STOCK	-0.400***	-0.257***	-0.356***	-0.214	-0.433***	-0.177
	(-4.820)	(-2.767)	(-3.547)	(-1.547)	(-5.523)	(-0.979)
STOCK09/10			0.076	0.078		
			(1.066)	(0.496)		
IR	-0.170***	-0.083	-0.139*	-0.052	-0.277***	-0.206***
	(-2.656)	(-1.228)	(-1.869)	(-0.515)	(-5.755)	(-3.251)
OIL	0.104	0.098	0.079	0.070	0.115	0.165
	(0.419)	(0.432)	(0.323)	(0.300)	(1.043)	(1.200)
IP	5.606***	4.784***	5.855***	5.071***	5.541***	4.992***
	(5.391)	(4.683)	(5.410)	(4.121)	(6.405)	(4.092)
TREND	0.001	0.008	0.001	0.008		
	(0.286)	(1.446)	(0.328)	(1.413)		
R^2	0.780	0.739	0.782	0.746	0.958	0.920
Adj. R^2	0.765	0.721	0.762	0.723	0.952	0.908

	(1)	(2)	(3)	(4)	(5)	(6)
VOLA	OLS	2SLS	OLS	2SLS	OLS	2SLS
	Trend	Trend	Trend	Trend	Year f.e.	Year f.e.
TURNOVER	0.133	0.638	0.294*	1.068	0.406**	2.777
	(0.754)	(1.052)	(1.723)	(1.604)	(2.524)	(1.595)
STOCK	-0.106	-0.120	0.027	0.064	0.023	-0.495
	(-1.504)	(-1.495)	(0.372)	(0.662)	(0.151)	(-0.985)
STOCK09/10			0.079***	0.115***		
			(3.349)	(2.936)		
IR	0.189***	0.182***	0.287***	0.319***	0.238***	0.101
	(3.520)	(3.124)	(5.513)	(4.365)	(3.444)	(0.645)
OIL	0.209	0.170	0.145	0.063	0.058	-0.143
	(1.183)	(0.923)	(0.856)	(0.353)	(0.363)	(-0.500)
IP	-4.885***	-4.599***	-4.315***	-3.645***	-4.117***	-1.856
	(-5.171)	(-4.356)	(-4.461)	(-3.178)	(-2.619)	(-0.643)
TREND	0.008***	0.006	0.009***	0.005		
	(2.827)	(1.242)	(3.376)	(1.193)		
R^2	0.567	0.540	0.607	0.547	0.694	0.269
Adj. R^2	0.537	0.508	0.571	0.506	0.648	0.160

t-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01

All estimations with Newey-West heteroscedasticity and autocorrelation robust standard errors

# of obs.: 108

References

Aghion, P., Bloom, N., Blundell, R., Griffith, R., Howitt, P. (2005), "Competition and Innovation: An Inverted U Relationship", Quarterly Journal of Economics, 120(2), 701-728.

Allaz, B. (1992), Oligopoly, uncertainty and strategic forward transactions, International Journal of Industrial Economcis 10, 297-308.

Allaz, B., Villa, J.L. (1993), Cournot competition forward markets, and efficiency, Journal of Economic Theory 59: 1-16

Arnuk, S.L., Saluzzi, J.C. (2012), Broken Markets: How High Frequency Trading and Predatory Practices on Wall Street are Destroying Investor Confidence and Your Portfolio, New Jersey.

Association of the Austrian MACHINERY & METALWARE Industries. "Sector Outlook, August 2012".

Banks, E., (2010), Dark Pools: The Structure and Future of Off-Exchange Trading and Liquidity, New York.

Benninga, S., Eldor, R., Zilcha, I. (1983), Economics Letters 13, 141-45.

Calvo, G. (2008), Exploding commodity prices, lax monetary policy, and sovereign wealth funds, www.VoxEU.org

Cox, C.C. (1976), Futures trading and market information, Journal of Political Economy, vol 83, 1215-37.

Cuddington, J.T., D. Jerrett (2008), Super cycler in real metal prices? IMS Staff papers 55, 541-565, doi:10.1057/imfsp.2008.19; published online 19 August 2008

Danthine, D.P. (1978), Information, futures prices, and stabilizing speculation, Journal of Economic Theory, vol. 17, 79-98.

Die Presse (2012), Industriemetalle mit Potenzial, 226.5.2012, http://diepresse.com/home/wirtschaft/boerse/anlagewerkzeuge/761165/Industriemetall-mit-Potenzial

Fattouh, B., L. Killian, L. Mahadeva (2012), The role of speculation in oil markets: What have we learned so far?, CERP Discussion Paper No. DP8916, March 2012.

Ferreira, J.L. (2003), Strategic interaction between futures and spot markets, Journal of Economic Theory 108, 141-51.

Frankel, J., (2008), The Effect of Monetary Policy on Real Commodity Prices" in: Campbell, J. (Ed.), Asset Prices and Monetary Policy, Chicago, 2008, Chapter 7, 291-327.

Friedman, M. (1953), Essays in positive economics, University Chicago Press, Chicago.

Gilbert, Chr., L, (2009), Speculative influences on commodity futures prices 2006-08, Working paper at CIFREM and Department of Economics, University of Trento, Italy.

Gilbert, Ch.L. (1997), Manipulation of metals futures: Lessons from Sumitomo, Centre for Economic Policy Research, London.

Gilbert, Ch.L. (2012), Price volatility and farmin income stabilization – Modelling outcomes and assessing market and policy based responses, Working Paper, Dublin, February 12

Gorton, G., K. Rouwenhorst (2006), Facts and fantasies about commodity futures, Financial Analysts Journal 62: 47-68.

Grossman, S. (1986), An analysis of the role of "insider trading" on futures markets, Journal of Business, Vol 59, no. 2, 129-46.

Hart, O.D., Kreps, D.M. (1986), Price destabilizing speculation, Journal of Political Economy Vol. 94, No. 5 (Oct., 1986), pp. 927-952.

Hart, O.D. (1977), On the profitability of speculation, Quarterly Journal of Economics, XCI, 579-97.

Hieronymus, T.A. (1977), Economics of futures trading afpr commercial and personal profit, 2nd ed., NY, Commodity Research Bureau.

Hotelling, H. (1931), The economics of exhausible resources", Journal of Political Economy 30, 137-75.

Irvin, S.H., D.R. Sanders (2010), The impact of index and swap funds on commodity futures markets – preliminary results, OECD food, agriculture and fisheries working papers, No. 27.

Irvin, S.H., D.R. Sanders, R.P. Merrin ((2009), Devil or angel? The role of speculation in the recent commodity price boom and bust, Journal of Agricultural and Applied Economics, vol 41/2 377-91.

Krugman, P. (2008), The oil nonbubble, New York Times, 12.05.2008.

Krutzler, Reisinger, Schindler (2012), „Ressourcenverbrauch der Industrie in Österreich – Analyse und Ausblick für die bedeutendsten Branchen und seltene Metalle". Studie des Umweltbundesamtes.

Mahenic, P., Salanie, F. (2004), Softening competition through forward trading, Journal of Economic Theory 116, 282-93.

Masters, M.W. (2008), Testimony before the U.S. Senate Committee of Homeland Security and Government Affairs, Washington, DC, 20 May 2008.

Newbery, D.M.G., J.E. Stiglitz (1981), The theory of commodity price stabilization, Oxford University Oress, Oxford, 1981.

Newbery, D.M. (1984), The manipulation of futures markets by a dominant producer, in: The Industrial Organization of Futures Markets, R.W. Anderson (Ed.), Lexington.

Newbery, D.M. (1987), When do futures destabilize spot prices? International Economic Review vol 28, 291-304.

Newbery, D.M. (1990), Cartels, storage, and the suppression of futures markets, European Econonomic Review 34: 1041-60.

Newey, Whitney K. and Kenneth D. West (1987): A Simple, Positive Semi-Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix, Econometrica 55 (3), 703-708.

OECD (2012): OECD.Stat. Available online at http://www.oecd-ilibrary.org/content/data/data-00285-en (Checked 09/06/2012).

Patterson, S. (2012), Dark Pools: High-Speed Traders, A.I. Bandits, and the Threat to the Global Financial System, New York.

Posch, P.N. (2011), Nickelmarkt – Spielfeld der Spekulanten oder fundamental getrieben? Studie im Auftrag von Oryx Stainless, Universität Ulm.

Rheinisch Westfälisches Institut für Wirtschaftsforschung Essen (RWI Essen) (2008), Trends der Angebot- und Nachfragesituation bei mineralischen Rohstoffen, Essen.

Raw Material Group (2012), Raw Material Data, Sweden.

Roberts, M. (1994), Cyclicality in metal prices, Resources policy, vol 20, no. 1, 49-57.

Roberts, M. (2009), Duration and characteristics of metal price cycles, Resource Policy 34(/3: 87-102.

Scherer, V., L. Hee (2008), The diversification benefits of commodity futures indices: a mean-variance spanning test, in: F.J. Nabozzi et al., The Handbook of Commodity Investing, Hoboken (NJ), Wiley 241-65.

Slade, M. (1991), Market structure, marketing method, and price instability, The Quarterly Journal of Economics, Nov.

Slade, M., H. Thille (2006), Commodity spot prices: An explanatory assessment of market structure and forward-trading effects, Economica, Vol 73, 229-56.

Slade, Margaret E. and Henry Thille (2004): Commodity Spot Prices: An Exploratory Assessment of Market Structure and Forward-Trading Effects, Economica 73 (290), 229-256.

Slade, M., H. Thille (1996), Hotelling confronts CAPM: a test of the theory of exhaustible resources, Canadian Journal of Economics, Vo. XXX, no. 3, 685-708.

Slade, M. (1997), Hotelling confronts CAPM: A test oft he theory of exhaustible resources, Canadian Journal of Economics 30, No. 3, 685-708.

Smith, A. (1789), An inquiry into the nature and causes of the wealth of nations, Cannan (Ed.), Modern Library, New York, reprinted in 1937.

Stein, J.C. (1987), Informational externalities and welfare-reducing speculation, Journal of Political Economiy, Vol. 95, No. 6 (Dec., 1987), pp. 1123-1145.

Werdinger, J., Creswell, J. (2010), Trader´s Cocoa Binge Wraps up Chocolate Market, The New York Times, 24.07.2010.

World Cocoa Foundation (2010), Cocoa Market Update, http://www.worldcocoafoundation.org/learn-about-cocoa/documents/CocoaMarketUpdateasof5.18.10.pdf

Die Studie wurde in Auftrag gegeben von:

- Fachverband der Maschinen & Metallwaren Industrie Ö (FMMI)
- Fachgruppe der Maschinen & Metallwaren Industrie NÖ (MMI NÖ)

Studienautoren:
Eva Pichler (WU Wien), Michael Böheim (WIFO), Matthias Firgo (WIFO)

Formulierung wirtschaftspolitischer Forderungen aus den Ergebnissen der Studie:
Christian Helmenstein (Economica)

Ansprechpersonen:

- Martin Baminger, FMMI
  T 0590900-3477, E baminger@fmmi.at
  Wiednerhauptstrasse 63, 1045 Wien

- Stefan Gratzl, Fachgruppe MMI NÖ
  T 02742-851-19240, E industrie.referat4@wknoe.at
  Landsbergerstraße 1, 3100 St. Pölten

Fachverband MASCHINEN & METALLWAREN Industrie

WIRTSCHAFTSKAMMER NIEDERÖSTERREICH
Maschinen & Metallwaren Industrie