AN ANALYSIS OF THE IMPACT OF FINANCIALIZATION ON COMMODITY MARKETS

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MASTER OF COMMERCE IN FINANCIAL MARKETS

(Half thesis)

By

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ABSTRACT

An unprecedented increase in real commodity prices from 2002-2011 fuelled an intense debate as to the causes of the steep rise in prices and its possible implications for producers and consumers. On the one hand, the prolonged and dramatic rise in almost all commodity prices is attributed to growing demand from emerging market economies, supply shocks such as adverse weather conditions, export bans as well as other macroeconomic factors. Collectively these are known as the fundamental (demand and supply) factors. On the other hand, there is a growing body of evidence that suggests these fundamental factors alone are not sufficient enough to explain recent commodity price developments. It is noted that alongside changes in the fundamental factors, there was a major shift in trading activities on commodity derivative markets related to the increasing presence of financial investors, institutional investors and hedge funds. This had important effects, it is argued, on the microstructure of these markets and on price dynamics in a process termed "financialization".

Most of the empirical literature covers the period of rising commodity prices from 2002-2011. This study seeks to add to the existing literature by examining, in addition, the impact of financialization when commodity prices were falling from 2011-2015. Whereas the literature focuses mainly on the rise of agricultural commodity prices, the focus of this study is on metals, oil and bulk commodities (coal and iron ore).

Two techniques are employed, namely the calculation of rolling correlations for futures and spot returns. Granger causality tests are then performed to examine the relationships between futures and spot prices. Rolling return correlations are calculated for i) different exchange-traded commodities and ii) exchange-traded commodities and bulk commodities not traded on exchanges. This is done to establish whether the increased correlations between different commodities found in the literature still hold now that commodity prices across all categories are falling. Granger causality tests are used in order to establish the link between the futures prices and spot prices both during the upswing period (2002-2011) and downswing period (2011-2015).

It is found that rapidly growing indexed-based investment in commodity markets (financialization) during the upswing period is concurrent with increasingly correlated returns on the prices of unrelated commodities in both the futures and spot markets. These correlations decline during the period of falling commodity prices (2011-2015). This was a

period in which the total amount of commodity assets under management fell sharply. This supports the *a priori* expectation that if the increased correlations of previously seemingly correlated and unrelated commodities during the upswing had been driven by financialization, the correlation would decline in the downturn. Granger causality results reveal statistically significant evidence of futures prices (returns) driving spot prices (returns) during the financialization period. However, post-financialization there is a shift to more bi-directional relationships.

The study therefore concludes that, in addition to changing fundamental and macroeconomic factors, the financialization of commodity markets further drove the excessive and volatile price levels in commodity markets from 2002 to 2011.

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Above all I would like to thank the Lord God Almighty, for guiding me and seeing me through my time at Rhodes University. Because of his grace and blessings this thesis is complete. Indeed I am a living testimony of Philippians 4 v 13 "I can do everything through Christ Jesus who strengthens me".

This thesis is dedicated to my late brother Tanyaradzwa Ndawona

DECLARATION

This page declares that the work produced is my own and was conducted whilst completing the degree of Master of Commerce in Financial Markets whilst at Rhodes University. This thesis has not been submitted to other Universities, Technikons or Colleges for degree purposes.

Takudzwa Ndawona

Signed: ……..

Date: ……..

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CHAPTER 1: INTRODUCTION

1.1 Context of the Research

Recent developments in commodity prices across all categories have been exceptional in many ways. The price boom between 2002 and mid 2008 was the most pronounced in several decades – in magnitude, duration and breadth. The price decline following the eruption of the global financial crisis in mid-2008 stands out for its sharpness and for the number of commodities affected (UNCTAD, 2011). Commodity prices recovered mid-2009 rising up until 2011. However since 2011, global commodity prices across all major categories have fallen by 40% (World Bank, 2016). The extreme scale of these price changes, and the fact that prices simultaneously increased and subsequently declined across all major categories of commodities suggests that factors other than the normal functioning of supply and demand in specific commodity markets were at work. According to Ederer *et al.* (2015) besides fundamental and macroeconomic factors, trading activities on commodity derivatives underwent major changes which altered the microstructure of commodity markets substantially.

A number of authors have argued (UNCTAD, 2011) that the unprecedented increase in real commodity prices from 2002 was the result of rapidly growing demand associated with urbanization and industrialization (resource intensive growth) as well as changes in dietary habits towards more protein rich diets in major emerging economies, particularly China and India. However, authors such as Tang and Xiong (2012), Mann and Keeton (2013), Bicchetti and Maystre (2012) and Masters (2008) argue that the extent of the price increases and their unusual synchronisation was greater than could be explained by "fundamental" determinants of commodity supply and demand. These authors note that the rising commodity prices coincided with the growth of the "financialization" of commodity markets – the purchase of commodities as financial assets (namely futures) by institutional investors (pension funds, hedge funds, wealthy individuals as well as university endowment funds) – and argue that this played an important role in increasing prices (Mann and Keeton, 2013). Volatile spot price levels across several commodities and growing correlation between returns of financial and non-financial assets also raised concern over the role of factors that are unrelated to market fundamentals in price formation (CEPS, 2013).

According to Falkowski (2011:5), financialization may be defined as "the increasing role of financial motives, financial markets and financial actors in the operation of commodity markets". Financialization of commodities increased in prominence following the widely publicized discovery of a negative correlation between commodity returns and stock returns by Greener (2000), Gorton and Rowenhorst (2006) and Erb and Campbell (2006). These findings highlighted the diversification benefits of including commodities in an investment portfolio. This therefore allowed financial institutions to successfully promote commodity futures as a new asset class for institutional investors (Falkowski, 2011). Financialization of commodity markets was further encouraged by the finding that commodity futures contracts have good hedging properties against inflation and commodity futures contracts were also deemed to provide a hedge against changes in the dollar exchange rate. As a result, billions of dollars were poured into the commodities futures markets with funds usually allocated between popular commodity indices such as the Standard & Poors–Goldman Sachs Commodity Index and the Dow Jones–AIG Commodity Index (Masters, 2008).

Economic theory traditionally explains commodity price formation in terms of changes in "fundamental" factors (normal demand and supply). Demand and supply may be impacted positively or negatively by factors such as weather conditions, crop diseases, political issues, technological developments, production disruptions due to strikes or natural disasters, changes in production capacity and changes in intensity of commodity usage. These changes in supply and demand are the key determinants of price movements. However, since the emergence of financialization, it is argued (Falkowski, 2011) that commodity prices are now also determined by a whole set of financial factors, such as the aggregation of risk appetite for financial assets and the indexed behaviour of diversified commodity index investors. Mann and Keeton (2013:3) note that "these commodity index funds differ from the usual short term investment and speculation in commodity futures in that they can only take a long position". Therefore investors are betting on prices continuously increasing (Wray, 2008). Furthermore, Falkowski (2011) suggests that because of the non–physical interest of their trading, the structure of index funds leads to the unwarranted driving of demand for commodities by rolling over expiring contracts. Rolling is profitable when the prices of futures contracts are progressively lower in the distant delivery months and negative if the reverse holds. Rolling futures forward was suspected to have inflated prices beyond fundamentally justifiable levels through creation of artificial demand on the futures market (Grosche, 2014).

The emergence of financialization led to a questioning of the purpose of commodity market futures contracts. Traditionally a commodity futures contract which can be defined as "a standardized contract which obligates the buyer to accept delivery of and the seller to deliver a standardized quantity and quality of an asset at a pre-specified price on a pre-stipulated date" (Faure, 2015:60), was meant to assist the producer to hedge against price risk and facilitate price discovery.

However, increased speculative trading by financial investors means the very functioning and purpose of the commodity futures market has been distorted (UNCTAD, 2011). Consequently, market participants with a commercial interest in physical commodities face greater uncertainty about the reliability of price signals emanating from commodity exchanges. More so, managing risk, making storage and trading decisions becomes more complex for physical producers.

Against this background much of the empirical literature revolves around two schools of thought. The first postulates that there is an unequivocal link between the "financialization'' of commodity market, rising prices and price volatility of commodities since 2002 (Mann and Keeton, 2013). Here, Masters (2008), Tang and Xiong (2012) and De Schutter (2010) advocate for strong and prompt regulatory responses to prevent commodity markets from being distorted by what they deem as excessive speculation.

The second school of thought (Stoll and Whaley, 2010, Irwin and Sanders, 2011, Dwyer *et al.,* 2011), whilst acknowledging that "financialization" may have played a "part'' in the commodity price boom from 2003-2011, argues that fundamental price determinants (simple demand and supply) were the major determining factors of rising prices. They reject any further regulation of the commodity markets and laud the positive effects of "financialization", such as greater market efficiency and deeper markets.

In support of their claim that financialization impacted on commodity prices, Tang and Xiong (2012) examined the rolling returns on daily futures of different commodities. They argued (Tang and Xiong, 2012:60) that "if index financialization played a significant role in the recent commodity price boom and increased volatility, then the prices of various unrelated commodities will be increasingly correlated". They found significant increases in the returns on seemingly unrelated commodities.

Mann and Keeton (2013) extended this study by analysing the relationship between the prices of different metals and between metals and oil prices. They also found significant increases in the correlation between price movements of different commodities. Bicchetti and Maystre (2012) observed intra-day co-movements between the returns on several commodities and changes in the stock market in the United States. Masters (2008), De Schutter (2010) and Mayer (2012) found that index investing and speculation did impact on commodity prices. Basak and Pavlova (2015) modelled the financialization of commodities and disentangled the effects of institutional flows from traditional demand and supply effects on commodity futures and revealed that in the presence of institutional flows, futures of all commodities rise, with future prices of index commodities increasing by more.

However, empirical work by Buyuksahin and Harris (2009), Stoll and Whaley (2010), Philips and Yu (2010), Dwyer *et al.* (2011), Irwin and Sanders (2011), Fattouh *et al.* (2012) and ICI (2012) argues that financialization did not impact on the level and volatility of commodity prices.

Fattouh *et al.* (2012), Alquist *et al.* (2012) and Amman (2012) argue that there is no relationship between the futures price and spot market. As financialization occurred in the futures market, it did not impact on spot prices. However, Mann and Keeton (2013) found an increased correlation in price changes in both the futures and spot markets during the period of increased financialization. Bohl and Stephan (2013) note that even if index speculators do not influence the physical demand for commodities, they may still distort spot prices indirectly given that the latter are related to futures prices through the arbitrage channel. It is therefore pertinent to determine if excessive speculation in the futures market fuelled record high spot prices (Mathews, 2012). Hernandez and Torrero (2010) as well as Tilton *et al.* (2011) show that the flow of information from the futures market to the spot market has gained significant momentum in the past fifteen years.

Most of the literature studied covers the period of rising commodity prices from 2002-2011. This study aims to contribute to existing literature by examining the impact of financialization post-2011, when commodity prices across all categories have been falling. This study is relevant given that commodity price volatility tends to have significant adverse effects. According to UNCTAD (2011), at the macroeconomic level it can lead to deterioration in the balance of payments and in public finance with the associated uncertainty likely to curtail investment and significantly depress long term growth. At the microeconomic

level, high and volatile commodity prices have severe consequences on the most vulnerable; especially food and energy insecure households.

1.2 Goals of the Research

The main goals of the research are therefore:

- To extend previous studies by Tang and Xiong (2012) and Mann and Keeton (2013) to incorporate more recent data so as to determine whether the correlations amongst commodity prices have changed now that commodity prices are falling.
- To establish whether there is a link between what has happened to commodity prices and the financialization of commodity markets. A sub-goal to achieve this, is to establish whether there is a link between movements in futures prices and spot prices both when prices are rising and when they are falling.

1.3 Methods, Procedures and Techniques

The principal method of research utilised will be that of quantitative analysis. The paradigm employed will be positivist. Informed by Tang and Xiong (2012), Mann and Keeton (2013), Bonato and Taschini (2015) and Stoll and Whaley (2010) correlations of rolling returns will be calculated for i) exchange-traded commodities (base metals and oil) and ii) exchange-traded commodities and bulk commodities not traded on exchanges. This method will be used to establish whether the previously found increased correlations between different commodities still hold now that commodity price across major categories are falling. The rolling correlation method used in the previous studies is an appropriate test for the hypothesis that "If index financialization played a significant part in recent commodity price increases and volatility, then the prices of various unrelated commodities will become increasingly correlated" (Mann and Keeton, 2013:6).

Given that the goal of the paper is to extend existing empirical findings by Tang and Xiong (2012) and Mann and Keeton (2013) the time period will be extended to 31 December 2015 to include the commodity price slump. Prices of base metals will be included, broadening the scope of the study beyond the focus on agricultural products in many previous studies. Correlations will also be calculated for spot prices.

The Granger causality test (see Section 3.5) is a well-established procedure for ascertaining (Granger) causality in econometrics and other disciplines (Mathews, 2012). Although it does

not imply actual causality (there could be a host of reasons for apparent causality in two series, including market fundamentals), Granger causality is generally considered a good measure of statistical coincidence (Mathews, 2012). Therefore, in order to determine if there is a link between futures prices and spot prices when commodity prices are falling, the study will follow Mathews (2012), Hernandez and Torrero (2010) and Amman (2012) by employing the Granger causality tests.

This study will utilize daily 3-month futures contracts and daily closing spot prices of various commodities taken from Thompson Reuters for the period 1994–2015.

1.4 Outline of Study

This study consists of five chapters and is structured as follows: Chapter 2 provides a review of the theory and literature on the financialization of commodity markets. Chapter 3 gives an overview of the methodology and data used in the research. Two techniques are used, namely the rolling correlation method and Granger causality tests. The outcome of this empirical study and its results are presented and discussed in Chapter 4. Chapter 5 concludes the study and discusses the policy implications based on the findings obtained.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of the backdrop, theory and literature on the financialization of commodity markets. Recent price developments in commodity markets suggest that, beyond the functioning of specific commodity markets, broader macroeconomic and financial factors that operate across a large number of markets need to be considered to understand commodity price developments fully (Mayer, 2012). According to Staritz (2012) significant structural changes in fundamental demand and supply conditions across physical commodity markets related to increased demand from growing emerging market economies (EMEs), alternative uses of commodities for energy production, and a reduction in supply due to low productivity and supply constraints have occurred. However, according to Staritz (2012) these factors alone are not sufficient enough to explain the recent price developments. Simultaneous to fundamental changes, trading activities on commodity derivatives have undergone a major shift related to the increasing presence of financial investors and, despite commodity-specific differences, their increased participation has affected the microstructure of commodity derivative markets and the price dynamics.

The chapter is structured as follows: Section 2.2 provides a brief explanation of the purpose and function of commodity markets. Section 2.3 analyses the formation of prices in commodity markets. Section 2.4 discusses the financialization of commodity markets. Section 2.5 provides a theoretical explanation of the relationship between futures prices and spot prices. Sections 2.6 and 2.7 provide reviews of empirical findings whilst Section 2.8 concludes the chapter.

2.2 The Purpose and Function of Commodity Markets

Commodities lie at the heart of the global economy. Access to and affordability of commodities are essential to the well-being, growth and competitiveness of economies which are highly dependent on commodity trade (CEPS, 2013). According to Mathews (2012) and Chang (1985) commodity markets exist in order to provide producers and users of physical commodities with publicly–known uniform price and contract terms for a given commodity. More so, Pirrong (1994) notes that commodity markets "transmit valuable information about demand and supply conditions". Market participants with private information will buy or sell depending on that information and thus the price will be forced towards the correct market

level whilst newly-available public information will encourage wise investments (UNCTAD, 2011).

Two types of commodity markets exist, namely the physical/spot and futures (derivatives) market. The former is a "general market (for which it is hard to point to one specific place where the trade is done) that accommodates the need to balance demand/supply disequilibria" (CEPS, 2013:14). In this market a spot contract exists which requires the two contracting parties (buyer and seller) to fulfil their obligations promptly (Staritz, 2012). The latter (futures markets), instead serves the intertemporal choice of end users by trading expectations on supply and demand patterns which occur mainly through changes of inventory levels or over a diverse time period (CEPS, 2013). More so, futures markets are an essential infrastructure to support risk management they allow for the transfer of risk from the risk averse (i.e. producers) to the risk tolerant (investors/speculators). Market participants who wish to hedge against future price fluctuations can "lock in" that price in advance of its production or availability for sale at a later date (Pirrong, 1994). According to Masters (2008), commodity futures markets also provide a key function for producers and consumers of commodities participating in spot markets. This is the price discovery function, as trading on the futures market enables open market discovery of prices of commodities that are used as a benchmark for spot transactions. Therefore, centralized futures markets are accepted as the best indicator for overall demand and supply condition across spot markets.

2.3 Commodity Price Formation

The basic theory of price formation tells us how the price of a particular asset will change based on the adjustment to its supply and demand. In the classical supply and demand model, the market is in equilibrium when the price of a commodity is such that the quantity supplied is equal to the quantity demanded. Quantity supplied is determined by the marginal cost of production, as profit maximising firms produce until marginal cost equals marginal revenue (the product price). Any variation in supply (marginal cost) or quantity demanded upsets the equilibrium and triggers supply/demand responses which equilibrate the two and move the price to its new equilibrium level. If an increase in demand causes the price to rise above marginal cost then, in perfect competition, this will trigger new entrants into the market. These new entrants shift the supply curve outwards, which forces the price back to equilibrium where it equates marginal cost and there is a return to "normal" profits in the industry (Parkin *et al.*, 2005:65-68)

In the case of commodities there are many factors that impact the movement of prices - for example, weather conditions, amount of acres planted, production strikes, crop diseases, technological developments, international trade unions, physical quality, location, political control through subsidies, taxes or trade restrictions, general economic conditions, cost of production and ability to deliver to buyers, availability of substitutes and shifts in taste and consumption (Falkowski, 2011, Horcher, 2005 and Trostle, 2008). These factors are often referred to as "fundamental" factors.

Producing commodities is also often capital intensive and there may be considerable time lags before bringing new production capacity online. This therefore, according to Meadows (1969) can lead to sustained shortages when demand suddenly rises, fuelling prolonged periods of high prices. Furthermore, commodity price movements are also closely tied to inventory and storage capacity (Falkowski, 2011). Inventories serve as a bridge between the physical supply of a commodity and the current global market demand. Therefore, an inability to manage either of these to cushion demand and supply shocks such as drought or production strikes can force prices to react quickly and aggressively. The easier and less costly it is to store a commodity the less volatile the price will most likely be. Furthermore, when a commodity has low inventories consumers are most likely to be charged a premium for the scarcer commodity.

According to Dwyer *et al.* (2011), commodity prices tend to be volatile as in the short run both global supply and demand tend to be price inelastic. For example, increasing the level of production takes time if new crops must be grown, mineral exploration undertaken or new mines built. Similarly, it can take considerable time to change consumption habits. This sluggish response implies that supply and demand shocks, due to cyclical changes in weather or natural disasters for example, can result in large price movements in order to clear the market.

Additional factors that influence the formation of commodity prices include exchange rates (in particular the US dollar exchange rate), expected levels of inflation and interest rates. Research by the International Monetary Fund (IMF) cited in ICI (2012) illustrates the inverse relationship between the US dollar exchange rate and the price of commodities. Simply put, commodities are priced in US dollars throughout the world and therefore, when the US dollar depreciates, foreign commodity producers whose costs are in their local currencies will want to receive more US dollars to cover production costs and thus demand higher prices (ICI,

2012). Traditionally holdings in commodities notably gold have been thought of as a hedge against inflation. Therefore, during inflationary periods or when inflationary expectations arise the prices and demand for commodities may rise (ICI, 2012).

According to Campbell (2006) high interest rates reduce the demand for storable commodities because of the higher carry costs of storage. Higher interest rates also increase the supply of commodities (Campbell, 2006) through a variety of channels: by increasing the incentive for extraction today rather than tomorrow; by decreasing firms desire to carry inventories; and by encouraging speculators to shift out of commodity contracts. Conversely a decrease in the real interest rate has the opposite effect, lowering the cost of carrying inventories and raising commodity prices.

2.4 Financialization of Commodity Markets

The dramatic increase in real commodity prices across many categories from 2002 was an exceptional event. Humphreys (2009:1) describes it as "the most powerful and sustained boom since World War II". This rise was widely believed to have been as a result of rapidly growing demand associated with urbanization and industrialization (resource intensive growth) as well as changes in dietary habits towards more protein rich diets in major EMEs particularly China and India (UNCTAD, 2011). However, many authors such as Tang and Xiong (2012), Mann and Keeton (2013), Bicchetti and Maystre (2012) as well as Masters (2008) argue that the extent of price increases across many commodities was greater than could be explained by "fundamental" determinants of commodity supply and demand. These authors note that rising commodity prices coincided with the growth of the "financialization" of commodity markets. Furthermore, Pradhananga (2015:3) raises doubt against the "fundamentals" (demand and supply) school of thought by stating that "the prices of two commodities may only move together if they are related - they are either complements or substitutes in production or consumption. Idiosyncratic demand and supply shocks in a particular commodity may be translated to other related commodities. However, commodity specific shocks cannot explain recently observed co-movements across unrelated commodities".

Volatile spot price levels across several commodities and growing correlation between returns of financial and non-financial assets have raised concerns over the role of factors that are unrelated to market fundamentals in price formation (CEPS, 2013). The extreme price increases and the synchronized behaviour across commodity prices suggests that beyond the

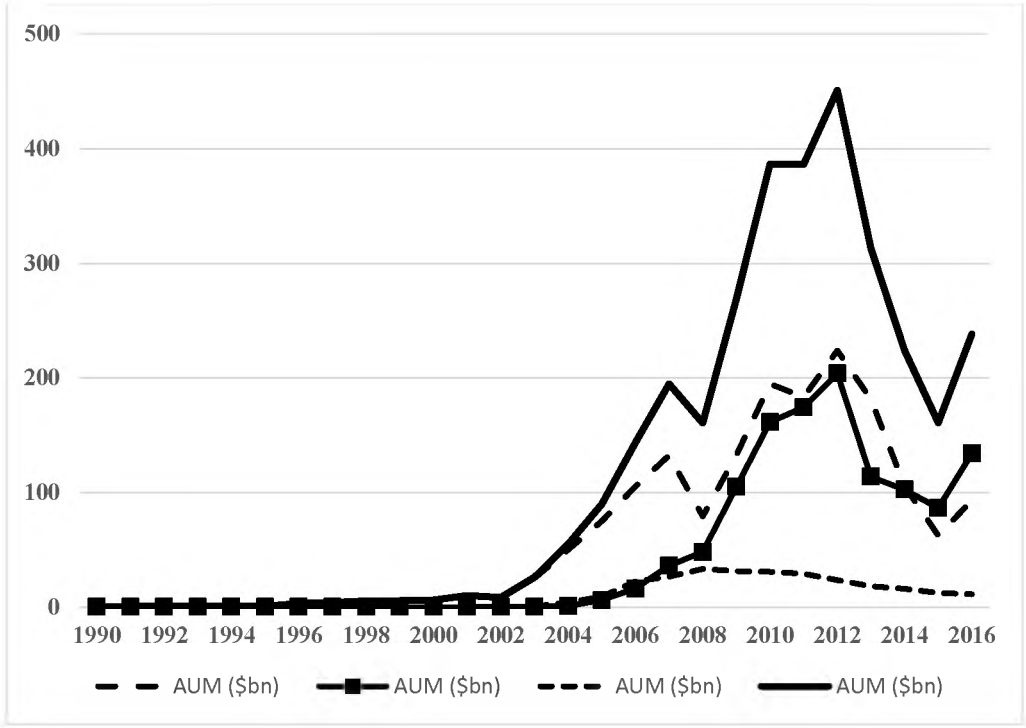
functioning of specific commodity markets, broader macroeconomic and financial factors that operate across a large number of markets need to be considered to understand commodity price developments fully (Mayer, 2012).

Pre-2000 evidence suggests that commodity markets were partly segmented from financial markets and from each other (Tang and Xiong, 2012). Erb and Campbell (2006) reveal that commodity prices previously had low positive correlations with each other. Furthermore, commodity returns were found to have negligible correlations with the S&P 500 returns especially at short horizons.[1] However, following the equity market collapse in 2000 the widely publicized discovery of a negative correlation between commodity returns and stock returns by Greener (2000) and Gorton and Rouwenhorst (2006) highlighted the diversification benefits of including commodities in a portfolio. This allowed financial institutions to successfully promote commodity futures as a new asset class for institutional investors. Other reasons for viewing commodities as an asset class were commodity futures contracts were found to have good hedging properties with inflation, and commodity futures contracts were also deemed to provide a hedge against changes on the dollar exchange rate. As a result, billions of dollars were poured into the commodities futures markets. Such funds were usually allocated between popular indices such as the Standard & Poors – Goldman and Sachs Commodity Index and the Dow Jones – AIG Commodity Index leading to a process termed "financialization" (Masters, 2008).

Figure 1 below depicts the total commodity assets under management from 1990-2016. Simultaneous with the period of increasing prices (Figures 2 and 3) the total amount of funds invested in commodities rose from $8.30 billion in 2002 to $451 billion in 2012. It then fell to $238.36 billion in 2016.

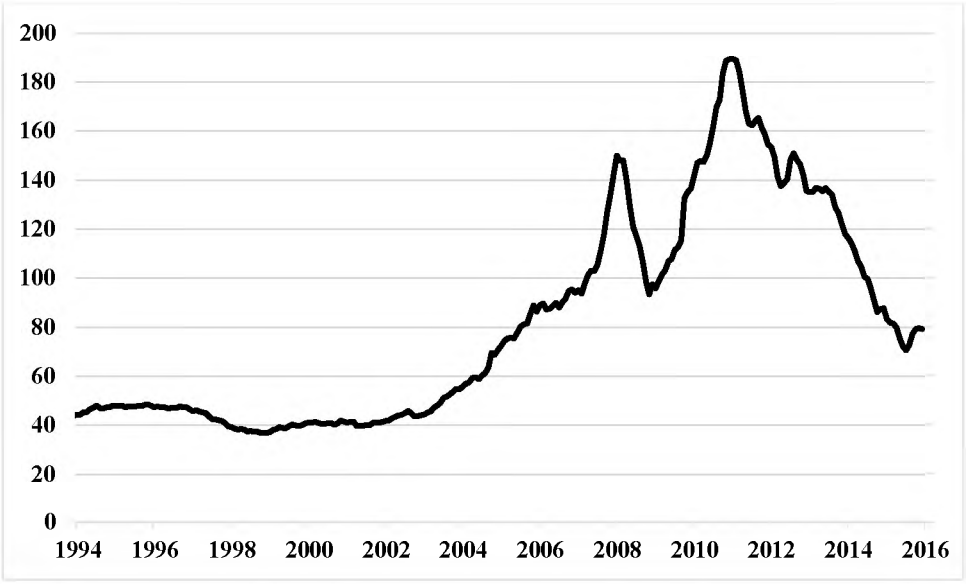
[1] Standard and Poor's (S&P 500) is an American stock market index based on the market capitalization of 500 large companies having common stock listed on the NYSE or NASDAQ.

Figure 1: Total Commodity Assets under Management (US$ billion)



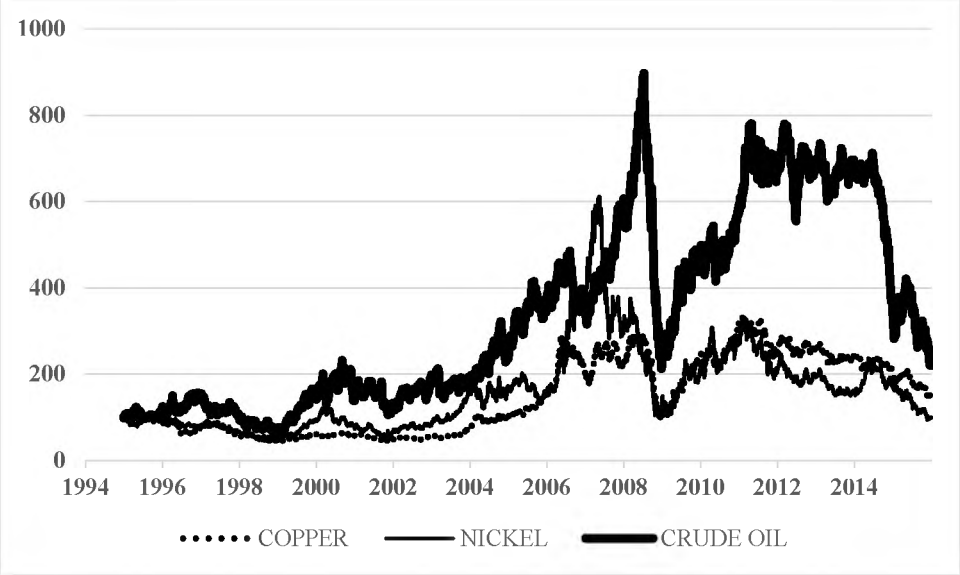
Source: Own graph derived from commodity data provided to the author by Barclays Bank plc (2016)

Figure 2: Reserve Bank of Australia Commodity Price Index (US$)



Source: Own graph data derived by the author from the Reserve Bank of Australia online database (2016)

Figure 3: Daily Spot Prices



Source: Own graph data derived by the author from data obtained from Thompson Reuters (2016) Index: 1994=100

Whilst the timing varied for different types of commodities, the surge in prices post-2002, the sharp correction in 2008 and subsequent rebound, followed by declines post-2011 was uniform for most commodities.

Though there are various definitions of financialization, it is imperative to note that they all carry the underlying theme of greater or increased financial participation in commodity markets. As noted earlier according to Falkowski (2011:5), financialization may be defined as "the increasing role of financial motives, financial markets and financial actors in the operation of commodity markets". CEPS (2013:3) define financialization "as the increasing interaction of commodity markets with the financial system". Casey (2011:6) describes financialization as "the vastly expanded role of financial motives, markets, actors and institutions in the operation of domestic and international economies, and in this case, the increasing role in commodities markets". Alternatively, the term "financialization of commodity trading" indicates the increasing role of financial motives, participants and actors in the operation of commodity markets (UNCTAD 2011:13).

According to Mann and Keeton (2013) the factors that resulted in the most powerful and prolonged commodity price boom can be split between the "fundamental" drivers of price, supply and demand, and "non-fundamental" factors, more specifically the role of financialization.

2.4.1 "Fundamental" Drivers

The most popular or common explanation of the synchronized commodity price boom across a broad range of commodities after 2002 was the rapid economic growth of China, India and other EMEs (Falkowski, 2011 and Mann and Keeton, 2013). During this period of rapidly increasing commodity prices there was a shift in the composition of global growth as EMEs, in particular China, came to prominence as the engines of world growth. Since these EMEs were at a relatively commodity-intensive stage of development as they industrialized, urbanized, expanded infrastructure and shifted their dietary habits towards more protein rich diets (UNCTAD, 2011 and Dwyer *et al.*, 2011) there was a shift in global demand to commodities. More so, the significant migration of people from rural areas to urban areas in China during this period resulted in a rapid increase in infrastructural requirements for urban dwelling, raising the demand for basic commodities like steel and copper. An estimated 10 million people were moving to urban areas yearly and this was estimated to increase four-fold to 40 million by the World Bank by 2010 (Heap, 2005). As a consequence China became the world's largest consumer of a number of industrial commodities during the past decade and a half, and accounted for much of the growth of global commodity consumption over the period. Virtually all of the global increase in demand for metals and more than half of the increase in primary energy demand between 2000 and 2014 was in China (Commodity Markets Outlook, 2016). The combination of industrialization, urbanization and shifting of dietary habits therefore led to a demand side shock in commodity markets (Mann and Keeton, 2013).

Humphreys (2009) notes rapidly rising demand and delayed supply responses as fundamental determinants of surging commodity prices from 2003. Mann and Keeton (2013:3) likewise note that "an increase in demand is sufficient to trigger sustained price increases only if supply does not rise in response. One therefore must look to the supply side to ascertain why such a substantial increase in demand did not immediately trigger a supply response which would bring prices back to equilibrium and neutralize the upward spiral of prices".

Low levels of investor confidence in the years on either side of 2000 meant that mining and metals companies had been unwilling and arguably in many cases simply unable to create new capacity (Humphreys, 2009). According to Humphreys (2009), at the time, the industry appeared to have an almost complete fixation on cost cutting and capital efficiency and, hence, when demand did start to rise there was relatively little spare production capacity

available in the system. Furthermore, Radetzki (2006) suggest the slow supply side response of the mining and metals industry was quite simply a product of the normal lags inherent in the supply side response of any capital-intensive industry. According to Heap (2005) supply sides response can be affected by increasing production costs. Whilst the majority of the production cost increases are cyclical they will also continue to rise on a structural basis. Therefore, additional supply required to meet higher trend demand growth will be at a higher cost, requiring higher prices.

Other explanations of fundamental drivers being partly responsible for the surge in commodity prices were the relatively low interest rates and the substantial decline in the value of the US dollar at that time (Akram, 2009; Krichene, 2008). Empirical evidence between 2003 and 2007 suggests that shocks to interest rates and the US dollar accounted for substantial shares of the fluctuations in commodity prices (Akram, 2009). Krichene (2008) noted the prevailing loose stance of monetary policy at the time caused further inflammation of commodity prices.

2.4.2 "Non-fundamental" Drivers

According to De Schutter (2010), the sudden massive inflow of index funds into commodities should be placed in the context of developments in the broader financial markets. Following the passing of the U.S. Commodity Futures Modernization Act in 2000 which "deregulated commodity markets, weakening speculative position limits and provided loopholes for speculation through completely unregulated "shadow markets", non-commercial participants therefore began to increase their share of the commodities futures market" (Frenk, 2010:2). Understandably, the number of futures and options traded globally on commodity exchanges increased five-fold between 2002 and 2008. The value of outstanding over-the-counter commodity derivatives grew from $0.44 trillion in 1998, to $0.77 trillion in 2002 to more than $7.5 trillion in June 2007 (De Schutter, 2010).

Beginning at the end of 2001, new investment vehicles, in particular commodity indexes, began to see an influx of non-traditional investors such as pension funds, hedge funds, sovereign wealth funds and large banks. This resulted in billions of dollars being invested in commodities. According to Baffes and Haniotis (2010) the "new" money, which is not associated with physical commodity transactions, can be linked to three sources: i) excess liquidity: here, the low interest rate environment followed by many central banks resulted in excess liquidity, part of which found its way to commodity markets; ii) diversification of

investment vehicles as investment managers searched for "uncorrelated assets" in order to broaden their portfolios; and iii) the rebalancing of investment portfolios by shifting funds from US dollar-denominated (and other) holdings to commodities added further inflows into commodity markets (Baffes and Haniotis, 2010).

Mann and Keeton (2013:3) note that "these commodity index funds differ from the usual short term investment and speculation in commodity futures in that they can only take a long position". Therefore, investors are betting on prices to continuously increase (Wray, 2008). Furthermore, Falkowski (2011) suggests that considering the non–physical interest of their trading, the structure of index funds leads to the unwarranted driving of demand for commodities by rolling over expiring contracts. Rolling is profitable when the prices of futures contracts are progressively lower in the distant delivery months given a backwardated market and negative if the reverse holds (Trade and Development Report, 2009).

Stoll and Whaley (2010:4) note that "commodity index investing refers to the practice of buying baskets of commodities albeit synthetically to diversify an investment". Over the past decade and a half two commodity indexes have emerged as industry benchmarks namely, the Standard and Poors–Goldman and Sachs Commodity Index (S&P-GSCI) and the Dow Jones-UBS Commodity Index (DJ-UBSCI). The former is the older commodity index with price levels dating back to August 1991. It is well diversified and is computed as a (quantity) production-weighted average of the prices from 24 commodity futures markets. The latter has data that dates back to October 1991 and the market weights that make up the index are based on a combination of economic significance and market liquidity (Stoll and Whaley, 2010 and Irwin and Sanders, 2010).

Masters (2008:5) distinguishes between index speculators and traditional speculators and notes that index speculation

> "arises purely from portfolio allocation decisions. When an institutional investor decides to allocate 2% to commodity futures for example, they come to the market with a set amount of money. They are not concerned with the price per unit; they will buy as many futures as they need at whatever price is necessary until all their money has been "put to work". Their insensitivity to price multiplies their impact on commodity markets".

This impact is magnified because index speculator demand increases the more prices increase. Masters (2008) claims that this explains the accelerating rate at which commodity futures prices (and actual spot commodity prices) increased after 2001. Rising prices attracted

more index speculators, whose tendency was to increase their allocation further as prices rose, and therefore their profit-motivated demand for futures was the inverse of what would be expected from price-sensitive consumer behaviour (Masters, 2008).

The scale of involvement of index funds in commodities thereby increased rapidly over the period 2003-2008 from having an estimated value of $8 billion at the end of 2002 to $200 billion by mid-2008 with a substantial amount of this invested in metals (Humphreys, 2009). Furthermore, commodity assets under management neared $410 billion in the first quarter of 2011 (see Figure 1), with the majority coming in the form of index fund investment (Dwyer *et al.*, 2011).

The exact impact of these funds is widely contested by several scholars. Proponents of the "non-fundamental" view describe them as playing a catalytic role in increasing prices far beyond their fundamental levels whilst others emphasize the role economic "fundamentals" of demand and supply played in the period of rising prices (Mann and Keeton, 2013).

2.5 The Relationship between Futures Prices and Spot Prices

Bohl and Stephan (2013) note that even if index speculators do not influence the physical demand for commodities at all, they may still distort spot prices indirectly given that the latter are related to futures prices through the arbitrage channel. Futures prices generally lead or are at least related to spot prices as evidenced by literature on the price discovery process (Staritz, 2012). It is therefore pertinent to establish a theoretical link between the two markets. This section aims to give a short overview of the literature underlying the relationship between futures and spot prices.

2.5.1 Theory of Storage

In its simplest terms the theory of storage focuses on the cost and benefits of holding physical stocks to explain the relationship between spot and futures prices (Lauiter, 2006). This theory is well known as the "cost of carry" approach and dates back to Kaldor (1939). This approach suggests the forward price can be determined as a function of the prevailing spot price, the interest rate and the cost of storage.

According to Peirson (2008:542) "a futures price [F at time 0] must be equal to the current spot price [S at time 0], plus the carrying cost [C]" and is depicted as follows;

$$F_0 = S_0 + C$$

where [C] comprises of interest and storage costs.

According to Hull (2002) as long as the spot price plus carrying cost is equal to the futures price no arbitrage opportunity is present. If the futures price exceeds the spot price plus carrying cost arbitrageurs buy the commodity on the spot market today and go short on the futures market simultaneously (selling a futures contract for the higher price). A risk-free profit is obvious. Arbitrageurs follow this procedure until spot prices plus carrying costs will be at least equal to the futures price (UNCTAD 2011). If the futures price is less than the spot price plus carrying cost an arbitrage opportunity is present as well. The commodity is sold on the spot market by arbitrageurs and immediately bought on the futures market (going long). They do so until spot prices plus carrying costs equal the futures price (Amman, 2012).

2.5.2 Contango and Backwardation

Futures prices and spot prices may be related in the following two ways: i) either the futures price at the time of purchase is higher than the spot price and falls to meet the eventual future spot in a situation known as contango; or ii) the futures price is less than the spot and hence rises to meet the spot price in a process known as backwardation (Mathews, 2012).

When the market is in contango investors will purchase physical commodities spot and sell them as futures. In economic parlance the trader will short the futures contract and then buy the underlying commodity for delivery thus earning a profit. However, in a backward-dated market the reverse holds. Traders will short the physical commodity and purchase futures. The resultant effect of these two actions is price convergence (Harper, 2007).

2.6 A Review of Empirical Findings

Much of the empirical literature revolves around two schools of thought. The first postulates that there has been an unequivocal link between the "financialization'' of commodity markets, rising prices and price volatility of commodities since 2002 (Mann and Keeton, 2013). Here, Masters (2008), Tang and Xiong (2012) and De Schutter (2010) advocate for strong and prompt regulatory responses to prevent commodity markets from being distorted by what they deem as excessive speculation.

On the other hand, Stoll and Whaley (2010), Irwin and Sanders (2011), and Dwyer *et al.* (2011), whilst acknowledging that "financialization" may have played a "part'' in the

commodity price boom from 2003-2011, argue that fundamental (simple demand and supply) price determinants were the major determinants of rising prices. They reject any further regulation of the commodity market and laud the positive effects of "financialization", such as greater market efficiency and deeper markets.

In this section, empirical literature which challenges or supports these differing schools of thought is presented.

2.6.1 Empirical work in support of non-fundamental factors

Tang and Xiong (2012) investigated the hypothesis that if index financialization played a significant role in the recent commodity price boom and increased volatility, then the prices of various unrelated commodities would be increasingly correlated because index-trading required the simultaneous purchase of a basket of commodity futures. Focusing on increased price co-movements between different commodities after 2004, one year rolling return correlations were plotted between oil and selected commodities from non-energy commodity sectors (soft, grains, livestock and metals). They discovered (Tang and Xiong, 2012) that future prices of the selected commodities became increasingly correlated with oil after 2004. Moreover, the increased correlation was more significant for indexed commodities (S&P-GSCI and DJ-UBS) than for off-indexed commodities. They concluded that these findings reveal a fundamental process of financialization in which "the price of an individual commodity is no longer determined by its supply and demand instead, commodity prices are determined by a whole set of financial factors such as the aggregate risk appetite for financial assets and investment behaviour of commodity index investor'' (Tang and Xiong, 2012:72).

Mann and Keeton (2013) extended Tang and Xiong's (2012) investigation by analysing the relationship between the prices of aluminium, tin, copper and zinc. Adopting the same methodology - namely, the calculation of rolling correlations of futures returns - it was discovered that there was a significant increase in the return correlation between the futures prices of tin, nickel, aluminium, copper and zinc in the period 2001-2013 as compared to the previous period 1994-2001. Correlations between prices of indexed commodities rose during the period 2003-2011, while correlations between prices of non-indexed commodities were unchanged. These findings confirm those of Tang and Xiong (2012) that the financialization of the commodity sector played a compelling role in the increasing commodity prices and price volatility post-2003.

Tang and Xiong (2012) also investigate several economic mechanisms other than financialization that could have caused the increases of return correlations amongst seemingly unrelated commodities in recent years. These include rapid growth of EMEs, the world financial crisis post-2007, and inflation. However, they find (Tang and Xiong, 2012) that none of these macroeconomic fundamentals can fully explain the increasingly synchronised price boom of unrelated commodities. Nor can they explain the greater increase in return correlations among indexed commodities compared to off-indexed commodities (Tang and Xiong, 2012).

Bonato and Taschini (2015) provide further evidence of the financialization of commodity markets through an analysis of the observed commodity price co-movement based upon the theory of co-movement proposed by Barberis *et al.* (2005). The difference between index and off-index commodities, considering 25 commodities, is investigated with the aim of complementing Tang and Xiong (2012). Univariate and bivariate regressions examining two time periods 1998-2005 (pre-financialization) and 2005-2011 (post-financialization) are run. In the univariate regression significant increased co-movement between indexed and non-energy commodities starting in 2005 is observed. Conversely, for off-indexed commodities either no change or a significant decrease in co-movement is observed. These results are further corroborated through bivariate regressions and thus present evidence of increase financialization post-2005.

Bicchetti and Maystre (2012) observe the intra-day co-movements between returns on several commodity markets and the stock market in the United States (US) over the period 1997-2011. By utilising a high frequency database, various rolling correlations are computed at one second, ten second, five minute and one hour frequencies. They find significant positive co-movements of the returns of the futures contracts of oil (crude) and a broad range of soft commodities (corn, wheat, sugar, soya beans and live cattle) with futures contracts of the E-Mini S&P500 stock market futures at all frequencies including up to one second intervals.[2] These findings contribute to the empirical evidence in support of the notion that financialization of commodity markets had an impact on price determination. Bicchetti and Maystre (2012) argue that the pre-2012 price movements of commodities are hardly vindicated on the basis of changes of their own supply and demand. They note (Bicchetti and Maystre, 2012) that the strong correlations shown at very high frequencies in their findings

[2] E-Mini S&P500 is a stock market index futures contract traded on the Chicago Mercantile Exchange's Globex electronic trading platform.

are unlikely to reflect economic fundamentals, since such fundamentals do not vary over such a small time period. Furthermore, given the array of commodities chosen in their study, Bicchetti and Maystre (2012) note that different behaviours in prices would be expected because individual commodities differ in their fundamentals, seasonality and specific physical market dynamics. However, no differences were observed between commodity price co-movements at any frequency.

Masters (2008), Mayer (2012) and De Schutter (2010) likewise emphasize the impact that index investing and index speculation has had on commodity prices. It was not until Masters (2008) gave testimony before the US Senate in 2008 that concern about the distortionary impact of index investment became prominent. In its simplest terms the "Masters Hypothesis" is an assertion that the large boom and bust in oil prices prior to 2008 was caused by index investment flows (Cheng and Xiong, 2013). Masters (2008) imputed commodity index trading positions in the SCOT[3] for Kansas City wheat, feeder cattle and soya bean oil and concluded that index speculator demand drove higher prices.

Masters (2008) distinguishes between pre-existing "traditional" speculator demand and index speculator demand. He notes that

> "Index speculator demand arises purely from portfolio allocation decisions. When an institutional investor decides to allocate 2% to commodities futures for example, they come to the market with a set amount of money they are not concerned with the price per unit, they will buy as many futures contracts as they need at whatever price necessary until all their money has been "put to work". Their insensitivity to price multiplies their impact on commodity markets. Increasing index speculator demand creates a cyclical effect in the sense that it only creates rising prices which in turn result in higher prices attracting more index speculators whose tendency is to increase their allocation as prices increase beyond their fundamental levels'' (Masters, 2008:3).

In a similar study, Mayer (2012) distinguishes between two types of investors - money managers and index investors (financial investors that replicate the returns on some broad based commodity futures index) and examines the impact of both on commodity price movements. Two methods are used. Firstly, the net long positions taken by index traders are compared with those taken by non-commercial traders for four agricultural and four non-agricultural products. Secondly, Granger causality tests are performed for the following

[3] Supplemental Commitment of Traders (SCOT) Report. This is sometimes referred to as the commodity index trader report CIT which breaks out the positions of index traders in 12 agricultural markets.

hypotheses: 1) index positions do not Granger cause prices and 2) money - manager positions do not Granger cause prices. The period of study was from June 2006 – June 2009.

Mayer (2012:765), concludes that "instead of being determined by commodity specific supply and demand balances commodity prices have become influenced by the position taking behaviour of financial investors. Index investors appear to have affected the prices of a wide array of commodities (maize, soya beans, soya bean oil, wheat, crude oil, gold, natural gas and copper) whilst money managers tended to influence the price of mainly non-agricultural commodities during the period of 2007-2008 significantly for oil and copper".

Basak and Pavlova (2015) model the financialization of commodities and disentangle the effects of institutional flows from the traditional demand and supply effects on commodity futures prices by developing a simple and tractable model of commodity futures markets in which prices fluctuate in response to three possible sources of shock namely i) commodity demand shocks ii) commodity supply shocks and iii) endogenous fluctuations in assets under management of institutional investors (capturing effects of financialization). Basak and Palova's (2015) findings reveal that in the presence of institutional flows future prices of all commodities rise, with future prices of index commodities increasing by more. Shocks to fundamentals (demand and supply) of index commodities get transmitted to prices of all other commodities and the volatilities of all other commodities futures rise, with those of index commodities increasing by more. Lastly, Basak and Palova (2015) find that there is an increase in cross-commodity and equity-commodity correlations, with correlations for index commodity futures increasing by more. These findings therefore support prior empirical evidence that commodity prices have been driven by non-fundamentals (i.e. financialization).

2.6.2 Empirical work detracting from non-fundamental factors

Although advocates of the fundamentals (demand and supply) argument (Dwyer *et al.*, 2011, Irwin and Sanders, 2011, Philips and Yu, 2010, Stoll and Whaley, 2010 and Gilbert, 2009) present empirical evidence which downplays the role of "financialization" in commodity markets and emphasize fundamental drivers, they do however acknowledge the temporary (short-run) non-negligible impact index funds may have had in some commodity markets.

Dwyer *et al.* (2011), undertake an extended literature study to examine the factors behind the increase in the level and volatility of commodity prices. Dwyer *et al.* (2011) conclude that available evidence suggests that while financial investment could alter short-run price

dynamics for some commodities, the level and volatility of commodity prices appeared to be primarily determined by fundamental factors. This conclusion corroborates the findings of Philips and Yu (2010) who concluded that financial investment does not seem to affect commodity prices over longer time horizons. Dwyer *et al.* (2011) attribute the substantial increase in commodity prices to fundamental drivers such as the shift in global growth as EMEs, particularly China, came to prominence as the engines of world growth. They note that EMEs are at a commodity-intensive stage of development and hence there was a shift in global demand towards commodities as these countries industrialised and expanded their infrastructure. Furthermore, Dwyer *et al.* (2011) argued that commodity supply struggled to keep up with the unexpected rise in EME demand. Weather (droughts, floods and cyclones) and related production short falls in some key producer countries boosted the prices of a number of agricultural products, while natural disasters and accidents periodically lessened the output of mines.

Further explanations as to why financial investors may have not significantly altered price dynamics offered by Dwyer *et al.* (2011) were: i) price increases of commodities were just as large for some commodities that did not have well developed futures markets as those who had; ii) historically, previous episodes of increased correlation between commodity prices and other financial assets had occurred, with financial investment having played little or no role in commodity markets whatsoever during these periods; iii) there was not a large enough increase in commodity inventories to accompany speculation driven prices, as available – albeit limited - data showed global inventory levels declining even as prices rose.

Adopting the same methodology as Dwyer *et al.* (2011) and Fattouh *et al.* (2012:3) critically review supporting evidence on the popular view that "the surge in real oil price during 2003-2008 cannot be explained by economic fundamentals but by the increased financialization of the oil market which in-turn, allowed speculation to become a major determinant of the spot price of oil". The academic literature reviewed by Fattouh *et al.* (2012) reaches the following conclusions: Firstly, although there is clear evidence of increased financialization of oil market futures and some evidence of increased co-movements between asset classes, that co-movement is also found in off-index markets with no futures exchanges, which is suggestive of an explanation based on common economic fundamentals. Secondly, there is a lack of conclusive evidence that movements in financial traders' positions determine movements in the price of oil futures. Thirdly, Fattouh *et al.* (2012) note that a simple static model that is used to highlight how an inflow of financial investment may cause an increase in the spot

price of oil is inconsistent with the dynamic models of oil storage. They conclude that the oil price-inventory relationship provides no evidence of a quantitative significance of speculation in oil markets. Lastly, vector autoregressive models that test alternative explanations of the evolution of the real price of oil (including speculative demand) do not provide evidence of speculation playing a key role in the oil price boom from 2003-2008. Fattouh *et al.* (2012) conclude that futures and spot prices were being driven by a common factor reflecting economic fundamentals.

Falkowski (2011) addresses the issue of "commodity financialization" by investigating the main factors behind commodity price movements and the extent to which financial market participants contributed to price movements over the period 2001-2008. Falkowski (2011) finds no clear correlation between the reaction of the DJ-UBSCI energy sub-index to investors' activities in the energy market. Furthermore, an analysis of the Commodities Research Bureau Index (representing a broader spectrum of commodities) compared to the speculators open-interest positions showed that the index replicating the behaviour of commodity prices reflected a similar trend to open-interest positions. Interestingly, sharp changes in investment strategies did not result in increased volatility of commodity prices, indicating that long term commodity prices are not closely affected by financial investment. Falkowski (2011), acknowledges that the rapid growth of index investment resulted in commodity prices becoming more and more correlated. "At least in the short term it seems plausible that financial investment may have worsened volatility resulting in a temporary over-pricing and under-pricing of commodity prices" (Falkowski, 2011:14). However, Falkowski (2011) concludes there is little evidence suggesting it was speculation rather than fundamentals which drove commodity prices over the long term.

The Investment Company Institute (ICI, 2012), discovered that fundamental economic factors (EME growth, sluggish global supply and US dollar depreciation) provided a better and more consistent explanation for the general pattern in commodity prices from 2004–2011 than did financial factors. Using multiple regressions to demonstrate i) the relative power of economic and financial factors in explaining changes in commodity prices as measured by the DJ-UBS commodity index total return and ii) the relative importance of economic fundamentals compared to new net cash flows into the commodity mutual funds, ICI (2012) concluded that economic fundamentals such as the US dollar (inverse relationship) and EME growth drove commodity price movements and fluctuations between February 2004 - December 2011. These two fundamental factors were found to account for more than a third of the month to

month variation as well as 90% of the movement in the level of commodity prices over the period (ICI, 2012:11).

Secondly, economic fundamentals provided a more significant explanation of the monthly variation in commodity price changes than commodity mutual fund flows. The correlation between the DJ-UBS commodity index and a forecast based on economic fundamentals was 0.8, whilst the correlation based on index inflows was -0.5 (ICI, 2012).

In order to provide a comprehensive evaluation of whether commodity index investing is a disruptive force not only in the wheat futures market but in commodity markets in general Stoll and Whaley (2010) examined: i) price co-movements of indexed commodities ii) price co-movements of non-indexed commodities iii) prices of 5 spot commodities with no futures market (cash commodities) and iv) the impact of futures prices resulting from periodic futures contract rolls that are necessary to mimic well known commodity indexes such as S&P–GSCI and DJ-UBSCI.

The first examination centred on daily returns of 18 commodities included in the two main indexes for the period January 2006 – July 2009. A contemporaneous correlation matrix computing the daily returns revealed low levels of correlation between different commodities, leading Stoll and Whaley (2010) to suggest that commodity index trading had little effect on futures returns and therefore the commodity price volatility was being driven by other factors. Secondly, price co-movements were found between indexed and non-indexed commodities for example soya beans v oats, gold v silver and palladium v platinum - implying that a common factor was determining the prices of these commodities simultaneously, but it could not be index investing. Thirdly, price co-movements were found for spot/cash commodities (coal, rhodium and cobalt) with no futures market, raising doubts about the effect of index investing at least for cash commodities.

Lastly, returns were compiled for specific futures contracts rolled with the S&P-GSCI and DJ-UBSCI and it was discovered that the magnitude of commodity index investing as a measure of roll activity of the indexes appeared to have no impact on futures prices. In summary, "commodity index rolls have little or no futures price impact and inflows and outflows from commodity index investment do not cause futures prices to change" (Stoll and Whaley, 2010: 65).

Stoll and Whaley's (2010) findings are further augmented by Irwin and Sanders (2011) who concluded that a critical review of empirical literature on the impact of index fund investment during the period 2007-2008 cast considerable doubt on the notion that index funds fuelled a price "bubble" and noted that there is a lack evidence linking index fund trading and commodity futures prices.

Using daily data sourced from the Commodities Futures Trading Commission's (CFTC's) internal large trader database for the period July 2000 – March 2009, Buyuksahin and Harris (2009) perform an array of tests on the relationship between crude oil futures prices and the index positions of various types of traders. Results from Granger causality tests provide no statistical evidence that the position changes (number of contracts) by any trader group systematically preceded price changes for the entire sample period.

Similarly, Irwin (2013) adopts the same methodology as Buyuksahin and Harris (2009) to investigate the relationship between index positions and price movements in the agricultural futures market. Confirming the findings of Capelle-Blancard and Coulibaly (2011), Stoll and Whaley (2010) and Hamilton and Wu (2012), Granger test results provide little support for the "Masters Hypothesis" in the agricultural futures markets (Irwin, 2013).

With respect to six heavily traded agricultural and energy commodities (corn, crude oil, natural gas, soya beans, sugar and wheat) and drawing upon the general autoregressive conditional heteroscedasticity (GARCH) model, Bohl and Stephan (2013) approximate conditional volatility and analyse how it is affected by speculative open interest positions for two equally long sub-periods between October 1992 – September 2012. Speculative open-interest positions do not show any consistent influence in either period for all six commodities. Therefore, Bohl and Stephan (2013) conclude that the volatility of raw material prices was not driven by financialization.

2.7 Empirical evidence on the relationship between futures prices and spot prices

The explicit relationship between futures prices and spot prices remains a major topic, despite limited empirical knowledge available. The question of whether futures prices drove spot prices or *vice versa* is widely contested. On the one hand, empirical investigations carried out by Fattouh *et al.* (2012), Alquist *et al.* (2012) and Amman (2012) argue that there is no relationship between the futures price and spot market. By contrast, Hernandez and Torrero

(2010) as well as Tilton *et al.* (2011) show that the flow of information from the futures market to the spot market has gained significant momentum in recent years.

Hernandez and Torrero (2010) uncover the direction of information flows between spot and futures prices in the agricultural commodities market for the period 1994-2008. Using weekly prices for spot price data and closing prices of futures contracts for wheat, corn and soya beans Hernandez and Torrero (2010) perform linear and non-linear Granger causality tests. Their findings suggest price changes in futures markets leads to changes in spot markets more often than the reverse and this, therefore, reinforces the price discovery role of futures markets. In a nutshell, it is concluded that the return in the spot market today is significantly related to past returns in the futures markets up to at least 10 weeks ago, whereas the impact of past spot returns on today's futures returns is generally not significant.

Adopting the same methodology as Hernandez and Torrero (2010), Mathews (2012) carries out Granger causality tests on the London Metal Exchange (LME) copper spot and 3-month futures, using monthly and daily data for the period January 1980 – January 2012. Interestingly, the results obtained are less conclusive as both spots and 3-month futures prices were shown to Granger cause each other (bi-directional). According to Dwyer *et al.* (2012), this could be due to a large number of participants with access to both markets and by institutional factors which enforce a close mechanical relationship between the two markets. This explanation seems plausible due to copper being a highly-traded commodity.

Dwyer *et al.* (2012) undertake Granger causality tests for ten commodities covering four commodity classes, namely base metals, agriculture, energy and precious metals over a sample period from 1997-2011. Findings for base metals (aluminium, copper, nickel and zinc) were mixed, with little evidence present of a consistent one way Granger-causal relationship from the futures price to the spot price. They (Dwyer *et al.*, 2012) find evidence of a bi-directional Granger causal relationship for copper and nickel but almost no evidence of a Granger causal relationship in either direction for zinc or aluminium. Agricultural commodities (corn, soya beans and wheat) were much more uniform with strong evidence suggesting changes in daily futures prices Granger cause changes in daily spot prices. Like the agricultural sector, the energy (US gas) and precious metals (gold and silver) sectors provide significant evidence of Granger causality from futures price to spot prices.

Tilton *et al.* (2011) depart from the conventional methodology of using Granger causality tests and focus on the conceptual examination of the key mechanisms by which investor

demand on the futures market might influence spot prices. Their (Tilton *et al.*, 2011) analysis discovers that prices in futures markets and spot markets are closely related when markets are in strong contango (see Section 2.5.2) as is typically the case when spot markets are depressed. Under such conditions investors play a key role in financing inventories by buying spot and simultaneously selling futures to take advantage of the arbitrage. This results in an increase in stocks and a reduction in the spread between futures and spot prices. Conversely, when markets are in weak contango (see Section 2.5.2) or backwardation, spot prices are mainly driven by current rather than future conditions.

Amann (2012) raises doubt about the belief that speculation was a major driver of rising commodity spot prices through his findings from Granger causality tests. Monthly spot price data for wheat, rice, maize and soya beans and financial variables such as (commercial long positions, non-commercial long positions and total reportable long positions) which cover the rising demand for commodity futures for the period January 2002 – May 2011 are used. Amann (2012) draws up eight hypotheses to investigate whether each spot price Granger causes the financial variable or according to bi-directionality whether financial variables Granger cause spot prices. Little evidence is found to support the claim that financial trading activities granger cause changes in spot prices. Out of the 32 tested hypotheses only one supports evidence of the financial trading activities Granger causing changes in spot prices. However, there seems to be some evidence of spot prices for rice, soya beans and maize Granger causing changes in long positions.

Korniotis (2010) examines the industrial metals market to investigate whether speculative activity in the futures market rises when the returns from investing in futures contracts are high. According to Korniotis (2010:5) "if speculation in futures in futures markets is driving commodity spot prices there should be a positive relationship between the total return of investing in futures contracts and commodity prices".

By estimating regressions in which the S&P-GSCI return is constrained to affect traded metals Korniotis (2010) discovers that the speculative activity proxy has no impact on the spot price growth rates and therefore concludes that financial investor participation in the futures market proxied by the S&P-GSCI returns is not related to the price appreciation of metals after 2002.

Similarly, Alquist *et al.* (2012) reach the same conclusion in the oil market by examining the out of sample accuracy of daily and monthly oil price futures to illustrate that there is no compelling evidence that oil price futures help forecast the price of oil.

2.8 Conclusion

This chapter provided an overview of the commodity markets, how prices are formed and an analysis of the financialization of commodity markets. A general conclusion from the literature assessed is that the impact of financialization is difficult to measure and the results are contradictory.

Part of this difficulty is due to the fact that the financialization of commodity markets became a major factor roughly at the same time as demand for physical commodities from EMEs started to increase rapidly. These simultaneous developments make it difficult to separate their relative price impacts. Therefore, most empirical investigations on the impact of financialization on commodity markets emphasized either fundamental supply and demand factors or variables that reflect the financialization of commodity investing. Given that the commodity prices have been influenced by both factors, both these groups of studies have found a significant impact on the variables they selected. According to UNCTAD (2011:24) "those that attribute most of the development of commodity prices to fundamental factors and those that point to an additional impact from increased financial investment have thus been able to provide empirical support from their point of view".

The question of whether rising futures prices drove up spot prices remains a further point of major contention. While limited research is available on this relationship, existing empirical or theoretical evidence proves divisive.

CHAPTER 3: DATA, METHODS AND TECHNIQUES

3.1 Introduction

Methods and procedures used to obtain the findings of the study are presented in this chapter. The principal method of research utilized is quantitative analysis and the paradigm employed will be positivist.

The chapter is structured as follows: Section 3.2 provides a description of the data and data sources. Section 3.3 details the rolling correlation method used to determine the correlations amongst the returns of different commodities. Section 3.4 describes the tests for stationarity that were used to determine the order of integration of the variables used in the analysis. Section 3.5 explains the Granger Causality tests employed to determine whether futures prices (returns) drove spot prices (returns) with Section 3.6 concluding.

3.2 Description of Data and Sources

The data in this study was collected from two main sources, namely, Thompson Reuters and the Reserve Bank of Australia (RBA) online database.

Given that the goal of the research is to extend existing empirical findings by Tang and Xiong (2012) and Mann and Keeton (2013) to account for the post-2013 commodity price slump, the time period under investigation is extended from January 1994 to December 2015. Previous studies have focused mainly on agricultural products. This study aims to broaden the scope of research to include the prices of base metals – namely, zinc, copper, tin, aluminium and nickel. Other commodities included are Brent crude oil and bulk commodities represented by the RBA bulk commodity index. The reason for using this index is that bulk commodities such as coal and iron ore are not traded on exchanges due to the multiple grades that are bought and sold.

The study utilizes daily 3-month futures prices and daily spot prices for the base metals and oil. Monthly spot prices for bulk commodities not traded on exchanges are used as daily data is not available. They are compared to average monthly spot prices of exchange-traded metals.

3.3 Correlation

One of the most basic and foundational statistical analysis techniques for establishing relationships between variables is the correlation method (REACH, 2009). In its simplest terms correlation can be described as a statistical tool that measures the extent of correspondence between the ordering of two or more random variables. Three types of correlation exist, namely, positive, negative and zero (no) correlation. Positive correlation occurs when changes in one variable are associated with changes in the same direction in another variable. For negative correlation the two variables move together, but in opposite directions. No correlation occurs when there is no linear dependency amongst the variables. It is imperative to note that just because two variables co-vary it does not mean that one causes the other. However, it can be said that correlation is a precondition for measuring causation (Beaumont, 2012).

3.3.1 Rolling Correlation

Based on the correlation method adopted by Tang and Xiong (2012) as well as Mann and Keeton (2013), 12-month rolling correlations of returns are undertaken for daily changes in 3-month futures prices as well as daily spot prices. The CORREL function in Microsoft Excel which returns the coefficient of two sets of data is used to obtain the correlation coefficients between various commodities. It is depicted as follows:

$$CORREL\ (X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2\,(y-\bar{y})^2}$$

where $\bar{x}$ and $\bar{y}$ are sample means.

Rolling correlations of returns are calculated, firstly, between daily returns of exchange-traded metals; secondly, between daily returns of exchange traded metals and oil; and, thirdly, between monthly returns of exchange-traded commodities and bulk commodities not traded on exchanges.

According to Stoll and Whaley (2010:9) the reasoning behind this methodology is that

> "Commodity index investing is a mechanical trading strategy based on a set of well-defined and well-known set of rules. Net funds flowing in to commodity index investments are immediately redeployed into the commodity index futures market through the simultaneous purchase of all index commodities. If commodity index trades are large enough to push prices upward, the prices in all markets should move upward concurrently.

> Put differently, the returns of all futures contracts used in index replication should be highly correlated".

Therefore, the same hypothesis as in Tang and Xiong (2012) and Mann and Keeton (2013) will be adopted: namely that if index financialization played a significant part in the commodity price increases and volatility, then the prices of various unrelated commodities within commodity indices will be increasingly correlated.

The reasoning provided by Stoll and Whaley (2010) as well as the hypothesis by Tang and Xiong (2013) provide the basis for a comparative analysis to establish whether the increased correlations between different commodities previously found by Tang an Xiong (2012) and Mann and Keeton (2013) as a result of increased commodity index trading still hold now that commodity prices across all categories are experiencing a slump.

3.4 Stationarity Tests

Granger causality tests are used to test whether changes in futures returns "cause" changes in spot returns. The first step in performing these tests is to determine whether each individual time series is stationary or non-stationary. If a time series is found to be nonstationary it is mandatory to conduct the appropriate transformation on the series. According to Gujarati (2009) this process is necessary to ensure that the mean, variance and covariance of the time series remain constant, independent of the point in time they are measured, thereby ensuring an accurate estimation of the model.

Although several tests for stationarity exist, only those that are prominently discussed in the literature are employed. A graphical analysis is first undertaken and the order of integration of both the futures prices (returns) and spot prices (returns) are examined using the Augmented Dicky-Fuller unit root test and the Kwiatkowski-Philips-Schmidt-Shin (KPSS) stationarity test, which according to Enders (2010) has more power.

Developed by Dickey and Fuller the ADF test, involves estimating the following regression:

$$\Delta Y_t = \beta_o + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{n} \Delta Y_{t-1} + \varepsilon_t$$

where ε_t is a pure white noise error term.

The objective of the ADF test is to test the null hypothesis which suggests the presence of a unit root in the time series ($\delta=0$) against the alternative hypothesis that the series is stationary

($\delta<0$). As in Hernandez and Torerro (2010) the ADF test will include a constant and the appropriate lag length will be selected according to the Schwartz Bayesian Criteria (SBC).

The KPSS test is motivated by the fact that unit root tests developed by Dickey and Fuller (1979) suggested that most aggregate economic series had a unit root and thus such tests had low power in samples of sizes occurring in many applications. Kwiatkowski *et al.* (1992) proposed that trend stationarity should be considered as the null hypothesis and the unit root should be the alternative hypothesis. This test is seen to be more powerful and has a much broader utility (Kokoszka and Young, 2016). The KPSS test statistic is depicted below:

$$\text{KPSS} = \frac{1}{T^2} \frac{\sum_{t-1}^{T} S_t{}^2}{\hat{\sigma}^2 \infty}$$

where T is the sample size, S_t is a partial sum and $\hat{\sigma}^2 \infty$ is the heteroscedasticity and autocorrelation consistent estimator of the variance (Kwiatkowski *et al.*, 1992:163).

3.5 Granger Causality

To analyse the dynamic relationship between futures prices (returns) and spot prices (returns) the Granger causality test developed by Clive Granger in 1969 is used. According to Hernandez and Torrero (2010) the linear Granger causality test examines whether past values of one variable can help explain current values of a second variable, conditional on past values of the second variable. Intuitively, it determines whether past values of the first variable contain additional information on the current value of the second variable that is not contained in past values of the latter. If so, the first variable is said to Granger cause the second variable.

The null hypothesis is depicted as follows:

H_o: Variable X does not Granger cause Y

If the F-stat is significant we will reject the null and conclude that variable X does Granger cause Y and this is the basis for predictive causality. The results are discussed in Section 4.4.

It is pertinent to note that the Granger causality test does not imply actual causality. It is, however, regarded as a good measure of statistical coincidence (Mathews, 2012).

This test allows us to make some inferences about the direction of information flows between futures and spot prices, allowing us to examine whether changes in the futures prices (returns) lead to changes in spot prices (returns) both in the upswing and downswing periods.

The use of linear Granger causality tests replicates the method of Hernandez and Torrero (2010) and Mathews (2012). Because prices are not necessarily stationary over time, the daily returns of commodities are used. This is done for two sub periods, namely: i) The boom period (financialization) and ii) the downswing period (post-financialization).

3.6 Conclusion

This chapter detailed the data, methods and techniques employed in conducting this research. As in previous studies by Tang and Xiong (2012), Stoll and Whaley (2010) and Bonato and Taschini (2015) the calculation of rolling returns correlations method is adopted. The Granger causality test is utilized to determine the direction of information flows between the futures and spot market. However, it is noted that the test measures precedence and information content, but does not by itself indicate causality in the more common use of the term. Nonetheless, it remains a good measure of statistical coincidence as shown by Hernandez and Torerro (2010), Mathews (2012) and Amman (2012).

CHAPTER 4: EMPIRICAL FINDINGS AND ANALYSIS

4.1 Introduction

The analysis will be broken down into two parts in which the results of the two different methods described in the previous chapter will be analysed separately. Section 4.2 presents the results of the rolling correlation investigation. Section 4.3 shows the results of the ADF and KPSS tests that were performed in order to determine the order of integration of the time series used in the model. Section 4.4 displays the Granger causality results for the various commodities investigated whilst Section 4.5 concludes the chapter.

4.2 Rolling Correlation Method Results

As stated in the methodology Chapter 3 one-year rolling correlations of returns on futures and spot prices were calculated. Based on Tang and Xiong's (2012) and Mann and Keeton's (2013) methodology the investigation was extended to include the relationship between the prices of copper, zinc, nickel, tin and aluminium with the timeline lengthened to end-2015 to include the recent downswing period of commodity prices.

Firstly, correlations were calculated for the boom period (2002-2011) to see if the results conformed to previous findings. The impact on correlations of the price slump (2012-2015) was then examined in order to determine if *a priori* expectations based on the reverse hypothesis (falling correlation) of Tang and Xiong (2012) would hold true given the fall in the amount of funds invested in commodity assets in the latter period.

The results are displayed in the subsections that follow. Changes in the measured correlations over the periods examined are shown. Average correlations during the periods are presented in Appendix A but are not shown in Tables 1-5 because average measures flatten significant changes in correlation across the periods. Hence, start and end period correlations and changes therein are shown. Appendix B provides graphical illustrations of changes in correlations across three periods, namely, pre-financialization, the financialization period (commodity price boom) and post-financialization (downswing period). The graphs demonstrate the importance of using the start and end period correlations and changes therein to depict changes in correlation across the various periods.

4.2.1 Correlation between traded metals futures and between metals and oil futures

Table 1 below summarises the results of the 1-year rolling correlation of daily returns of metals futures. The changing correlations of the individual metals across the whole period are shown graphically in Appendix B.

Table 1: Three-month traded metals futures prices: Correlation and changes in correlation between the start and end of periods

	Zinc v Copper	Zinc v NI	Zinc v Tin	Zinc v Alum	Copper v NI	Copper v Tin	NI v Tin	Alum v Copper	Alum v NI	Alum v Tin
START 1995	0.4883	0.5328	0.5887	0.5706	0.5762	0.4760	0.5869	0.5288	0.5147	0.5203
END 2001	0.5061	0.3745	0.2449	0.4942	0.5079	0.3610	0.3174	0.7598	0.4276	0.2712
Change in Correlation	**0.0179**	**-0.1583**	**-0.3438**	**-0.0764**	**-0.0682**	**-0.1150**	**-0.2694**	**0.2310**	**-0.0871**	**-0.2491**
Change in Correlation %	**3.6596**	**-29.7157**	**-58.3999**	**-13.3946**	**-11.8431**	**-24.1555**	**-45.9094**	**43.6779**	**-16.9226**	**-47.8710**
START 2002	0.5054	0.3756	0.2455	0.4942	0.5094	0.3618	0.3173	0.7601	0.4279	0.2714
END 2011	0.7945	0.6509	0.6214	0.7141	0.6998	0.6680	0.6428	0.7295	0.6470	0.5915
Change in Correlation	**0.2892**	**0.2753**	**0.3759**	**0.2199**	**0.1905**	**0.3062**	**0.3255**	**-0.0306**	**0.2191**	**0.3201**
Change in Correlation %	**57.2133**	**73.2894**	**153.0691**	**44.5033**	**37.3917**	**84.6431**	**102.5996**	**-4.0292**	**51.2001**	**117.9623**
START 2012	0.7946	0.6511	0.6215	0.7142	0.6994	0.6684	0.6438	0.7299	0.6478	0.5915
END 2015	0.6675	0.5594	0.3704	0.6360	0.6334	0.2679	0.3458	0.6055	0.5379	0.2797
Change in Correlation	**-0.1270**	**-0.0917**	**-0.2511**	**-0.0782**	**-0.0659**	**-0.4005**	**-0.2980**	**-0.1244**	**-0.1100**	**-0.3118**
Change in Correlation %	**-15.9869**	**-14.0825**	**-40.4018**	**-10.9472**	**-9.4278**	**-59.9194**	**-46.2857**	**-17.0469**	**-16.9767**	**-52.7146**

In line with previous findings by Tang and Xiong (2012) and Mann and Keeton (2013), mostly low and falling levels of correlation are experienced for the pre-financialization period (1995-2001). However, with increased indexed buying of commodity futures during the financialization period (2002-2011) all metals, except for the return between aluminium and copper, experienced increases in correlation. The correlation between returns for zinc and tin showed the most marked increase of 0.3759 (a 153.1% increase).

Given the goal of this research is to examine the impact on correlation returns in the post-financialization period, it is the results for the 2012-2015 period that are especially important. The results show a substantial fall in correlations across all metals. The largest decrease in correlation of -0.4005 (-59.9%) was between returns on copper and tin.

The results confirm the findings of Tang and Xiong (2012) and Mann and Keeton (2013) that financialization led to increased correlations across metals futures and the *a priori* assumption of this research that correlations across metals futures would fall in the post-

financialization period. The exception to these findings is the correlation between aluminium and copper returns, which increases prior to the period of financialization, falls during financialization and then falls further post-financialization. A possible explanation is that of aluminium and copper being substitutes however, a detailed explanation is beyond the scope of this research.

The next step followed in Tang and Xiong's (2012) methodology was to test the returns between traded metals and oil. The results appear in Table 2.

Table 2: Three-month oil futures versus three-month traded metal futures prices start and end periods

	Oil v Zinc	**Oil v Copper**	**Oil v NI**	**Oil v Tin**	**Oil v Alum**
START 1995	0.1780	0.0741	0.0969	0.1355	0.1902
END 2001	-0.0672	0.0252	0.0308	0.0486	0.0038
Change in Correlation	**-0.2451**	**-0.0489**	**-0.0661**	**-0.0869**	**-0.1864**
Change in Correlation %	**-137.7309**	**-65.9955**	**-68.2435**	**-64.1502**	**-98.0031**
START 2002	-0.0672	0.0253	0.0307	0.0486	0.0038
END 2011	0.4523	0.5329	0.4553	0.4887	0.5043
Change in Correlation	**0.5195**	**0.5077**	**0.4246**	**0.4401**	**0.5005**
Change in Correlation %	**-773.4968**	**2010.1995**	**1380.8749**	**906.1909**	**13136.0376**
START 2012	0.4540	0.5361	0.4598	0.4895	0.5052
END 2015	0.2582	0.3430	0.2569	0.0741	0.2799
Change in Correlation	**-0.1958**	**-0.1932**	**-0.2029**	**-0.4154**	**-0.2253**
Change in Correlation %	**-43.1233**	**-36.0325**	**-44.1246**	**-84.8671**	**-44.6035**

Results displayed above confirm Tang and Xiong's (2012) and Mann and Keeton's (2013) findings for the pre-financialization and financialization periods. Initially low and falling levels of correlation are experienced between all metals and oil futures. This is expected because the supply and demand dynamics in these markets are likely to be very different. However, during the financialization period significant and positive increases in correlations between metals and oil futures occur. The correlation between oil and copper futures has the most marked increase of 0.5077 (2010.2%).

During the post-financialization period of falling commodity prices the correlations between all metals and oil futures fall. The fall in the correlation between oil and tin is largest falling -0.4154 (-84.7%).

The findings of falling levels of correlations during the post-financialization downturn in commodity prices provides further evidence of the role financialization has played in commodity market futures. The increased correlations of futures during the boom period disappeared in the downturn. This coincided with the sharp reduction in index buying of commodity futures that had characterised the period of financialization. The findings reinforce those of Tang and Xiong (2012) and Mann and Keeton (2013) who provided evidence that financialization impacted significantly on the prices of metal futures and oil futures by showing the impact disappeared once financialization decreased in importance.

4.2.2 No increase in the return between traded and non-traded metals

The next logical step, as utilized by Tang and Xiong (2012) is to check if correlations of commodities that are not traded on exchanges (and were therefore not subject to financialization) changed during the period of falling commodity prices. This test looks at the correlations of returns for the same metals futures used in the previous sections and the spot bulk commodities price index of the RBA. As in Mann and Keeton (2013) the rationale behind this test is that bulk commodities such as coal and iron ore are not traded on exchanges (because grades differ greatly) and therefore could not form part of the commodity futures purchases of financial investors. Nor are there futures markets for bulk commodities, so spot prices must be used.

Table 3: Three-month traded metal futures prices versus bulk commodities start and end periods

	RBA v Zinc	RBA v Copper	RBA v Tin	RBA v NI	RBA v Oil	RBA v Alum
START 1995	0.3167	0.2867	0.1585	0.4233	0.2659	0.3637
END 2001	-0.1810	0.0184	-0.1142	0.4549	0.2991	0.1191
Change in Correlation	**-0.4976**	**-0.2683**	**-0.2727**	**0.0316**	**0.0333**	**-0.2447**
Change in Correlation %	**-157.1453**	**-93.5676**	**-172.0862**	**7.4720**	**12.5179**	**-67.2658**
START 2002	-0.1667	0.1298	0.0181	0.2722	0.1887	0.2710
END 2011	-0.0917	-0.0063	0.1397	0.1702	0.1873	0.3733
Change in Correlation	**0.0749**	**-0.1361**	**0.1215**	**-0.1020**	**-0.0013**	**0.1023**
Change in Correlation %	**-44.9528**	**-104.8405**	**669.6589**	**-37.4856**	**-0.7056**	**37.7594**
START 2012	-0.0637	-0.0354	0.1600	0.0717	0.2067	0.4005
END 2015	-0.5297	-0.0373	-0.3868	-0.1985	-0.1165	-0.5075
Change in Correlation	**-0.4660**	**-0.0019**	**-0.5468**	**-0.2701**	**-0.3232**	**-0.9080**
Change in Correlation %	**731.7866**	**5.3311**	**-341.8121**	**-376.8522**	**-156.3891**	**-226.7213**

The results of these tests were conclusive in that the correlations for the majority of the commodities did not increase during either the period of financialization or post-financialization. This supports Tang and Xiong's (2012) findings and reinforces the central claim that financialization was the cause of the increased correlations for returns on traded metal futures.

4.2.3 Correlations between spot prices of traded metals and between spot metals and oil

Mann and Keeton (2013) suggest that the fact that financialization caused increased correlation between metals futures prices does not automatically mean it translated into an effect on spot prices. For every buyer of a future there must be a seller. These are not necessarily the same operators as in the spot markets, unless the sellers of futures hedge their position in the spot market. However, the analysis in Tables 4 and 5 demonstrates that financialization impacted on the spot market returns of traded commodities in the same way as it impacted on futures returns. Appendix C graphically illustrates the increasing and decreasing correlations of spot returns during financialization and post-financialization respectively.

Table 4: Spot daily traded metals: Correlation and change in correlation between the start and end periods

	Zinc v Copper	Zinc v NI	Zinc v Tin	Zinc v Alum	Copper v NI	Copper v Tin	NI v Tin	Alum v Copper	Alum v NI	Alum v Tin
START 1995	0.4987	0.5821	0.6211	0.5764	0.5828	0.4843	0.5878	0.5188	0.5120	0.5248
END 2001	0.5018	0.3838	0.2676	0.4838	0.5127	0.3489	0.3350	0.7387	0.4367	0.2681
Change in correlation	**0.0031**	**-0.1983**	**-0.3535**	**-0.0926**	**-0.0700**	**-0.1354**	**-0.2528**	**0.2199**	**-0.0753**	**-0.2567**
Change in correlation %	**0.6304**	**-34.0694**	**-56.9163**	**-16.0589**	**-12.0185**	**-27.9627**	**-43.0138**	**42.3889**	**-14.7070**	**-48.9163**
START 2002	0.5013	0.3845	0.2680	0.4838	0.5132	0.3492	0.3349	0.7388	0.4369	0.2682
END 2011	0.7919	0.6445	0.6166	0.7146	0.6986	0.6655	0.6414	0.7256	0.6403	0.5822
Change in correlation	**0.2906**	**0.2600**	**0.3486**	**0.2308**	**0.1853**	**0.3163**	**0.3065**	**-0.0132**	**0.2034**	**0.3141**
Change in correlation %	**57.9614**	**67.6320**	**130.0862**	**47.7081**	**36.1135**	**90.5833**	**91.5069**	**-1.7807**	**46.5688**	**117.1272**
START 2012	0.7918	0.6445	0.6168	0.7147	0.6981	0.6659	0.6424	0.7259	0.6411	0.5823
END 2015	0.6611	0.6611	0.3355	0.6278	0.6201	0.2511	0.3212	0.5973	0.5198	0.2541
Change in correlation	**-0.1307**	**0.0166**	**-0.2812**	**-0.0869**	**-0.0780**	**-0.4148**	**-0.3212**	**-0.1286**	**-0.1213**	**-0.3282**
Change in correlation %	**-16.5070**	**2.5745**	**-45.5947**	**-12.1538**	**-11.1739**	**-62.2899**	**-50.0004**	**-17.7134**	**-18.9154**	**-56.3627**

Most spot metals returns experience low and falling correlation levels pre-2002. Almost all experience rising correlations during the period of financialization with zinc versus tin having the highest increase of 0.3846 (130.1%). Almost all had falling correlations in the post-financialization period, with the correlation between spot copper and tin returns presenting the largest fall of -0.4148 (-62.3%). As was the case in the futures market, the correlation between spot aluminium and copper returns rose prior to the financialization period and fell during the financialization and post-financialization periods (see Section 4.2.1). The correlation between spot zinc and nickel rose slightly in the post-financialization period.

Table 5: Spot daily oil price versus traded metal spot prices start and end periods

	Oil v Zinc	Oil v Copper	Oil v NI	Oil v Tin	Oil v Alum
START 1995	0.0846	0.0351	0.0454	0.0957	0.0913
END 2001	-0.0267	-0.0297	0.0370	-0.0938	-0.0198
Change in Correlation	**-0.1113**	**-0.0649**	**-0.0084**	**-0.1895**	**-0.1111**
Change in Correlation %	**-131.4994**	**-184.5913**	**-18.6078**	**-197.9843**	**-121.7265**
START 2002	-0.0267	-0.0297	0.0370	-0.0966	-0.0198
END 2011	0.4339	0.4959	0.4530	0.4758	0.4752
Change in Correlation	**0.4605**	**0.5256**	**0.4161**	**0.5725**	**0.4950**
Change in Correlation %	**-1727.2650**	**-1767.8711**	**1125.7788**	**-592.3263**	**-2497.0890**
START 2012	0.4359	0.4992	0.4578	0.4756	0.4763
END 2015	0.2623	0.3362	0.2478	0.0732	0.2758
Change in Correlation	**-0.1737**	**-0.1630**	**-0.2100**	**-0.4025**	**-0.2005**
Change in Correlation %	**-39.8363**	**-32.6439**	**-45.8698**	**-84.6167**	**-42.0950**

As with the futures markets, significant increases in correlations are found during the commodity price boom period in metals spot market and oil returns. The percentage changes are large for all metals in absolute terms. (Note that the negative percentage changes reflect increases in correlation from negative to positive correlations). These findings confirm those of Mann and Keeton (2013). Oil and aluminium spot returns present the highest percentage increase of 2497.1%. However in the downturn all these correlations between spot returns fall appreciably, with the correlation between spot oil and tin returns recording the largest fall of -84.6%.

4.2.4 Summary and conclusions

From the results above it is evident that increased indexed fund buying associated with financialization not only impacted on the futures prices of commodities but seemingly impacted on commodity spot prices as well. During the commodity price boom increased fund buying was accompanied by increased correlation between futures returns and spot returns of various commodities, whilst in the downturn correlations of returns fell significantly in both the futures market and the spot market.

The fact that returns in the futures market and spot prices rose and fell simultaneously raises questions as to the link between the futures market and the spot market. The next section aims to establish a link between the two markets, to determine if there is evidence of a causal relationship between futures and spot returns.

4.3 Tests for Stationarity

It is necessary to conduct stationarity tests on the variables to be used in Granger causality analysis as the Granger causality test requires the data to be in stationary form (Gujarati, 2009). Table 6 displays the results of ADF unit root tests on the relevant variables. The ADF tests indicated that all variables were stationary in level terms (integrated of order zero) as the null hypothesis of a unit root can be rejected in each case.

Table 6: ADF test for stationarity

Variable	Test Statistic (Level Terms)	P Value *	Order of Integration
Alum FUT	-63.64101	0.0001	I(0)
Alum SP	-63.50530	0.0001	I(0)
Copper FUT	-65.04692	0.0001	I(0)
Copper SP	-64.91777	0.0001	I(0)
Nickel FUT	-60.72873	0.0001	I(0)
Nickel SP	-60.25391	0.0001	I(0)
Oil FUT	-61.43114	0.0001	I(0)
Oil SP	-60.86207	0.0001	I(0)
Tin FUT	-64.68098	0.0001	I(0)
Tin SP	-59.51712	0.0001	I(0)
Zinc FUT	-62.00944	0.0001	I(0)
Zinc SP	-61.94210	0.0001	I(0)

Notes:
Null Hypothesis: Series is non-stationary
Lag Length: Automatic Selection (Schwarz Info Criterion)
*MacKinnon (1996) one-sided p-values
Source: Author's own estimates using EViews 9

The results obtained from the KPSS tests for stationarity are shown below in Table 7. The KPSS test in accordance with the ADF test indicates that all variables were stationary in level terms.

Table 7: KPSS test for stationarity

Variable	Test Statistic (Level Terms)	Order of Integration
Alum FUT	0.226410	I(0)
Alum SP	0.217630	I(0)
Copper FUT	0.577051	I(0)
Copper SP	0.594034	I(0)
Nickel FUT	0.507183	I(0)
Nickel SP	0.440849	I(0)
Oil FUT	0.714077	I(0)
Oil SP	0.656075	I(0)
Tin FUT	0.295900	I(0)
Tin SP	0.357142	I(0)
Zinc FUT	0.255594	I(0)
Zinc SP	0.254553	I(0)

Notes:
Null Hypothesis: Series is Stationary
Automatic bandwidth selection: Newey-West Bandwidth
Source: Author's own estimates using EViews 9

4.4 Granger causality results

As detailed in Section 3.5 Granger causality tests are carried out over the two sub-periods between 2002-2011 and 2012-2015 to determine if the relationships between the futures price returns and spot price returns have changed across time. The test results for all five base metals (zinc, copper, tin, aluminium and nickel) as well as oil are presented in Tables 8 and 9. The upper section of each table reports the F-statistic for the null hypothesis that futures returns do not Granger cause spot returns, and the lower section that spot returns do not Granger cause futures returns. As in the studies by Hernandez and Torero (2010), Mathews (2012) and Dwyer *et al.* (2012) the test results for different lag structures are included for 1-10 lags.

According to Dwyer *et al.* (2012), there are four possible outcomes of these tests, each with the following different implications.

i) If changes in futures prices are found to be driving changes in spot prices this suggests price discovery is occurring in the futures market, or it could indicate that futures markets tend to absorb news about changes to fundamentals more quickly than the spot market. A less benign interpretation could be that speculative developments (or in this case financialization) in futures prices are distorting spot prices (at least temporarily).

ii) If changes in spot are found to be driving changes in futures prices, price discovery is likely to be occurring in the spot market. Hence, speculation driven activity (financialization) in the futures market is likely to have no effect on spot prices.

iii) Evidence of a bi-directional causal relationship suggests futures and spot prices are jointly determined, possibly due to a large number of participants with access to both markets, the perceived news being simultaneously reflected in both markets or there are institutional factors which enforce a close mechanical relationship between the two markets.

iv) No Granger causal relationships suggests futures and spot prices are sufficiently segmented to prevent arbitrage from occurring and therefore developments in one market are unlikely to affect the other.

A priori if financialization affected both futures and spot price returns we would expect the direction of causality to run from futures to spot prices. This is because index-driven trades occurred in the futures markets. If those futures trades were hedged in the spot market then the direction of causality would flow from the futures market to the spot market. But in the post-financialization period there is no *a priori* expectation of direction. Investors withdrawing from index-driven trades did not sell futures, they simply stopped buying them. Any impact they might have had on returns in the financialization period would be removed, but there would be no expectation of a reversal of causality.

Table 8 below presents the results of the first sub-period (2002-2011) which is considered to be the commodity price boom/financialization period.

Table 8: Granger causality tests of daily returns in futures and spot markets (2002-2011)

H_0 : Futures returns do not Granger-cause spot returns						
# Lags	**Aluminium**	**Copper**	**Zinc**	**Nickel**	**Tin**	**Oil**
1	0.03791	7.45814 *	1.85006	8.36937 *	3.19215 ***	1.59015
2	1.82188	4.29394 **	1.11008	5.34727 *	1.57675	5.84556 *
3	1.20724	4.05608 *	0.92082	4.02612 *	1.22741	4.63892 *
4	0.90222	3.25551**	1.07502	2.99894 **	1.13833	3.44142 *
5	1.22074	2.71029 **	0.87486	2.87102 **	0.95067	2.68534 **
6	1.10790	2.32708 **	0.75397	2.46231 **	1.45033	3.00195 *
7	0.97095	2.00154 ***	0.90773	2.42157 **	1.28263	3.41576 *
8	1.01667	1.78477 ***	0.81066	2.26075 **	1.27149	2.89154 *
9	0.92443	1.60831	0.73585	2.46218 *	1.23318	2.53163 *
10	1.14488	1.53306	0.67119	2.17245 **	1.10918	2.64172 *
H_0 : Spot returns do not Granger-cause futures returns						
# Lags	**Aluminium**	**Copper**	**Zinc**	**Nickel**	**Tin**	**Oil**
1	0.37930	2.40236	1.89028	1.69930	8.04831 *	91.0868 *
2	1.57919	2.32016 ***	1.03949	1.39593	3.98084 **	46.2918 *
3	1.06785	2.51768 ***	0.77056	1.29948	2.72667 **	30.8232 *
4	0.83000	2.01560 ***	1.16661	0.95141	2.03215 ***	24.6292 *
5	0.94219	1.65975	0.97817	0.93319	1.62170	19.8745 *
6	0.83564	1.41898	0.82346	0.76642	2.10293 **	16.8374 *
7	0.72297	1.22177	0.88604	0.91489	1.88590 **	14.3494 *
8	0.76305	1.08941	0.79526	1.05204	1.83385 **	12.7210 *
9	0.68580	0.99231	0.72243	1.32725	1.79776 **	11.4024 *
10	0.77844	0.98008	0.66143	1.18169	1.61681 ***	10.2019*

Notes:
H_0: Null Hypothesis
*1%, **5%, ***10% Significance. F- Statistic reported
Source: Author's own estimations using EViews 9

Results for the period of financialization are mixed:

i) There is strong evidence of futures returns leading spot returns for copper and nickel at 1-8 and 1-10 lags respectively.

ii) Zinc and aluminium show no evidence of a causal relationship between futures and spot returns at all lags (1-10). This confirms Dwyer *et al.* (2012) who also found an absence of

any Granger causal relationship between the futures price and spot prices of zinc and aluminium. Dwyer *et al.* (2012) suggest there could be barriers to arbitrage between the futures and spot markets for these commodities, or it is possible that some adjustment occurs through other factors, such as storage and or financing costs.

iii) Oil displays a significant bi-directional relationship between futures and spot returns at all lags. These findings are similar to those of Alzahrani *et al.* (2014) in which causality is revealed in both directions for oil, with no market necessarily dominating the other in terms of price discovery. These results indicate that causality moves from one direction to another over time, and thus speculators, who trade in the oil futures market, have no systematic impact on oil spot prices. Furthermore, results suggest the spot market can have a similar impact on oil futures prices (Alzahrani *et al.*, 2014).

iv) Tin futures returns are driven by spot returns at all lags. Therefore, futures prices for tin are most likely to be derived from spot prices.

The second period considered is that of the commodity price slump (2012-2015). Results in Table 9 show considerable changes in the identified causal relationships between the commodities. Results show strong statistical evidence of aluminium, nickel, zinc, and copper displaying bi-directional causal relationships between futures and spot returns. Tin, as in the earlier period (2002-2011), maintains the same relationship with spot returns Granger causing futures returns, whilst oil shifts from a bi-directional relationship to the spot returns driving futures returns.

Table 9: Granger causality tests of daily returns in futures and spot markets (2012-2015)

H_0 : Futures returns do not Granger-cause spot returns						
# Lags	**Aluminium**	**Copper**	**Zinc**	**Nickel**	**Tin**	**Oil**
1	3.02998 ***	6.38683 **	6.21832 **	0.00287	0.95023	2.67339
2	2.28949	5.94806 *	4.32380 **	1.22788	0.46987	1.35972
3	1.86374	4.19493 *	3.38155 **	1.34001	0.80519	0.90541
4	2.38190 **	3.27343 **	2.67155 **	2.70356 **	0.98636	0.80031
5	2.39470 **	3.37777 *	2.36403 **	2.34961 **	1.07451	0.63725
6	2.27998 **	3.12189 *	2.58664 **	1.98552 ***	0.94314	0.54476
7	2.00059 ***	2.73903 *	2.16002 **	1.76820 ***	0.81642	0.51654
8	2.28672 **	2.56404 *	1.94493 ***	1.63893	0.70728	0.45450
9	2.25698 *	2.20955 **	1.93056 **	1.41188	0.62937	0.48636
10	2.04213 **	2.03791 **	0.0573 ***	1.18704	0.59755	0.44044
H_0 : Spot returns do not granger cause futures returns						
# Lags	**Aluminium**	**Copper**	**Zinc**	**Nickel**	**Tin**	**Oil**
1	3.68099 ***	4.44306 **	4.80233 **	0.68812	64.1279 *	37.9423 *
2	4.12668 **	5.43247 *	4.04587 **	1.11738	55.2628 *	20.3357 *
3	3.07190 **	4.23994 *	3.86169 *	1.38405	45.6498 *	13.6311 *
4	3.49999 *	3.37481 *	3.05004 **	3.10709 **	35.2799 *	10.4097 *
5	3.02981 **	3.49479 *	2.68738 **	2.60581 **	29.4659 *	8.24524 *
6	2.82993 *	3.29973 *	2.69991 **	2.21608 **	24.8955 *	6.88229 *
7	2.51364 *	2.86601 *	2.25112 **	2.02793 **	21.4623 *	5.91286 *
8	2.69589 *	2.62920 *	1.98149 **	1.83450 ***	18.9539 *	5.16517 *
9	2.64310 *	2.27624 **	2.01580 **	1.57117	17.4321 *	4.66641 *
10	2.41997 *	2.11023 **	0.0467 **	1.31872	15.6267 *	4.24334

Notes:
H_0: Null Hypothesis
*1%, **5%, ***10% Significance. F- Statistic reported
Source: Author's own estimations using EViews 9

The bi-directional results for copper, zinc, nickel and aluminium suggest that there is a large number of participants with access to both markets, or there are institutional factors that enforce a close mechanical relationship between the two markets. Such explanations seem reasonable for copper, for example, as both markets are highly liquid (Mathews, 2012, Dwyer *et al.*, 2012, Malde, 2016 and Arora and Kumar, 2014). Findings for the tin market continue

to suggest price discovery occurs in the spot market and, hence, speculative trading in the futures market is unlikely to have any effect.

4.4.1 Interpretation of Granger Causality Findings

The Granger causality results in the upswing period (financialization) vary significantly from those recorded in the downswing period (post-financialization). Evidence of a more bi-directional relationship between the futures and spot returns in three of the six commodities (zinc, aluminium and copper) and an increasing statistical significance of spot returns driving futures returns in the downswing as compared to the upswing suggests a combination of fundamental factors in the downswing has impacted the spot market negatively and hence the direction of information inflow has shifted to spot driving futures prices.

These fundamental factors include weaknesses in the global economy, slow growth in China, resultant falling demand at a time of increasing supply of commodities. The weakness of the Chinese economy has been noted as the overriding reason for the current global commodity price weakness (Financial Worldwide Magazine, 2016). China's position as the fastest growing economy in the past decade was based on a growth model of investment and export and this led to increased demand for commodities with the country consuming 20% of non-renewable resources, 40% of base metals and 23% of agricultural produce globally. This has changed. China's transition from an investment-based economy to a consumer-based economy has meant its demand for raw materials is declining. This has affected commodity prices negatively as a global surplus has been created, resulting in downward pressure on spot prices (Igbinoba, 2016).

According to the Financial Worldwide Magazine (2016), other factors contributing to the downward trend in key commodity markets include tightening of monetary policy across developing countries, a consumer confidence crisis, environmental pressures, the strength of the US dollar, alternative sources of supply for manufacturing operations and the supply decisions undertaken by the Organisation of Petroleum Exporting Countries (OPEC). Falling spot returns have in turn precipitated the outflow of investment/fund buying away from the futures markets as evidenced by Figure 1 (see Section 2.4).

Therefore, it seems plausible that a combination of falling spot returns and the exit of index investors has caused a bi-directional relationship between commodity futures and spot returns in the downturn. Table 9 suggests that the phenomenon of spot returns driving futures returns

became more significant in the downturn. However, there is also evidence of causality in the opposite direction and this may be linked to the fact that while financialization diminished in the downturn, index-buying still exists (Figure 1).

The aforementioned reasons, are possible explanations also for the surprising results for the zinc and aluminium markets which in the upswing period showed no evidence of causality between futures and spot returns, however in the downturn causality turned out to be bi-directional. For tin, causality remained unidirectional in both periods. A possible explanation for this could be the very small size of the tin market and the fact that tin is one of the most illiquid contracts on the LME (Brosnan, 2015).

Oil on the other hand experienced a shift from a bi-directional relationship between futures and spot returns in the period of financialization to a unidirectional relationship post-financialization in which spot returns drove futures returns. This result is not surprising given that the spot price of oil fell by about 50% between June 2014 and January 2015 (Husain *et al.,* 2015). This sharp fall in the spot price was very significant, but is not unprecedented. It has significant parallels with the price collapse in 1985-86 in terms of magnitude and size (Baffes *et al.,* 2015). This significant fall in spot market therefore led to the spot prices driving futures prices.

4.5 Conclusion

This chapter presented and analysed the empirical findings obtained using the method and procedures discussed in the Chapter 3.

The findings confirm the study's *a priori* expectations. Concurrent with declining index investment in commodity markets since 2011, the correlations between futures prices of various commodities and between spot prices of various commodities declined. During the downturn correlations amongst several commodities fell substantially and it seems likely that this was caused by the reduced role of financialization.

However, that did not mean there was no longer any Granger causality between futures and spot returns. In fact, there is evidence of a shift from predominantly futures prices driving spot prices during the financialization period to a more bi-directional relationship in the downturn in which the impact of spot prices driving futures prices became more significant. A combination of the gradual reduction in financialization (through unwinding of contracts),

and significant changes in fundamental factors (supply and demand) in the downturn seem to have driven the bi-directional relationships observed.

Interestingly, Figure 1 (see Section 2.4) shows signs of a recovery in index-buying after 2015, with the level of total commodity assets under management rising steadily. Questions likely to arise are therefore, whether there is likely to be a reversion to the results of the financialization period? Will previous price peaks be reached and will there be a shift back to futures returns driving spot returns? This calls for a closer monitoring by policy makers and regulators of the futures and spot commodity markets.

CHAPTER 5: CONCLUSION

A significant increase in the level and volatility of commodity prices over the past decade-and-a-half has led to a heated debate as to what drove these developments. On the one hand, the school of thought led by Masters (2008), strongly believes that the extremely high and volatile price levels experienced were the result of the increasing role and presence of financial investors in commodity markets in a process termed "financialization". These scholars (Masters, 2008, De Schutter, 2010, Tang and Xiong, 2012, Mayer, 2012 and Bonato and Taschini, 2015) argue that this phenomenon drove commodity prices from 2002-2011 far and beyond levels that could be justified by changes in fundamental factors.

On the other hand, scholars such as Stoll and Whaley (2010), Irwin and Sanders (2011) and Dwyer *et al.* (2011), believe that the increases in commodity prices were determined by significant structural changes in the fundamentals (demand and supply), as well as macroeconomic factors. However, they acknowledge financialization may have played a minor role in driving prices upwards.

Existing empirical literature covers the period of rising prices (the commodity price boom) from 2002-2011. The aim of this study was to add to this literature by examining the impact of financialization on commodity prices post-2011, a time when commodity markets experienced a downturn, with commodity prices falling across the board.

Chapter 2 discussed the theory behind commodity price formation, the financialization of commodity markets and gave an overview of existing empirical literature. Having formed the theoretical foundations and examined relevant existing empirical literature, Chapter 3 set out the analytical and methodological techniques employed in this study. Two methods were used. These were the measurement of rolling correlations of commodity price returns in futures and spot markets, and Granger causality analysis of the relationship between futures and spot prices. Chapter 4 presented and discussed the empirical results from the methods employed.

5.1 Summary of Main Findings

The following are the main findings which can be identified from this study.

- The study finds that between 2002 and 2011, concurrent with rapidly growing index-based investment in commodity markets (financialization), returns on the prices of

unrelated commodities became increasingly correlated in both the futures and spot markets. This trend was significantly more pronounced for indexed commodities than off-index commodities. These findings support those of Tang and Xiong (2012) and Mann and Keeton (2013). They suggest that although there were common fundamental and macroeconomic developments that affected all commodities, the steep increase and growing correlation between commodity prices suggests that an explanation of the drivers of commodity prices based solely on fundamental factors is insufficient.

- The study extended those of Tang and Xiong (2012) and Mann and Keeton (2013) to include base metals (copper, tin, zinc, aluminium and nickel). Importantly, it lengthened the time period under investigation to incorporate the commodity market slump post-2011. This was done to measure the impact, if any, of the significant fall in the total amount of funds invested (commodity assets under management) between 2011 and 2015. *A priori* it was expected that if the increased correlations during the upswing of previously seemingly low-correlated and unrelated commodities had been driven by financialization, these correlations would decline in the downturn. This was found to be the case. Lower correlations were found between traded metals and between traded metals and oil returns for both futures and spot prices. As in earlier studies no correlation was found between off-indexed and indexed commodities (Tang and Xiong, 2012 and Mann and Keeton, 2013). The fact that the fall in commodity prices (downturn period) coincided with the outflows from commodity index funds and this in turn coincided with falling correlations between the various commodity price returns, provides further evidence of the impact of financialization on commodity markets.
- Given that commodity price correlations rose in both the futures and spot market during the period of rising prices (financialization) and fell during the post-financialization period, Granger causality tests were undertaken to measure possible changes over the periods in the dynamic connection between futures and spot returns. It was found that during the financialization period there is statistically significant evidence of futures prices driving spot returns. This is supportive of the belief that index-based buying of commodity futures during the period of growing financialization also impacted on spot prices. However, during the downturn there is a shift to more bi-directional relationships. These bi-directional relationships in the

downturn are not surprising as it is expected that the reduction of commodity index investing would mean that commodity prices would become increasingly driven by fundamental factors impacting on both commodity demand and supply. These fundamental factors can be driven through either the futures or spot markets

- The study therefore finds that, in addition to changing fundamental and macroeconomic factors, the financialization of commodity markets further drove the excessive and volatile price levels in commodity markets from 2002 to 2011.

5.2 Implications for policy and future research

The changes in commodity price correlation and volatility due to the increased index-based trading by institutional investors has profound implications for a wide range of issues. These include commodity producer hedging strategies, countries' energy and food policies and the impact of excessive price volatility on commodity dependent low income countries' (LICs') balance of payments accounts, public finances, inflation and exchange rates.

According to UNCTAD (2011), Mayer (2012) and Staritz (2012), the financialization of commodity trading has distorted the functioning and purpose of commodity exchanges. The traditional functions of the exchanges were to facilitate price discovery and allow the transfer of risk (hedging) from producers and consumers to other agents prepared to assume the price risk. Physical commodity producers and consumers relied upon this price discovery function to reflect fundamental supply and demand conditions accurately, and used the insurance function to eliminate price risks in the absence of other price stabilization mechanisms. However, these functions are impaired to the extent that trading by financial investors has increased price volatility and has driven prices away from fundamentals. If commodity futures prices are no longer being determined by fundamentals they provide unreliable, misleading and incorrect price signals to producers and consumers, especially in resource based developing economies. Mayer (2012) notes that this leads to a greater insecurity about the reliability of the futures market with respect to making storage, investment and trading decisions, as well as managing the price risk of market positions. In a nutshell, the very functioning of the futures market becomes distorted.

In LICs, high and volatile import and export prices impact on macroeconomic indicators, in particular the balance of payments accounts, public finances, inflation and the exchange rate (Staritz, 2012). Significant strain is put on public finances and current account balances by

high commodity prices in countries that are net importers. Furthermore, countries that are commodity exporters may adopt pro-cyclical fiscal policies and expand commodity production on the basis of false price signals. This results in substantial difficulties when prices fall. In this regard, van der Ploeg (2011) argues that to the extent that financial investment increases commodity price volatility, it may become more difficult to use an abundant natural-resource endowment for sustained economic development. This is premised on the belief that the observed adverse growth effect of natural resources ("Dutch disease") results mainly from the volatility of commodity prices. Mayer (2012) therefore suggests that a deeper investigation into the effects of the financialization of commodity markets on economic development may be fertile ground for future research.

Although this study did not analyse agricultural and food prices, authors such as De Schutter (2010) illustrated the role index-based investment played in causing excessive increases in the price of basic food commodities and oil. This meant that the number of people living in extreme poverty rose, with millions estimated to have been driven to hunger and deprivation as a result of the dramatic rise in food prices in 2008. Inflated metal prices are likely to have driven infrastructure and development costs to unprecedented levels.

The extent to which financialization drove up commodity prices therefore raises questions of morality. It can be argued that institutional investors bought up essential commodities that exist in limited quantities with the sole purpose of reaping speculative profits. Their actions provided no benefit to the futures market, but instead inflicted a tremendous cost on society (Masters, 2008).

Given the implications noted above, a relatively broad consensus has developed against excessive speculation in commodity markets. It is therefore not surprising that authors such as Masters (2008), De Schutter (2010), UNCTAD (2011), Mayer (2012) and Staritz (2012) have called for a tighter regulation of commodity derivative markets and of the role of financial investors. Increased regulation would ensure prompt intervention when irregularities are detected. One common regulatory measure advocated by Masters (2008), UNCTAD (2011) and Staritz (2012) is the introduction of position limits for traders. Position limits, they suggest, are necessary in markets for commodities of finite supply to curb the impacts of excessive speculation and hoarding. Limits would ensure that physical hedgers rather than speculators dominate in commodity trading.

However, UNCTAD (2011) warns that the regulation of commodity exchanges needs to find the right balance between being overly restrictive in the imposition of limits on speculative positions and being overly lax. A regulation that is too restrictive could impair the hedging function of commodity exchanges. On the other hand, a slack regulatory approach would ensure prices are driven beyond fundamental supply and demand levels, thus equally impairing the hedging function of the exchange. Finding an appropriate balance will not be easy.

While this research has provided evidence that the activities of index-based investment drove price returns in both the futures and spot markets, it has not explained how this link occurred. It has been suggested that the link might be caused by sellers of futures hedging their positions in the spot markets. But no evidence that this actually occurred was provided. Future research is needed to investigate the mechanisms of the linkages between the futures and spot markets.

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APPENDICES

Appendix A: Average Tables

Table A1: Average return correlation of Three-month traded metal futures prices

	Zinc v Copper	Zinc v NI	Zinc v Tin	Copper v NI	Copper v Tin	NI v Tin	Alum v Zinc	Alum v Copper	Alum v NI	Alum v Tin
1995-2001	0.4627	0.4225	0.3177	0.4848	0.3271	0.3581	0.4539	0.5679	0.4396	0.3332
2002-2011	0.7342	0.5622	0.4407	0.6018	0.5014	0.4397	0.6612	0.7434	0.5283	0.4294
2012-2015	0.7235	0.5685	0.4838	0.5852	0.4926	0.4780	0.7371	0.6710	0.5442	0.4514
Change in Correlation	0.2715	0.1396	0.1229	0.1170	0.1743	0.0816	0.2073	0.1755	0.0887	0.0961
Change in Correlation %	58.6696	33.0521	38.6926	24.1247	53.3024	22.7809	45.6712	30.9039	20.1718	28.8485
Change in Correlation	-0.0107	0.0064	0.0431	-0.0165	-0.0088	0.0383	0.0758	-0.0724	0.0159	0.0221
Change in Correlation %	-1.4590	1.1317	9.7816	-2.7474	-1.7607	8.7026	11.4709	-9.7385	3.0003	5.1436

Table A2: Average return correlation of Three-month oil futures versus three-month traded metal futures prices

	Oil v Zinc	Oil v Copper	Oil v NI	Oil v Tin	Oil v Alum
1995-2001	0.0469	0.0457	0.0704	0.0404	0.0150
2002-2011	0.2281	0.2737	0.2126	0.1934	0.2455
2012-2015	0.2932	0.3418	0.2666	0.2351	0.2935
Change in Correlation	0.1812	0.2280	0.1422	0.1530	0.2305
Change in Correlation %	386.0444	499.1748	201.9394	379.0955	1534.4122
Change in Correlation	0.0650	0.0681	0.0539	0.0417	0.0480
Change in Correlation %	28.5088	24.8790	25.3754	21.5517	19.5582

Table A3: Average return correlations of Three-month traded metal futures prices versus bulk commodities

	RBA v Zinc	RBA v Copper	RBA v Tin	RBA v NI	RBA v Oil	RBA v Alum
1995 - 2001	-0.2357	-0.1868	0.0241	0.0525	-0.0050	-0.0945
2002- 2011	-0.2286	-0.1486	-0.0892	-0.2303	0.0623	-0.1081
2012 - 2015	0.2509	0.2333	0.2096	0.1595	0.1593	0.2133
Change in Correlation	0.0071	0.0382	-0.1134	-0.2828	0.0673	-0.0136
Change in Correlation %	-2.9964	-20.4475	-469.4549	-538.7798	-1350.5549	14.4278
Change in Correlation	0.4795	0.3819	0.2988	0.3898	0.0970	0.3215
Change in Correlation %	-209.7474	-256.9742	-334.9276	-169.2293	155.5807	-297.2577

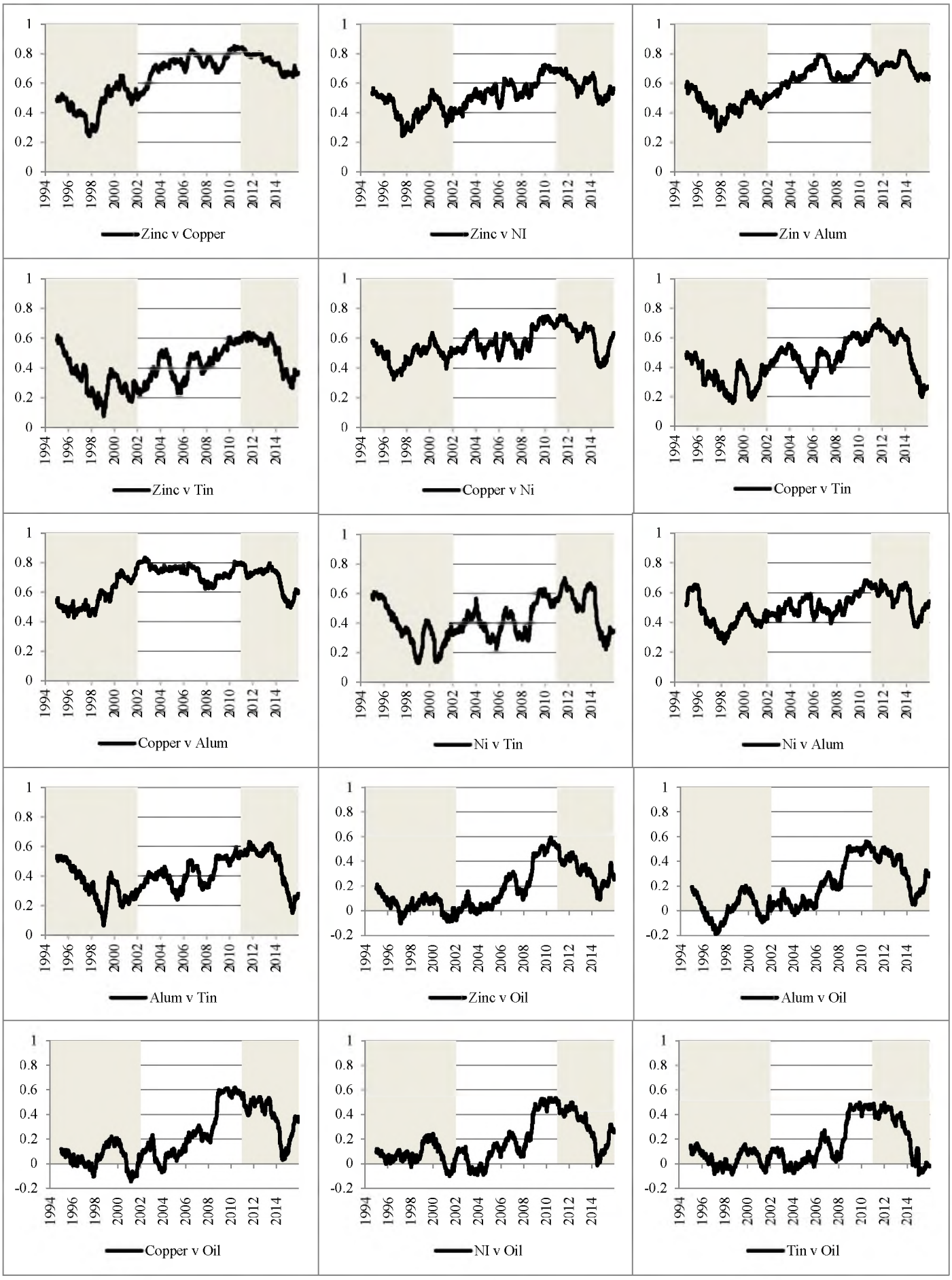
Table A4: Average return correlations of traded metal spot prices

	Zinc v Copper	Zinc v NI	Zinc v Tin	Copper v NI	Copper v Tin	NI v Tin	Alum v Zinc	Alum v Copper	Alum v NI	Alum v Tin
1995-2001	0.4527	0.4302	0.2883	0.4758	0.2851	0.3119	0.4330	0.5378	0.4352	0.3002
2002-2011	0.7271	0.5554	0.4375	0.5899	0.4949	0.4337	0.6499	0.7294	0.5210	0.4254
2012-2015	0.7104	0.5609	0.4734	0.5775	0.4906	0.4740	0.6962	0.6607	0.5331	0.4415
Change in Correlation	0.2744	0.1252	0.1492	0.1141	0.2098	0.1217	0.2168	0.1916	0.0858	0.1253
Change in Correlation %	60.6191	29.1069	51.7608	23.9840	73.6074	39.0289	50.0648	35.6247	19.7038	41.7314
Change in Correlation	-0.0168	0.0055	0.0358	-0.0124	-0.0044	0.0403	0.0464	-0.0687	0.0122	0.0161
Change in Correlation %	-2.3069	0.9926	8.1912	-2.1002	-0.8803	9.2936	7.1345	-9.4197	2.3387	3.7767

Table A5: Average return correlations of oil spot price and traded metal spot prices

	Oil v Zinc	Oil v Copper	Oil v NI	Oil v Tin	Oil v Alum
1995-2001	0.0293	0.0186	0.0552	0.0118	0.0172
2002-2011	0.2444	0.2712	0.2124	0.2003	0.2304
2012-2015	0.2919	0.3492	0.2657	0.2427	0.2940
Change in Correlation	0.2151	0.2526	0.1572	0.1886	0.2132
Change in Correlation %	735.2334	1361.1866	284.8159	1598.5222	1236.7679
Change in Correlation	0.0475	0.0780	0.0534	0.0424	0.0635
Change in Correlation %	19.4389	28.7639	25.1219	21.1555	27.5657

Appendix B: Futures prices -12 month rolling correlations



Appendix C: Spot prices - 12 month rolling correlations