



A tale of two tails: Explaining extreme events in financialized agricultural markets



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ABSTRACT

The substantial booms and busts in agricultural prices marked by extreme events across commodities lead to heated debates about the effects of speculative trading on commodity price fluctuations. This study proposes a new approach to understanding extreme events and boom–bust processes in agricultural markets. Using weekly futures data for twelve indexed agricultural commodities during 2006 to 2016, we find that extreme price changes, located in the 10% tails of the distribution, cluster across agricultural markets. We then implement a multinomial logit model to investigate which factors are associated with the propagation of extreme events. Specifically, we disentangle three transmission conduits. (1) The macroeconomic conduit captures the possibility that the synchronized extreme price events are generated by business-cycle driven demand shifts mainly in emerging economies. (2) The financial conduit refers to potential links between extreme returns and the increasing flow of money from financial participants into agricultural futures markets. (3) Finally, the energy conduit accounts for possible spillover effects due to oil price shocks. Our results indicate an important role of managed money positions and oil prices while the real demand channel remains mostly insignificant.

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1. Introduction

Following the collapse of stock markets in early 2000s and fueled by tentative evidence that commodity futures offer diversification against stock market downturns (Erb and Harvey, 2006), commodity futures have become a popular asset class for several financial institutions and the general investment community (Rouwenhorst and Tang, 2012). The creation of new investment vehicles, such as exchange-traded index funds, has facilitated the rapidly rising participation of financial investors in commodity markets which is reflected by an impressive growth in the levels of activity as measured by open interest in commodity futures from \$103 billion at the end of 2003 to \$509 billion in July 2008 (Hong and Yogo, 2010). Concurrently, a broad set of commodities across the energy and agricultural sector has experienced synchronized sequences of large price swings, drawing renewed attention

from policymakers and academics to commodity markets. A central and vigorously debated question is whether traditional supply and demand fundamentals or new financial amplification mechanisms dominate price formation in financialized commodity derivatives markets (Cheng and Xiong, 2014; Irwin and Sanders, 2012).

The present study aims to broaden the discussion by assessing the occurrences of tail events in agricultural commodity markets during the boom–bust period from June 2006 to September 2016. Although fat tails in the distribution of commodity returns are a well-known phenomenon (Mandelbrot, 1963), empirical research has markedly overlooked the driving factors behind such disruptive price moves. Indeed, differently from the extant literature that has examined conventional co-movements, this study contributes to the analysis of agricultural commodity linkages in the context of extreme price movements. Tail events are used as triggers for information and early warning systems on food security (Kalkuhl et al., 2016; Torero, 2016): It is the occurrence of rarely observed extreme events that poses a challenge for stakeholders and policymakers rather than a continuous situation of high or low prices.

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Analyzing tail events can therefore provide a complementary understanding of food security risks that are associated to international commodity markets.

We characterize the propagation of tails events across agricultural markets, its economic significance and its determinants using a multinomial logit approach. In particular, our approach allows us to pinpoint the relevance of three conduits through which tail events may operate: (1) The “macroeconomic conduit” captures the possibility that synchronized extreme price events are triggered by business-cycle driven demand shock mainly from emerging economies (Krugman, 2008; Kilian and Hicks, 2013). (2) The “energy conduit” accounts for possible spillover effects due to oil price shocks (e.g. Algieri and Leccadito, 2017). (3) The “financial conduit” refers to the financialization and speculation in commodity markets and captures potential links between extreme returns and the increasing flow of speculative money into agricultural futures markets (Etienne et al., 2015; Tadesse et al., 2014).

We use weekly data for twelve agricultural commodities with futures contracts included in the Commitments of Traders (COT) – Supplemental Report namely cocoa, coffee, corn, cotton, feeder cattle, lean hogs, live cattle, soybeans, soybean meal, soybean oil, sugar and wheat. These commodities are particularly well suited to the analysis at hand because they represent the relevant part of the financialized agricultural market. We first filter each original return series with AR-GARCH (Generalized Autoregressive Conditional Heteroskedasticity) models including a set of exogenous variables. This pre-filtering accounts for the serial clustering of extreme events that is due to serial correlation and/or periods of heightened volatility. In addition, the inclusion of common predictors of commodity returns in the procedure (e.g. exchange rate, yield spread) reduces the possibility that we attribute the clustering of extreme price changes to commonly known risk factors. We then employ the residuals from these regressions to identify extreme returns for each agricultural commodity. We define extreme returns as located in the 10% tails of the distribution, whereby we treat negative extreme returns (“bottom-tail events”) separately from positive extreme returns (“top-tail events”). As robustness check we also consider 5% and 15% cut-offs on tail distributions. Finally, we create a categorical dependent variable that indicates the number of agricultural commodities that simultaneously experience top-tail and bottom-tail events and estimate a multinomial logit model to evaluate the likelihood of observing each tail event category and their drivers. The potential drivers are grouped into three conduits and include, among others, the Baltic dry freight index (macroeconomic conduit), oil futures price (energy conduit) and net position changes of two types of financial traders, managed money traders and commodity index traders, provided by the US Commodity Futures Trading Commission (financial conduit).

Our main findings are as follows: First, with reference to the macroeconomic channel, demand factors remain mostly insignificant which indicates that traditional market fundamentals have little role in explaining extreme price changes despite their undisputed general impact on prices. Second, we find strong evidence that managed money positions help explaining the transmission of joint extreme price changes. In fact, this financial conduit is strongly associated to tail events in either direction and, in particular, for synchronous tail events. For example, the strongest increase of the net long position results in a probability of extreme price rises in two or three (four or more) markets equal to about 28% (29%). In contrast, index traders have only little impact on tail events. In addition, there is some evidence of shock spillover effects from the stock market to agricultural markets. Finally, regarding the energy conduit, oil price returns are highly significant for synchronous tail events of multiple agricultural commodities. The important role of oil prices suggests that the agricultural

markets are linked to energy markets through the production cost side.

The remainder of the study is organized as follows. Section 2 reviews the literature on the topic. Section 3 describes the data used. Section 4 first presents the GARCH and multinomial logit regression methodology, and then discusses the results. Section 5 concludes.

2. Literature review

Since the 2007–2008 price spikes, much research has focused on traditional and new drivers of agricultural commodity prices. While classical supply and demand fundamentals, like harvest failure, stock-to-use ratios and demand growth, remain important determinants of prices, energy and financial market linkages have become more important (Tadesse et al., 2014; Abbott, 2009; Trostle, 2010). There are two different concerns that need to be distinguished: One is the “excessive speculation” hypothesis which claims that excessive speculation in commodity markets could push up futures and spot prices above levels justified by market fundamentals – i.e. they fuelled a “bubble” (Adämmer and Bohl, 2015; Aulerich et al., 2013); the second is the “financialization hypothesis” stating that, driven by financial inflow and new investment vehicles, commodity markets are experiencing increasing price co-movements with financial markets, so that shocks from financial markets could transmit to commodity markets and destabilize them.

On the speculation hypothesis, theoretical models are able to assess whether specific trading strategies can destabilize prices or fuel a bubble. These models are often agent-based models where some traders have bounded rationality or behave according to stylized trading rules (e.g. Westerhoff and Reitz, 2005). Nevertheless, it is also possible to show that speculation can destabilize prices in a setting of fully rational traders without the existence of any market frictions (Hart and Kreps, 1986). As the models are very stylized or rely on assumptions that are difficult to observe on available data, their empirical validation is difficult to accomplish. Rather, empirical analysis on speculation attempts to find (statistically significant) correlations between the activities of specific trader groups and prices. This reduced-form approach is often confronted with a severe identification problem which makes it difficult to conclude about causal effects. Granger causality tests are widely used, but they show mixed evidence on the impact of trading activities on returns (Robles et al., 2009; Brunetti et al., 2011; Aulerich et al., 2013). Granger causality tests have been considered problematic as the considered time-lag (typically one week) is too long to infer about causal effects in liquid markets where transactions have an immediate impact on prices (Gilbert and Pfuderer, 2014). Additionally, Granger causality tests have been criticized to suffer from omitted variable bias on market fundamentals and non-rejection of non-causality can occur despite the presence of causal effects (Grosche, 2014). Sanders and Irwin (2016) address each of the major criticisms of Granger-style tests of the relationship between index fund positions and commodity futures prices and show that these tests are robust. Other works have integrated market fundamentals with speculation and trading activities. Tadesse et al. (2014), Algieri (2014a) and Gilbert (2010) find a significant and positive impact of speculation (non-commercial traders’ market activities) or index funds investment on prices and returns, but not on volatility (Tadesse et al., 2014). Henderson et al. (2015) also find a positive and significant impact of commodity market inflows in a dataset of transactions where trading based on the arrival of new information can be ruled out. In contrast to these previous studies, we investigate the link between speculative trading and commodity price behavior exclusively during periods of extreme

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