Available online at www.centmapress.org

Proceedings in
System Dynamics and Innovation in Food Networks 2016

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Financial Markets and Agricultural Commodities: Volatility Impulse Response Analysis

Lucia Baldi, Massimo Peri and Daniela Vandone
University of Milan
Via G. Celoria, 2
20133 Milan
Italy
lucia.baldi@unimi.it

1. Introduction

The recent global food crisis has caused an increase in agricultural market volatility, raising important questions on the determinants of this instability. Many studies have analyzed this issue focusing on main factors affecting price volatility, as past volatility and trends, transmission across prices, oil price volatility, export concentration, stock levels and yields (Balcombe, 2010).

Existing empirical literature identifies different drivers of volatility; among them, financialization and speculation are by far one of the most important. Indeed, with the introduction of agricultural commodity as an alternative asset class in investment portfolios, and the consequent increasing integration between commodity markets and major financial markets, there has been a growing convergence of risk-adjusted returns on assets class across markets, and an increase in the risk of volatility spillovers from outside to commodity markets due to portfolio rebalancing of institutional investors (Adams and Gluck, 2015).

Since the beginning of the new millennium, in fact, there has been a steady flows of financial investments in commodities. As reported by Irwin and Sanders (2011), commodity investments have grown between 2003 and 2009 from 15 billion to 250 billions of dollars. Investments in these markets is made through different financial instruments, driven by different motivations: in futures, both for hedging and speculative purposes, and also in commodity index funds and hedge funds, mainly for portfolio diversification purposes. Increase in investing in the latter two types of investments, however, has been much stronger, compared to the past (Cheng et al. 2014).

This process of massive increase in investments in commodities through financial instruments, knows as “commodity finanziarization”, has generated a gradual integration between commodities market and financial markets which, in turn, has risen spillover volatility between markets due to investors’ rebalancing of portfolio’s asset classes.

In this paper we examine the relationship between stock markets and agricultural commodity prices by estimating volatility impulse response functions. Our aim is to understand to what extent shocks in financial stock markets impact commodities’ price volatility and the persistency of this phenomenon.

DOI 2016: pfsd.2016.1612

Specifically, we analyse the effect of the two most important bubble burst in financial markets since 2000, i.e. the dot.com bubble and the 2008 financial crises; for each bubble, we analyse spillover volatility in the period before and after the burst of the bubble.

The presence of spillover volatility from financial markets to commodities markets may be interpreted as an increasing financialization of commodities.

We use weekly data from 1970 to 2015 for S&P500 and S&P indexes for agriculture and grain.

To analyze the dynamic effect of financial market shocks on commodity price volatility we employ Hafner and Herwartz (2006) methodology. This method allows to examine volatility impulse response functions (VIRF) for multivariate GARCH models.

2. The dot.com bubble and the 2008 financial crises

During the time period of our analysis, stock markets experienced two bubble bursts, the first related to the so-called dot.com bubble and the second, even more dramatic, related to the 2008 financial and economic crises.

The dot.com bubble originated in the mid-90s when widespread process of euphoria began due to the extreme confidence by investors in the growth potential of companies operating in the New Economy. In March 2000, the bubble bursts and prices began to fall; the Nasdaq lost almost 9% in three days and during 2001, many dot-com companies closed or were the target of M&A deals.

The 2008 financial crises began to take shape in the US in 2003, with the significant increase in the supply of subprime mortgages. The factors that have stimulated the growth of subprime mortgages are due, among other things, to the dynamics of the US housing market and the development of securitization.

In fact, since 2000 and until the middle of 2006, the US housing prices have grown steadily and significantly, generating a real estate bubble. This performance was helped by the accommodative monetary policy of the Federal Reserve (Fed), which kept interest rates at historically low until 2004, in response to the crisis of the Internet bubble and the attack of September 11, 2001.

Lower interest rates means lower interest rates for individuals applying for mortgages; this stimulated housing demand further fuelling their prices. The housing bubble, also made it attractive mortgage lending from the perspective of financial institutions too: in the event of insolvency of the borrower they could recover the money lent through the seizure and the resale of the house in a rising market.

In addition to the real estate bubble and low interest rates, the growth of subprime mortgages has also been supported by the development of the securitization, ie the possibility for credit institutions to transfer mortgages to third parties (so-called 'special purpose vehicle').

Securitization allowed banks, to get fresh cash from the sale of long-term assets that would otherwise been paid back at the end of the loans contracts (10, 20 or 30 years later); in turn, cash could be reused to supply new mortgages to new borrowers, mainly subprime. Indeed, given that securitization apparently allowed banks to get rid of the risk of default by borrowers of funds, in fact it weakened the incentive to properly assess the reliability of customers.

DOI 2016: pfsd.2016.1612

The SPV, in turn, financed the purchase of securitized loans by issuing to investors in short-term securities (so-called Asset Backed Securities - ABSs). These securities were purchased by many investors both in the US and in Europe, this is one of the factors that contributed to the transmission of the crisis from the US economy to European economies and, more in general, worldwide.

The bubble bursts in 2008. As a consequence financial institutions involved in providing subprime recorded heavy losses; the situation triggered a crisis of confidence and liquidity that soon became systemic.

3. Empirical issues and results

We use the Hafner and Herwartz (2006) method to investigate the dynamic effect of S&P500 and S&P indexes shocks on commodity price volatility. First we define a bivariate GARCH model with the mean equation modelled as a bivariate ARMA (1,1) model. Then a BEKK specification was used to model the conditional variance H_t (Engle and Kroner, 1995).

In agreement with Hafner and Herwartz (2006), the BEKK model is then transformed in its *Vech* representation so as to generate volatility impulse response functions defined as the expectation of volatility conditional on initial shock and history minus the expectation conditional only upon history.

In this paper we date external shocks in correspondence to stock market bubbles; the March 2000 information technology bubble (dot-com bubble) and the September 2008 financial crises, starting with the Lehman and Brothers default. VIRF analysis permits to compare the means of the VIRF of a set of dates before and after these two shocks.

A bivariate VARMA-GARCH and VIRF methodology was then implemented between: S&P500 and S&P indexes-agriculture; S&P500 and S&P indexes-grain. Then, following Hafner and Herwartz (2006) the average value of estimated volatility impulse responses functions was calculated for the two couples. Specifically, average VIRF that correspond to twenty four observation before and after the two bubble bursts.

Weekly data from 1970 to 2015 for S&P500 and S&P indexes for Agriculture and Grain were used. S&P 500 represents financial stock markets trends, whereas S&P indexes for Agriculture provides a benchmark for investments performance in the global agriculture commodity market and includes wheat, corn, soybeans, coffee, sugar, cocoa, and cotton. S&P index for Grain focuses on investment performance in the grain commodity markets, composed by soy, corn and wheat.

The following figures show the main results from the VIRF, derived from the estimates of the Hafner and Herwartz methodology.

Figure 1and 2 report the results for the impact of the dot.com bubble on Agriculture and Grain S&P index, respectively. Firstly, the impact are negative before the bubble burst, which means that expected conditional variance before the shock tends to decrease rather than increase. A similar pattern, is detected also before the burst even if it is smoother, especially concerning the agricultural index, that is almost zero. This result is not surprising, given that agricultural index includes all

DOI 2016: pfsd.2016.1612

agricultural commodities and different trends are amortized. Moreover, in the early 2000s, the the phenomenon of commodities finanziarization was still not so evident.

On the other hand, volatility spillovers from financial to agricultural markets noticeably emerge for the period of the 2008 bubble. Indeed, figure 3 and 4 highlight a strong increase in volatility spillovers only after the burst. In facts, for agriculture market volatility transmission shows a 50% increases and for grain a 85% increase.

Figure 1 – Volatility impulse response function for Agriculture S&P index before and after Dot.com bubble

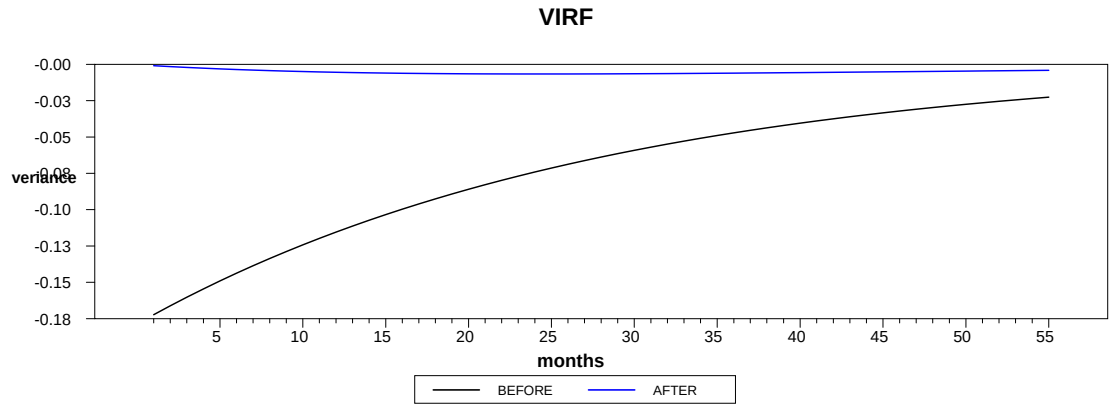


Figure 2 – Volatility impulse response function for Grain S&P index before and after Dot.com bubble

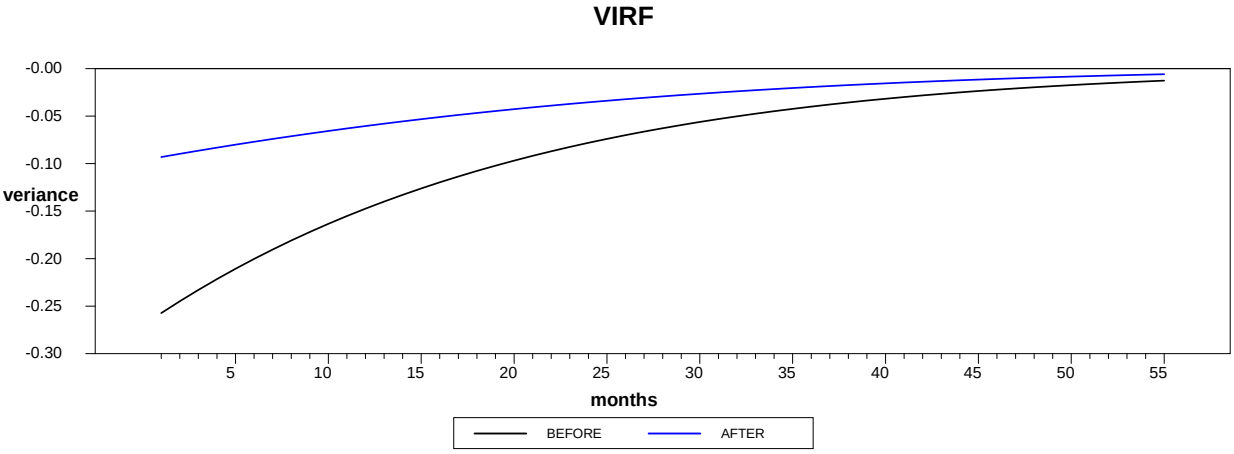


Figure 3 – Volatility impulse response function for Agriculture S&P index before and after 2008 bubble

DOI 2016: pfsd.2016.1612

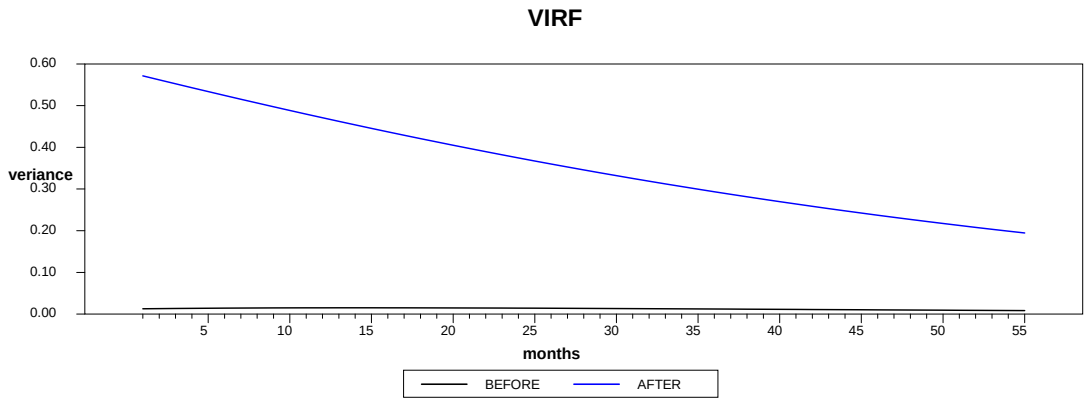
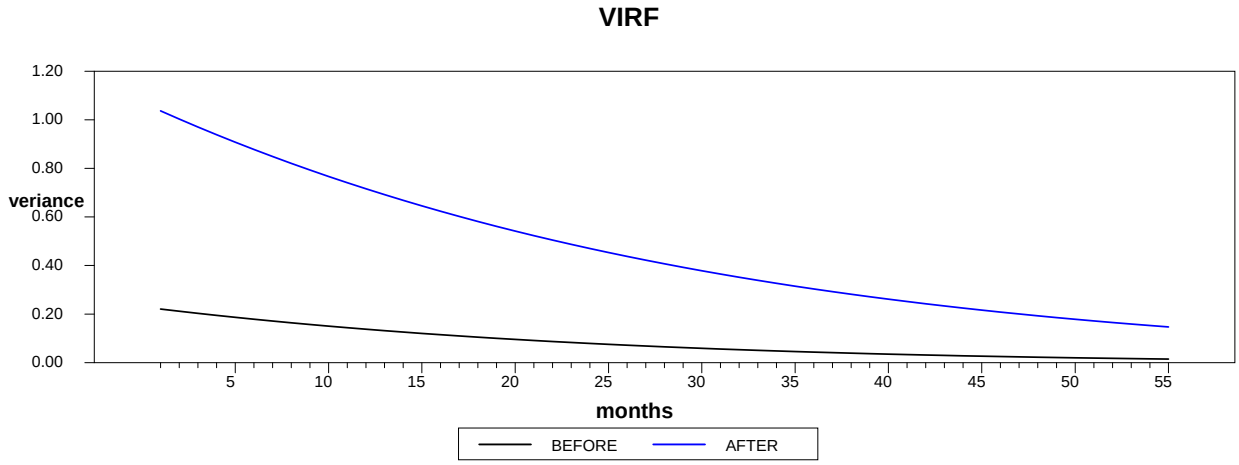


Figure 4 – Volatility impulse response function for Grain S&P index before and after 2008 bubble



5. Conclusion

Results show that volatility spillovers from stock markets to commodity markets were negative and slightly negative, respectively before and after the dot-com bubble. Conversely volatility spillovers have increased significantly after the 2008 financial crisis, in particular for those commodities - like wheat, corn and soy - that are largely traded on stock markets as alternative asset class and, thus, are more "financialized".

References

Adams, Z., & Glück, T. (2015). Financialization in commodity markets: A passing trend or the new normal?. *Journal of Banking & Finance*, *60*, 93-111.

Balcombe, K. (2010). The nature and determinants of volatility in agricultural prices: an empirical study from 1962-2008. Commodity Market Review 2009 – 2010, FAO, Rome

Cheng, I.-H., Kirilenko, A., Xiong, W. (2014). Convective risk flows in commodity futures markets. *Review of Finance*, 1–49.

Engle, R. F., & Kroner, K. F. (1995). Multivariate simultaneous generalized ARCH. Econometric theory, 11(01), 122-150.

DOI 2016: pfsd.2016.1612

Hafner, C. M., Herwartz, H. (2006). Volatility impulse responses for multivariate GARCH models: An exchange rate illustration. *Journal of International Money and Finance*, 25(5), 719-740.

Irwin, S.H., Sanders, D.R. (2011). Index funds, financialization, and commodity
futures markets*. Applied Economics Perspective Policy* 33 (1), 1–31.

Jin, X., Lin, S. X., & Tamvakis, M. (2012). Volatility transmission and volatility impulse response functions in crude oil markets. *Energy Economics*, 34(6), 2125-2134.

Le Pen, Y., Sévi, B. (2010). Volatility transmission and volatility impulse response functions in European electricity forward markets. *Energy Economics*, 32(4), 758-770.

Olson, E., Vivian, A. J., & Wohar, M. E. (2014). The relationship between energy and equity markets: Evidence from volatility impulse response functions. *Energy Economics*, 43, 297-305.

Panopoulou, E., Pantelidis, T. (2009). Integration at a cost: evidence from volatility impulse response functions. *Applied Financial Economics*, 19(11), 917-933.

DOI 2016: pfsd.2016.1612