SCHRIFTEN DER GESELLSCHAFT FÜR WIRTSCHAFTS- UND SOZIALWISSENSCHAFTEN DES LANDBAUES E.V.

Lehecka, G.: Have food and financial markets integrated? An empirical assessment on aggregate data. In: Kirschke, D., Bokelmann, W., Hagedorn, K., Hüttel, S.: Wie viel Markt und wie viel Regulierung braucht eine nachhaltige Agrarentwicklung? Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 49, Münster-Hiltrup: Landwirtschaftsverlag (2014), S. 39-49.

Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Bd. 49, 2014, S. 39 – 49

HAVE FOOD AND FINANCIAL MARKETS INTEGRATED? AN EMPIRICAL ASSESSMENT ON AGGREGATE DATA

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Abstract

This paper analyzes co-movements and discusses possible market integration between aggregate food and stock markets in the period of 1990 to 2012. Correlations, price return distributions, cointegration, and Granger-causalities are tested in subsamples on monthly FAO Food Price Index and MSCI World Stock Market Index data to better assess why and whether linkages between food and financial markets have increased. Empirical results suggest that while there is only weak indication of greater co-movements concurrent with structural changes such as changed agricultural policies, new demand due to growth in emerging markets and energy mandates, and the financialization of food markets since the early 2000s, they did start to increase in particular substantially during the financial stress of the Lehman crisis and the Great Recession. It is concluded that while structural changes may have amplified price linkages across markets, results do not suggest that they are the key factors for greater price co-movements. Instead, it is discussed that the effects of the late-2000s recession as a time of great economic weakness and uncertainty may have changed concurrently the behavior of both food and financial market participants, such that different market prices exhibit increased co-movements.

Keywords

co-movements, financialization, food commodity market, market integration, stock market, structural change.

1 Introduction

The decade of the 2000s has experienced several structural changes in agricultural markets that may have changed agricultural price dynamics: new demand due to biofuel policies and heightened linkages to the energy complex, strong and continued increases in income in China and India, low aggregate grain stocks, poor weather, and the sharp changes in aggregate demand resulting from the financial crisis and recession (e.g., WRIGHT, 2011, 2012). Further, structural changes occurred in futures markets of food and agricultural commodities (IRWIN and SANDERS, 2012): a shift to electronic trading, easier access to futures markets, and an emergence of new financial market participants (index funds, exchange-traded funds). In this context, uncertainty about future agricultural supply and demand conditions has increased dramatically in the last decade, and agricultural prices have experienced sharp increases, higher volatility, and also greater co-movements with other commodities and financial prices.

Prior to the 2000s, agricultural prices, and commodity prices in general, had little co-movements and correlations with financial prices (e.g., GORTON and ROUWENHORST, 2006) and with each other (e.g., ERB and HARVEY, 2006). These aspects were in contrast to price dynamics of typical financial assets since they are highly correlated with market indices and with each other. Further, the growth of population and welfare as well as the production of bioenergy has increased demand for food and agricultural products, and this new demand may have caused an upward shift in the long-term trend of declining agricultural real prices (e.g., KELLARD and

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WOHAR, 2006; HARVEY et al., 2010) in form of a commodity price boom in the second half of the 2000s (e.g., RADETZKI, 2006; CARTER, RAUSSER and SMITH, 2011).

Low correlations with financial assets and increasing agricultural prices led to the assertion that agricultural futures market portfolios are potential diversification investments that may enhance returns and serve as an inflation hedge. Investments that track a commodity index have become a widespread alternative investment for institutions and pension funds. Agricultural futures and options markets began to grow rather rapidly around 2004, both in held positions and traded volume. In particular, the magnitude of financial traders' positions in agricultural futures markets has grown remarkably in absolute terms and relative to the positions of physical market participants such as farmers, packers, mills, grain elevators, etc. The emergence of these new financial market participants is referred to as the "financialization" of agricultural markets (e.g., IRWIN and SANDERS, 2011, 2012; BUYUKSAHIN and ROBE, 2012).

The nature and effects of the financialization of agricultural markets have been the subject of world-wide debate and have been empirically analyzed by an increasing body of recent literature. One line of research has investigated empirical relationships between futures market positions, in particular of commodity index funds, and price movements in agricultural markets. While some studies provide some evidence for a relationship (e.g., COOKE and ROBLES, 2009; GILBERT, 2010a, b), the vast majority of empirical analyses fail to find a direct link between trading positions and price movements in commodity markets (e.g., BRUNETTI and BUYUKSAHIN, 2009; STOLL and WHALEY, 2010; IRWIN and SANDERS, 2011; SANDERS and IRWIN, 2011a, b; WILL et al., 2012; LEHECKA, 2013). Based on these results, the available research provides rather little evidence supporting general influences of trading positions, including commodity index positions, on price movements in agricultural markets.

Another line of research focuses on increasing co-movements and correlations between commodity and financial prices since the 2000s. It has been asked whether commodities and financial markets form a "market of one" (BUYUKSAHIN et al., 2010). For example, TANG and XIONG (2010, 2012) argue that commodity markets were not fully integrated with financial markets and with each other prior to the development of the financialization, through which commodity prices may have become more correlated with financial markets. BUYUKSAHIN and ROBE (2011, 2012) find that, while the level of commodity-equity linkages has widely fluctuated over the past two decades, correlations between commodity futures and financial returns have substantially increased in particular since the time of the financial crisis and the demise of the Lehman Brothers (Sep. 2008). They argue that cross-market linkages increase among financial stress as during the Lehman crisis and the Great Recession. Furthermore, their results suggest that speculative activities in general and hedge fund activities in particular (those that trade both in stock and commodity markets), but not index traders and others, help to explain co-movements between commodity and financial markets.

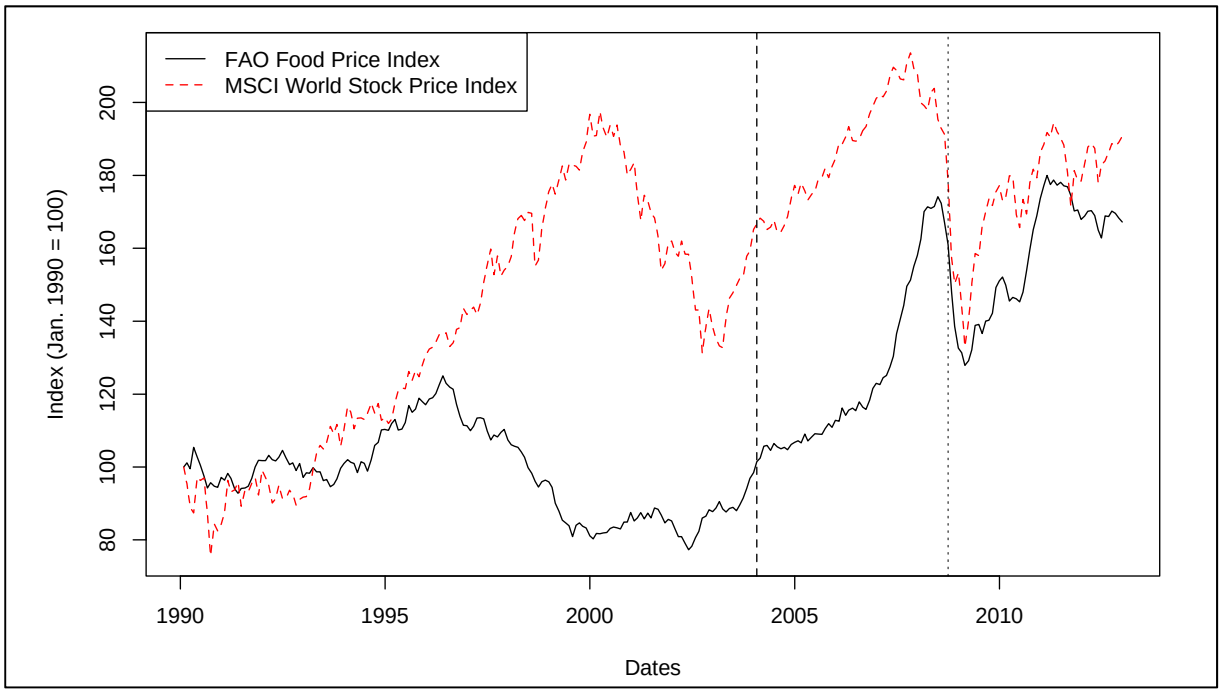
Given the ongoing debates on the effects of the financialization and other structural changes in agricultural markets, the purpose of this paper is to contribute to the growing literature by empirically analyzing co-movements and by discussing possible market integration between aggregate food commodity and stock prices in the period of 1990 to 2012. Previous studies have mostly focused on increased correlations between market prices that may not justify the notion of market integration with financial markets. In this paper, besides correlations, also price return distributions, cointegration relationships, and Granger-causalities are presented and tested in subsamples to better assess why and whether linkages between food and financial markets have increased. The full sample is divided by the start of the financialization (2004), and the second period is furthermore divided by the financial crisis (event of the Lehman Brothers in Sep. 2008). Data series used in this study include the FAO Food Price Index and the MSCI World Stock Market Index as proxies for global food commodity and stock prices, respectively. The combination of alternative statistical tests and a sample period

of 23 years provides new evidence on structural changes in co-movements between food commodity and financial markets, and finally, on the notion of market integration.

2 Data

To analyze whether market integration of aggregate food and financial markets have increased, this paper uses two major aggregated price indices as proxies for global food commodity and financial prices. The FAO Food Price Index is a measure of the monthly change in international prices of a basket of food commodities. It consists of the average of five commodity group price indices (representing 55 quotations), weighted with the average export shares of each of the groups for 2002 – 2004. The MSCI World Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of 24 developed markets. It is often used as a common benchmark for "world" or "global" stock performance. Monthly data for both indices are collected from Jan. 1990 to Dec. 2012 (276 data points).

Figure 1: FAO Food Price Index and MSCI World Stock Market Index on a comparative logarithmic scale, January 1990 – December 2012



Source: FAO, MSCI

Figure 1 depicts the time series of the food commodity and stock price indices on a comparative logarithmic scale. The sample is divided into two subsamples by the start of the financialization (Jan. 2004) to analyze possible structural changes in co-movements, and, as previous studies (e.g., BUYUKSAHIN and ROBE, 2011, 2012) find increased correlations since the event of the demise of the Lehman Brothers (Sep. 2008), the second subsample period is furthermore divided for the analysis. That is, period 1 ranges from Jan. 1990 to Dec. 2003, and period 2 from Jan. 2004 to Dec. 2012. The second subsample is divided in period 2a: Jan. 2004 to Aug. 2008, and period 2b: Sep. 2008 to Dec. 2012. The sample split dates are highlighted in figure 1 by vertical dashed and dotted lines. Simple visual inspection of the two indices may suggest that co-movements have increased in the first half of the 2000s.

For further analysis, monthly returns are computed as follows:

$$r_{i,t} = \ln(p_{i,t}/p_{i,t-1})$$

where *i* is the particular index (FAO Food Price Index and MSCI World Stock Market Index), *t* it the time in months, and ln is the natural logarithm.

Table 1: Summary statistics of FAO Food Price Index and MSCI World Stock Market Index, January 1990 – December 2012

	Median	Mean	Min.	Max.	Sd.	Skew.	Kurtosis	ADF
Indices								
Food index	113.60	129.20	85.20	237.90	40.90	1.28	3.42	-1.93
Stock index	1028.00	984.80	432.10	1682.00	319.79	-0.05	1.95	-1.78
Returns								
Food index	0.17	0.19	-8.47	5.70	2.04	-0.28	3.75	-7.87**
Stock index	0.65	0.23	-14.02	10.90	3.28	-0.66	5.57	-15.87**

Notes: Returns are computed as the difference in the natural logarithm of the index multiplied by 100. Number of observations is 276 monthly data points. ADF denotes the Augmented Dickey-Fuller test statistic on stationarity. Tests are conducted with a constant, a linear trend and lags of order determined by the Bayesian Information Criteria (BIC). Double asterisks (**) denote significance at the 1% level.

Source: FAO, MSCI, own calculations

Table 1 shows summary statistics of price indices and returns. Augmented Dickey-Fuller tests on stationarity suggest that index time series are difference-stationary since one differencing yields rejection of the null hypothesis of non-stationarity (LÜTKEPOHL and KRÄTZIG, 2004). In addition, summary statistics of returns indicate different return distributions for food and stock indices. In particular, median, standard deviation, and kurtosis is higher for stock index returns. Thus, over the entire sample period, simple summary statistics suggest different price behavior.

3 Empirical analysis of increased co-movements

Co-movements between food commodity and stock prices in subsamples are analyzed and assessed by using four lines of empirical methods. If markets are integrated, then they should exhibit not only positive correlations, but also a common distribution in their price return behavior and a long-term relationship in form of, e.g., cointegration (assuming that time series variables are difference-stationary). Therefore, at first, correlations of the returns are estimated and tested. Then, return distributions are compared and tested to assess common price behavior. Next, cointegration is tested using the Johansen procedure (LÜTKEPOHL and KRÄTZIG, 2004). Finally, to assess whether one market dominates the other, Granger-causality tests are applied to test for lead-lag relationships. The combination of these statistical tests will contribute evidence on structural changes in co-movements between food commodity and financial prices.

3.1 Have correlations increased?

Table 2 shows return correlation test results for the respective periods divided by the start of the financialization and the demise of the Lehman Brothers. In period 1, correlation is negative and insignificant. In contrast, in period 2, correlation is positive and significant. In fact, there is substantial positive correlation (0.41) between food commodity and stock index returns. However, the sample split in pre- and post-Lehman periods reveals that this greater correlation in period 2 is solely contributed to period 2b (Sep. 2008 – Dec. 2012). In the time before the Lehman Brothers crisis, correlation is negative and insignificant as from Jan. 1990 – Dec. 2003. This supports findings of previous studies (e.g., BUYUKSAHIN and ROBE, 2011, 2012) that correlations did not increase before Sep. 2008. In summary, results indicate that

while there are no significant correlations in the period before the demise of the Lehman Brothers, correlations between food commodity and stock index returns increased significantly and substantially in the period after Sep. 2008.

Table 2: Correlation estimates for the FAO Food Price Index and the MSCI World Stock Market Index

	N	Corr.	t_{corr}
Period 1: Jan. 1990 – Dec. 2003	168	-0.08	-1.08
Period 2: Jan. 2004 – Dec. 2012	105	0.41	4.55**
Period 2a: Jan. 2004 – Aug. 2008	53	-0.10	-0.76
Period 2b: Sep. 2008 – Dec. 2012	49	0.53	4.32**

Notes: Returns are computed as the difference in the natural logarithm of the index multiplied by 100. t values denote statistics for a test of the null hypothesis that the coefficient estimates are zero. Double asterisks (**) denote significance at the 1% level.

Source: FAO, MSCI, own calculations

3.2 Common return distributions?

In order to assess common price behavior, return distributions are compared and tested. Summary statistics over the full sample period (1990 – 2012) given in table 1 for food commodity and stock indices indicate different return distributions.

Table 3: Return distribution statistics of the FAO Food Price Index and the MSCI World Stock Market Index

	Median	Mean	Min.	Max.	Sd.	Skew.	Kurtosis	D
Period 1: Jan. 1990 – Dec. 2003								
Food index	-0.09	-0.01	-4.71	5.70	1.93	0.13	2.53	0.20**
Stock index	0.70	0.30	-14.02	10.90	3.53	-0.51	5.05	
Period 2: Jan. 2004 – Dec. 2012								
Food index	0.48	0.47	-8.47	4.94	2.17	-0.81	5.43	0.08
Stock index	0.55	0.13	-12.61	7.13	2.88	-1.12	6.4	
Period 2a: Jan. 2004 – Aug. 2008								
Food index	0.97	0.91	-3.16	4.67	1.61	0.07	2.84	0.18
Stock index	0.54	0.25	-4.23	2.90	1.51	-0.79	3.60	
Period 2b: Sep. 2008 – Dec. 2012								
Food index	0.16	0.07	-8.47	4.94	2.53	-0.77	4.83	0.16
Stock index	0.65	0.13	-12.61	7.13	3.75	-0.90	4.41	

Notes: Returns are computed as the difference in the natural logarithm of the index multiplied by 100. D denotes the Kolmogorov-Smirnov statistic on a two-sample test of the null hypothesis that both return series are from the same continuous distribution. Double asterisks (**) denote significance at the 1% level. Logarithms of index series are used.

Source: FAO, MSCI, own calculations

However, table 3 shows that statistics on return distributions, in particular median, standard deviation, skewness, and kurtosis, are more similar for the second period. This is to some degree consistent in periods before and after Sep. 2008 since Kolmogorov-Smirnov tests (D statistics) on the null hypothesis of same distributions highly reject for the first period, however, fail to reject the null of same distributions in the other periods. Thus, statistics on return dis-

tributions provide some evidence of common price behavior for the second period starting 2004. In contrast, return distributions are significantly different in the first period. This may imply that, contrary to results found for correlations, common price behavior already started to evolve concurrent with the time of the financialization and other structural changes in agricultural markets.

3.3 Are prices cointegrated?

If markets are integrated, then their prices should exhibit a long-term relationship. In the case of difference-stationary time series, this can be tested by tests on cointegration. Statistically, two or more time series are cointegrated if they share a common stochastic drift. In economic interpretation, they share an equilibrium relationship. In order to test for cointegration relationships, the Johansen test is used (LÜTKEPOHL and KRÄTZIG, 2004). The Johansen procedure requires testing the cointegration rank r by sequences of hypothesis tests (i.e. testing the null hypotheses $r = 0$ and $r \leq 1$). If $r = 0$ cannot be rejected, then there is not cointegration between the price series. Only if $r = 0$ can be rejected and $r \leq 1$ cannot, then time series cointegrate and exhibit a long-term equilibrium relationship. The Vector Autoregression (VAR) lag order for the cointegration test is determined by multivariate information criteria such as the Bayesian Information Criteria (BIC).

Table 4: Johansen's procedure cointegration test results between the FAO Food Price Index and the MSCI World Stock Market Index, maximum eigenvalue statistics

	Lags	$r = 0$	$r \leq 1$	Cointegration
Period 1: Jan. 1990 – Dec. 2003	2	5.58	2.69	no
Period 2: Jan. 2004 – Dec. 2012	3	16.03*	2.48	yes
Period 2a: Jan. 2004 – Aug. 2008	2	17.75*	4.75	yes
Period 2b: Sep. 2008 – Dec. 2012	2	8.17	2.82	no

Notes: The standard model with a constant in the cointegration relationship is used. The VAR lag order is determined by minimizing multivariate BIC. Single asterisk (*) denotes significance at the 5% level. Logarithms of index series are used.

Source: FAO, MSCI, own calculations

Table 4 shows cointegration test results of the Johansen procedure. They suggest that while there is no significant cointegration between food and stock price indices in the first period (Jan. 1990 – Dec. 2003), significant cointegration can be found for the second period (Jan. 2004 – Dec. 2012). This does only hold for period 2a (Jan. 2004 – Aug. 2008), however, not for the time thereafter in period 2b (Sep. 2008 – Dec. 2012). Contrary to results obtained for correlations and return distributions, cointegration analysis gives mixed results, and may not provide general evidence for integrated food and stock markets.

3.4 Are there lead-lag relationships?

Tests on correlation, common return distributions, and cointegration provide mixed results. Nevertheless, they indicate that co-movements have increased between food and financial markets, at least since Sep. 2008. However, it may be that price changes in only one market cause changes in the other, or vice versa. Therefore, tests on Granger-causality are applied. In the case of two time series, F_{index} and S_{index}, F_{index} Granger-causes S_{index} if S_{index} can be better predicted using the histories of both F_{index} and S_{index} than it can by using the histories of S_{index} alone. In particular, $S_{index,t}$ is not Granger-causal for $F_{index,t}$ iif the bivariate VAR(p) process, including constants and linear time trends, of the form

$$\begin{bmatrix} F_{index,t} \\ S_{index,t} \end{bmatrix} = \sum_{i=1}^{p} \begin{bmatrix} \gamma_{11,i} & \gamma_{12,i} \\ \gamma_{21,i} & \gamma_{22,i} \end{bmatrix} \begin{bmatrix} F_{index,t-1} \\ S_{index,t-1} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + t \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \begin{bmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{bmatrix}$$

has $\gamma_{12,i} = 0$ for all $i = 1,2, \dots, p$, and vice versa. It requires checking whether specific coefficients are zero, therefore standard tests for zero restrictions are applied (F-test). A rejection of the null hypothesis implies there is Granger-causality. The VAR is modeled with additional constant terms α_1 and α_2, linear time trend terms β_1 and β_2, and $\epsilon_{1,t}$ and $\epsilon_{2,t}$ are error terms. However, tests have nonstandard asymptotic properties if the VAR contains difference-stationary variables (TODA and PHILLIPS, 1993; LÜTKEPOHL and KRÄTZIG, 2004) – as for the present time series. This can be overcome in fitting VAR processes whose order exceeds the true order. Based on TODA and YAMAMOTO (1995), a lag-augmented model with one additional lag can be used in the test. The hypothesis of zero coefficients has to be tested on only the first p coefficients.

Table 5: Granger causality test results for the FAO Food Price Index and the MSCI World Stock Market Index

	Period 1: Jan. 1990 – Dec. 2003	**Period 2: Jan. 2004 – Dec. 2012**
Food index → Stock index F	1.81	4.74**
Stock index → Food index F	0.83	6.23**
	Period 2a: Jan. 2004 – Aug. 2008	**Period 2b: Sep. 2008 – Dec. 2012**
Food index → Stock index F	2.45	6.24**
Stock index → Food index F	5.97**	4.86**

Notes: Food index → Stock index F denotes an F statistic for the null hypothesis that the Food index does not Granger-cause the Stock index. Double asterisks (**) denote significance at the 1% level. A VAR model with a constant and a linear trend is used. The lag order used is the same as for cointegration tests. One additional lag is included (TODA and YAMAMOTO, 1995). Logarithms of index series are used.

Source: FAO, MSCI, own calculations

Granger-causality test results, shown in table 5, imply that Granger-causality between food commodity and stock index prices appears generally to be bi-directional in the second period while the null of no Granger-causality cannot be rejected in the first period before 2004. Food commodity index levels cause stock index levels and vice versa. This suggests greater co-movements between food commodity and financial markets, and even supports markets integration as bi-directional Granger-causalities may imply that food markets reflect shocks to the general economy and vice versa. However, results for the subsamples of period 2 show that before the demise of the Lehman Brothers (Jan. 2004 – Aug. 2008), only the stock index Granger-caused food prices while lead-lag relationships are bi-directional thereafter. This may suggest that lead-lag relationships already evolved before the financial crisis, however, have been bi-directional since the time of financial stress.

4 Discussion

For the two periods split by 2004, the empirical analysis presented in this paper would provide a rather conclusive picture: food and financial markets exhibit greater co-movements, and they may have even integrated. In the period before the start of the financialization and other structural changes in agricultural commodity markets (Jan. 1990 – Dec. 2003), price returns exhibit insignificant price return correlation, different price return distributions, are not cointegrated, and do not Granger-cause each other. In contrast, in the period from Jan.

2004 to Dec. 2012, price return correlation is significantly and substantially positive, both indices have more common price return distributions, do cointegrate and have therefore a long-term relationship, and finally, are characterized by bi-directional Granger-causality.

However, the split of the second subsample in a period before (Jan. 2004 – Aug. 2008) and after the financial crisis (Sep. 2008 – Dec. 2012) challenges these results substantially and, in particular, a general market integration due to, e.g., the financialization of agricultural markets. Correlations between food and stock price returns did not increase before Sep. 2008, cointegration tests give mixed results for subsample periods, and bi-directional Granger-causality does only hold for the time after Sep. 2008. These results add to the evidence for markets found by previous studies on overall commodities (BUYUKSAHIN and ROBE, 2011, 2012; TANG and XIONG, 2010, 2012) that co-movements started to increase in particular around 2008.

There are different possible explanations why co-movements between commodity and financial prices could have increased. Historically, food and agricultural markets had some special characteristics that may have prevented market integration for a long time. For example, there have been trade barriers as well as production distorting subsidies and declining prices for decades. For the most part in Europe, trade barriers have almost been eliminated with the Agenda 2000 reform of the EU's Common Agricultural Policy, which became fully active in 2004. Trade distorting subsidies have been eliminated in the EU with the Fischler Reform implemented in 2005. In the US, market orientation increased due to farm programs of the 1996 and 2002 Farm Bills. In general, there has been a liberalization of agricultural markets, which may have caused greater integration with other markets. However, previous studies also find that agricultural prices have reacted to macroeconomic variables such as interest rates, expected inflation and economic growth, at least since the 1960s (e.g., BJORNSON and CARTER, 1997).

Another line of reasoning suggests that the new financial market participants who started to emerge in the mid-2000s could have made commodity markets, including agricultural markets, more affected by "financial market sentiment" (e.g., BUYUKSAHIN and ROBE, 2011, 2012). An important difference between traditional market participants and the new financial institutions trading in agricultural futures markets is that the latter tend to trade in various markets. IRWIN and SANDERS (2012), TANG and XIONG (2010, 2012), and CHENG, KIRILENKO and XIONG (2012) discuss that this greater market participation by financial traders may lead to a more efficient sharing of commodity price risk. By trading in many different markets, they could improve risk sharing among markets in normal times but also transfer the effects of financial market stress in times of market crashes and economic weaknesses. As a consequence, co-movements between food and financial markets could increase, leading to a higher degree of market integration.

Furthermore, the increased co-movements could also be due to factors such as the growing impact of crude oil on agricultural markets because of biofuel mandates (DE GORTER and JUST, 2010; CARTER, RAUSSER and SMITH, 2013). For example, GILBERT and PFUDERER (2013) argue that greater co-movements between stock and food prices may not be due to integration between these markets. In contrast, since food and crude oil markets started to be linked due to the evolution of biofuels (corn for ethanol and vegetable oils for biodiesel), food prices may have indirectly (through crude oil) become more correlated with stock prices. Their results show, after controlling for crude oil linkages, only modest correlation increases between food commodity and stock price returns in the 2000s while correlations between food commodity and crude oil price returns, controlling for stock price, have risen substantially.

However, in line with findings of previous papers, results in this study suggest that co-movements between food and financial prices increased in particular substantially concurrent with the financial crisis (2008), and there is only mixed evidence for greater market integration

before that time. That is, while previous changes in agricultural policies, new demand due to energy markets, and the financialization of food markets may have increased linkages and amplified price effects of the financial crisis and the recession, results do not indicate that they are the main explanatory factors for increased co-movements between food and financial prices after 2008.

Instead, increased co-movements could possibly be due to effects of the financial crisis and recession. For example, analyzing correlations between commodities and stocks over a longer sample starting in 1960, BHARDWAJ and DUNSBY (2012) find that they exhibit a business cycle component, with higher correlation in times of economic weakness. BUYUKSAHIN and ROBE (2011, 2012) argue that during the late-2000s recession as a time of great economic uncertainty, market participants in financial and commodity markets may shortened their horizon radically such that different market prices became concurrently more focused on short-term or less focused on long-term economic developments (without increasing direct integration).

Irrespective of the causes of the increased co-movements observed between food commodity and stock prices, if they are persistent, they may pose new challenges for agricultural market participants. The agro-food business may face changed price behavior and risks due to increased co-movements with financial prices. Implications for farmers may be that they have now to emphasize the general market development in their decisions. On the other hand, the presumed benefits of portfolio diversification in commodity markets (assuming different price behavior of stock and commodity markets) by index fund investors may be questionable.

Indeed, the analysis in this study comes with some limitations in their interpretations. It cannot provide causal evidence whether new agricultural policies, biofuel mandates, the emergence of financial futures market participants, or effects of the financial crisis are helpful in explaining greater co-movements between food commodity and financial markets. Still, available evidence tends to suggest that markets did not integrate concurrent with structural changes in agricultural markets, but that co-movements started to increase in particular during the financial stress of the Lehman crisis and the Great Recession. It is also in question whether these greater co-movements are long-run changes or only short-run phenomena. This will be the subject of future studies, as the time progresses and new evidence emerges.

5 Summary and Conclusion

This paper empirically analyzes the increased co-movements between food commodity and stock markets in the period of 1990 to 2012 and asks why and whether these markets have integrated with each other. Data series include the FAO Food Price Index and the MSCI World Stock Market Index as proxies for global food commodity and stock prices, respectively. Different co-movements of food and stock prices in subsample periods divided by the start of the financialization and other structural changes (2004), and the Lehman Brothers crisis (Sep. 2008) are highlighted and assessed by using estimations and tests on correlation, common return distributions, cointegration, and Granger-causality.

Empirical results show that in the period from Jan. 2004 to Dec. 2012 the price return correlation is significantly and substantially positive, both indices have more common price return distributions, do cointegrate and have therefore a long-term relationship, and finally, are characterized by bi-directional Granger-causality.

However, a further split of the subsample in a period before (Jan. 2004 – Aug. 2008) and after the demise of the Lehman Brothers and the Great Recession (Sep. 2008 – Dec. 2012) challenges these results and, in particular, a general market integration. Correlations between food and stock price returns did not increase before Sep. 2008, cointegration tests show mixed results in detecting long-run relationships in the two subsamples, and bi-directional Granger-causality does only hold for the time after Sep. 2008. In conclusion, while changes in agricultural policies, new demand due to energy markets, and the financialization of food markets

may have increased linkages since the early 2000s, results imply that co-movements started to increase sharply concurrent with and perhaps due to the financial stress of the Lehman crisis and the Great Recession.

This article has contributed to questions on greater market integration between aggregate food commodity and stock prices. Many more questions remain, however. Heightened co-movements between commodity and financial markets (and among commodities) call for more empirical and theoretical research. There is no unifying theory whether these increased co-movements are beneficial for market efficiency (e.g., better risk sharing across markets) or a distressing market distortion. Finally, if increased co-movements continue and markets have become more integrated, food and agricultural market participants may have to change the way they form their production and marketing decisions, attaching greater importance to changes of general financial and economic indices.

Acknowledgements

This study was started while the author was visiting the Department of Agricultural and Consumer Economics at the University of Illinois at Urbana-Champaign and he gratefully acknowledges their hospitality. He also thanks Michel Robe for useful discussions. The comments of an anonymous reviewer for presentation and attendants at the 2013 GEWISOLA conference have very much contributed in improving this article.

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