Energy Economics 42 (2014) 152–160

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneco

Causality and predictability in distribution: The ethanol–food price relation revisited

Andrea Bastianin [a,b,*], Marzio Galeotti [c,d], Matteo Manera [a,b]

[a] University of Milan-Bicocca, Milan, Italy
[b] Fondazione Eni Enrico Mattei, Milan, Italy
[c] University of Milan, Milan, Italy
[d] IEFE-Bocconi, Milan, Italy

ARTICLE INFO

Article history:
Received 7 July 2013
Received in revised form 20 December 2013
Accepted 21 December 2013
Available online 30 December 2013

JEL classification:
C22
C53
Q13
Q42
Q47

Keywords:
Biofuels
Ethanol
Field crops
Density forecasting
Granger causality
Quantiles

ABSTRACT

This paper examines the relationship between biofuels, field crops and cattle prices in the U.S. from a new perspective. We focus on predictability in distribution by asking whether ethanol returns can be used to forecast different parts of field crops and cattle returns distribution, or vice versa. Density forecasts are constructed using Conditional Autoregressive Expectile models estimated with Asymmetric Least Squares. Forecast evaluation relies on quantile-weighed scoring rules, which identify regions of the distribution of interest to the analyst. Results show that both the centre and the left tail of the ethanol returns distribution can be predicted by using field crops returns. On the contrary, there is no evidence that ethanol can be used to forecast any region of the field crops or cattle returns distributions.

1. Introduction

Large world food price increases and huge price volatilities are generally interpreted as problematic for many developing nations, which are compelled to face higher costs to feed large parts of their populations and have to manage the subsequent political instabilities. The level and volatility recently hit by the price of corn are often viewed as the effects of the massive development of biofuels, ethanol in particular (Mercer-Blackman et al., 2008; Mitchell, 2008; Parker, 2013; UNCTAD, 2008). According to the so-called "Food versus Fuel" claim food price inflation is primarily due to the ethanol production boom. This proposition relies on the implicit assumption that, if the amount of arable land is fixed over the short run, Granger causality runs from ethanol price to corn prices and from corn prices to the price of other corn-based products.

We examine short-run Granger causality relations for the whole distribution of returns on the price of ethanol, field crops and cattle in Nebraska from January 1987 through March 2012.

We focus on in-sample and out-of-sample short-run relations to answer the following questions: *a*) Can lagged returns on ethanol be used to forecast field crops or cattle returns? *b*) Can lagged returns on field crops predict returns on ethanol? *c*) Is the whole distribution of returns predictable? *d*) Or, is predictability limited to some parts of the distribution?

We provide a number of interesting results. In particular, ethanol has no predictive power for field crops and cattle. This finding holds: *i*) in-sample; *ii*) out-of-sample; *iii*) for the whole returns distribution. Moreover, ethanol can be forecasted using lagged returns on field crops. This result has been obtained: *iv*) in-sample; *v*) out-of-sample; *vi*) for the centre and the left tail of the distribution. Finally: *vii*) there is no evidence of predictability in the right tail of the distribution. While results *i*) and *iv*) are in line with most of the related literature (see Section 2), findings *ii*), *iii*), *v*), *vi*) and *vii*) represent new empirical evidence on the biofuel–food price relation.

Many studies have analysed the impact of biofuels on food prices, along two main lines of research (for a comprehensive survey see

* Corresponding author at: DEMS — Department of Economics, Management and Statistics, University of Milan-Bicocca, Via Bicocca degli Arcimboldi, 8, I-20126 Milan, Italy. Tel.: +39 02 64455879.
E-mail address: andrea.bastianin@unimib.it (A. Bastianin).

0140-9883/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.eneco.2013.12.014

Zilberman et al., 2013). The first relies on time-series econometrics to analyse the linkages between biofuel and food prices (Serra and Zilberman, 2013 for a survey). The second, by means of simulation- and theory-based methods, deals with the impact of the introduction of biofuels on food prices (Kretschmer and Peterson, 2010). Time-series studies show that the price of biofuels is positively correlated with the prices of food and fuels, but that the reverse correlation is very weak.

Our paper can be placed in the first strand of the literature. We analyse short-run Granger causality linkages between returns on ethanol, field crops and cattle in the U.S. by considering their whole distribution, rather than focusing on few specific moments such as the mean or the variance. Compared to previous studies about the ethanol–food relation, our approach is innovative in many respects.

First, we test for Granger causality both in-sample and out-of-sample. On the contrary, a common feature to most of the previous empirical literature is to analyse the relationship between biofuel prices and agricultural prices, using only in-sample Granger causality tests, while nothing is said about the out-of-sample performance of the estimated models.

Second, many studies which are surveyed in Section 2 show evidence of in-sample Granger causality running from field crops prices to ethanol prices, but not vice versa. These findings are entirely based on empirical models for the first or second moments of the variables of interest, which ignore the issue of predictability in other parts of the distribution.[1] Since returns are generally non-normal, their distribution can be hardly summarized by the mean. As a consequence, even if there is no evidence of Granger causality in mean, we might still find evidence of predictability in higher moments (see Cenesizoglu and Timmermann, 2008; Granger and Pesaran, 2000; Pesaran and Skouras, 2002 for theoretical motivations of the use of density forecasts).

We extend the previous analyses by using the Asymmetric Least Squares (ALS) estimator of Newey and Powell (1987) to produce forecasts for the whole distributions of returns, as well as for specific areas of the distributions including the first moment.

Third, our density forecasts evaluation, which relies on the quantile scoring rule of Gneiting and Ranjan (2011), is of interest for a variety of forecasts users. A scoring rule is a loss function for density forecasts, which associates a lower score to a better forecast. The quantile scoring rule assigns more weight to the part of distribution (either centre, tails, right or left tail) which is of interest for a forecasts user. For instance, the tails of the distribution are usually the main focus of risk managers (e.g. Value-at-Risk), while policy makers, who often exploit confidence intervals around point forecasts to assess the effects of potential economic interventions, are generally more interested in the centre of the distribution. For example, the Energy Information Administration has been publishing since 2009 confidence intervals for crude oil and natural gas futures prices in its Short Term Energy Outlook.

Fourth, we include cattle price in the analysis to assess whether biofuel induced price variations, if any, are transmitted along the food market chain. Interestingly, although Serra and Zilberman (2013) identify this as a topic that should be high on the biofuels research agenda, in their survey of the econometric literature there are only three studies that include meat (Balcombe, 2011; Esmaeili and Shokoohi, 2010; Nazlioglu and Soytas, 2011).

The rest of the paper is organized as follows. In Section 2 we briefly review the relevant literature. Section 3 illustrates the data, while in Section 4 we detail our modelling approach. Section 5 contains the empirical results, and Section 6 concludes.

2. Related literature

The relation between ethanol and field crops prices has been discussed in the empirical literature from two main perspectives: the assessment of the presence of long-run relationships between fuel and agricultural prices, and the investigation of existence, as well as the direction, of their Granger causality links. Given the approach followed in our paper, in this section we concentrate on contributions pertaining to the second strand of research, while we address the interested reader to Serra and Zilberman (2013) and Nazlioglu et al. (2013) for exhaustive surveys of the time series literature.

The studies testing the presence and the direction of the relationship between fuel and agricultural prices deal with a variety of empirical methods applied to weekly or monthly spot and futures prices: structural vs. reduced form models, linear vs. non-linear models, statistical vs. econometric methods. In general, this literature has tackled the issue of Granger causality only with in-sample analyses. The majority of the contributions find evidence of Granger causality running from the prices of field crops, corn in particular, to the price of ethanol. This result is robust to the method of analysis, to the sampling frequency and the type of price.

Ubilava and Holt (2010) is the only study that focuses on out-of-sample predictability. Using weekly averages of U.S. futures prices for the period October 2006–June 2009 and a non-linear time series model for corn, the authors conclude that the inclusion of energy prices (oil and ethanol) in the model does not improve corn price forecasts.[2]

Kristoufek et al. (2012b, 2013a) rely on weekly price data for the period between November 2003 and February 2011 to analyse relations between biofuels (U.S. ethanol and German biodiesel), their production factors and fossil fuels. The authors show that in the U.S. short-term and medium-term Granger causality linkages run from corn to ethanol, but not vice versa.

These findings are consistent with those of Vacha et al. (2013) who use wavelet coherence analysis to study time and frequency dependent correlations between biofuels, agricultural commodities and fossil fuels. The results show that the price of production factors (U.S. corn and German diesel) lead the price of biofuels (ethanol and biodiesel), but not vice versa.

Zhang et al. (2009) estimate a vector error correction model (VECM) on U.S. weekly data for corn, oil, gasoline, ethanol, and soybean prices over the period March 1989 through December 2007. In the pre-ethanol boom period, 1989–1999, the authors find evidence of Granger causality running from the price of corn to ethanol price, whereas a causality reversal occurs in the boom period, 2000–2007.

Zhang et al. (2007) test whether the limit-price hypothesis can explain pricing patterns in the U.S. ethanol–fuel market by means of a structural vector autoregression (SVAR) model estimated on monthly data from April 1998 to July 2005. The variables included in their SVAR model are corn, ethanol, MTBE (i.e. methyl–tertiarybutyl ether), gasoline prices and MTBE and ethanol quantities. The results indicate that corn prices Granger cause the price of ethanol, but not vice versa.

Zhang et al. (2010) use monthly price data for corn, rice, soybeans, sugar, wheat, ethanol, gasoline, and oil from March 1989 through July 2008 to analyse short and long-run impacts of fuels on agricultural commodities in the U.S. The authors fail to find any evidence of long-run and short-run Granger causality between fuel and agricultural commodity prices.

Saghaian (2010) analyses pairwise Granger-causality relations by relying on monthly data on oil, ethanol, corn, soybean, and wheat prices for the period January 1996–December 2008. The results point to the existence of unidirectional relationships running from soybeans and wheat price series to ethanol, and hence indicate that ethanol does not Granger cause soybeans or wheat price series. Moreover, there seems to be a feedback relationship between corn and ethanol prices. However, the author shows that the evidence of causality is stronger from corn price to the price of ethanol than vice versa; in fact, causality

[1] A notable exception is Nazlioglu (2011), who studies non-linear Granger causality linkages between oil and agricultural commodity prices.

[2] These results are consistent with those in Bastianin et al. (2013).