Resources Policy 50 (2016) 34–48

Contents lists available at ScienceDirect

Resources Policy

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

Explaining commodity prices through asymmetric oil shocks: Evidence from nonlinear models ☆

Shuddhasattwa Rafiq [a], Harry Bloch [b,*]

[a] School of Business, Deakin University, Burwood, Victoria, Australia
[b] School of Economics and Finance, Curtin University, Perth, Western Australia, Australia

ARTICLE INFO

Article history:
Received 6 April 2016
Received in revised form
16 August 2016
Accepted 17 August 2016

Keywords:
Oil prices
commodity prices
symmetry
asymmetry
price volatility

ABSTRACT

Linkages between oil and 25 other commodity prices are examined using annual data for 1900 to 2011. We identify long-run relationships using both linear and nonlinear ARDL models and capture short-run causalities through asymmetric Granger causality tests. Nonlinearity can't be rejected for the relationship between oil and most other commodity prices. Long-run positive impacts of oil price increases are found for 20 commodities and short-run negative impacts for 13 commodity prices. Oil prices don't have much impact on beverage or cereal prices once endogeneity is accounted for, but they have substantial impact on metal prices.

1. Introduction

With sharply rising commodity prices at the beginning of the 21st century and the subsequent dramatic collapse, there has been a surge of interest in understanding the determinants of commodity price movements. Explanations for the observed commodity price increases include increased demand for commodities from emerging markets, quantitative easing in monetary policy and speculative commodity demands in stock markets (Frankel and Rose, 2010). Explanations of the subsequent price collapse include excessive expansion of production capacity for oil and key minerals, slowing Chinese economic growth and stagnation in the advanced developed economies.

Linkages between oil and other commodity prices are part of the overall dynamics of resource prices. They are of particular importance to resource companies and investors in designing portfolios of assets for the diversification risk. Understanding the linkages is also important in macroeconomic forecasting for countries, such as Australia, with heavy exposure to commodities in terms of exports or countries, such as Japan, with heavy exposure to commodities in terms of imports. Some of the poorest countries are particularly exposed to fluctuations in prices of their commodity exports, so understanding the linkages of their main exports to oil prices is particularly helpful in designing their development and macroeconomic policies (see Nissanke and Mavrotas (2010)).

Most studies investigating the linkages between oil and commodity (mainly food, other agriculture, metals and energy) prices are undertaken within linear frameworks, assuming symmetry of the impact of oil price shocks, *i.e.* they assume that the impact of a positive price shock is identical, but opposite, to the impact of a negative shock. However, this assumption of linearity or symmetry is too restrictive, as in many cases there is potentially an asymmetric structure regarding the magnitude and direction of impacts. Asymmetries can reflect institutional arrangements, such as price cap regulation, and market structure, such marketing cartels, or the way production capacity reacts differently to positive and negative changes in current market conditions. In the last two decades, methods have been developed in the econometrics literature for dealing with nonlinearity (Balke and Fomby, 1997; Hansen and Seo, 2002; Psaradakis et al., 2004; and Kapetanios et al., 2006, among others). We utilize these methods to add a further dimension to the empirical literature examining the impact of oil prices on the prices of other commodities.

Imposition of the assumption of symmetry when in fact there are asymmetric responses to shocks in the oil price series can lead to bias in estimates of the impact of these shocks. Also, treating the effects of shocks as symmetric implies that volatility in oil prices has no impact on the net movement in the prices of other commodities. Equal positive and negative shocks in oil prices would have a net negative (positive) impact on the price of a commodity if the elasticity of the

☆We thank two referees for helpful comments on earlier drafts. All remaining errors or omissions are the responsibility of the authors.
* Corresponding author.
E-mail addresses: Srafiq@deakin.edu.au (S. Rafiq), h.bloch@curtin.edu.au (H. Bloch).

http://dx.doi.org/10.1016/j.resourpol.2016.08.005
0301-4207/

response to the negative shock were larger (smaller) than the elasticity of the of response to a positive shock. This can provide a possible channel for oil price volatility having negative impacts on the broader economy as found in Rafiq et al. (2009).

We also diverge from much of the earlier research linking oil and commodity prices by estimating both long-run cointegration and dynamic interactions between oil and commodity prices by implementing two very recent nonlinear asymmetric estimation techniques, namely, the nonlinear ARDL (Autoregressive Distributed Lag) model due to Shin et al. (2014) and the asymmetric causality test of Hatemi-J (2012). With the application of these methods, we make four contributions to the literature. First, we estimate both long-run impacts and dynamic causalities running from oil prices to 25 other commodity prices. Second, these impacts and causalities are investigated through both linear and nonlinear frameworks. Third, we use a long time series of annual data from 1900 to 2011 for the purpose of capturing long-lasting relationships. Finally, we include a wide range of commodities to identify the variety of causal relationships, which can contribute to formulating diversification strategies for investors and policymakers.

The rest of this paper is organized as follows. Section 2 offers a brief overview of the time-series data for oil and other commodity prices and reviews the existing literature. This is followed by discussion of analytical models in Section 3. A description of data sources and discussion of the empirical results are presented on Section 4, while Section 5 discusses policy implications that emerge from the results and concludes the paper.

2. Linking oil and commodity prices: historical, theoretical and empirical perspectives

In an anatomy of the commodity prices, Radetzki (2006) depicts three periods of sharp commodity price increases in the post-WW II period. The first boom is from 1950 to 1953 and is directly linked with the Korean War through increased insecurity regarding industrial material supply, which prompted a widespread build-up of strategic inventories. The second boom of 1970s is identified with three events, a substantially strong macroeconomic performance during 1972 and 1973, deficiency in inventories for both food and agriculture raw materials due to two consecutive years of widespread crop failures, and with oil price shocks. According to Radetzki (2006), the third boom from 2003 is identified with demand shocks in commodity markets, especially for oil and copper.

For the period prior to WW II, Brémond et al. (2013) indicate that sharp commodity price rises following the Great Depression of 1930s reflected recovery in commodity markets after the sharp decline during 1929–1932. Further instability in commodity prices in the period from 1939 to 1947 is attributable to the effects of international conflict and its aftermath. The historical pattern of individual commodity prices and their relationship with oil prices over the full course of the Twentieth Century is depicted in the graphical representations of prices in Appendix Fig. A1.

Mitchell (2008) identifies two major channels through which oil prices have positive linkages to other commodity prices. One is the increase in production cost and the second is an increase in transport cost. These two studies conclude that the combined increase in production and transport costs for major US food commodities, like corn, soybeans and wheat, account for 20–30% of the increase in the US export prices of these commodities. Offsetting these positive cost-push relationships, Gohin and Chantret (2010) identify a negative real-income effect between world commodity (food) and energy (oil) prices in terms of a reduction in consumer real income following an oil price increase eventually puts downward pressure on prices of other commodities. Of course, real income shocks from sources other than oil price changes may have common demand influences on prices of oil and other commodities.

Following the seminal work of Pindyck and Rotemberg (1990), estimation of the dynamic linkages between oil and commodity prices has been mostly undertaken within linear cointegration or causality frameworks. The majority of the studies focus on identifying the impact of oil prices on food, other agricultural, metal and other energy commodity prices. The results tend to vary according to the group of commodities studied, the sample period, data frequency and estimation method.

Divergent results regarding the co-movement of oil and other commodity prices are particularly evident for agricultural commodities. For example, using Johansen cointegration and Granger causality techniques, Abdel and Arshad (2009) and Saghaian (2010) find long-run cointegrating relationships between oil and food prices, while Zhang et al. (2010) and Baumeister and Kilian (2014) fail to find any. Using a linear ARDL cointegration approach, Chen et al. (2010) find significant linkages between oil and grain prices, whereas Sari et al. (2011) only demonstrate some weak causality.

Ambiguity in the relationship between oil and agricultural commodity prices is also found in studies using non-linear estimation. Peri and Baldi (2010) employ the Hansen and Seo (2002) threshold-based cointegration approach and find significant cointegration between rapeseed and diesel prices, while sunflower and soybean oil prices are found to have no cointegrating relation with diesel. Natanelov et al. (2011) use similar threshold analysis to investigate the price relationship of future contracts of crude oil, gold and eight food commodities and conclude that only cocoa, wheat and gold move together with crude oil in the long run over the entire sample period.

The relationship between oil and agricultural commodity prices is generally clearer when allowance is made for structural breaks. After identifying a structural break around 2008 financial crisis, Pala (2013) finds strong linkages between oil and food prices. Also, Nazlioglu (2011) and Nazlioglu and Soytas (2012) use panel data cointegration and Granger causality tests to find positive relationships between oil and agricultural prices. Finally, Gozgor and Kablamaci (2014); utilize second generation panel data estimation techniques under cross-sectional dependence and find statistically significant and positive interactions between oil and agricultural commodity prices.

Studies investigating the linkages between oil and other energy prices also tend to find significant positive relationships. Using Johansen and Breitung's cointegration tests, Brown and Yücel (2006) find significant positive long-term cointegration between oil and natural gas prices. Hartley et al. (2008) reach the same conclusion indirectly using the price of residual fuel oil, while Asche et al. (2006), Panagiotidis and Rutledge (2007) and Chevelliar and Ielpo (2013) find significant positive cointegrating relationships between oil and natural gas prices.

A recent study by Gupta et al. (2014) employs the same long-run database as is used in our study. They perform time-varying causality tests to identify the linkages between oil and a wide range of commodity prices over more than 100 years, finding that oil price causes banana, beef, copper, cotton, lead, rubber, timber, tin, tobacco and wool prices. However, the analysis is only for short-run causality.

From the survey of the literature several conclusions are in order. First, most of the studies are performed with linear techniques and focus on food, agricultural and energy commodities. Second, with respect to non-linear studies, all of them employ long-run cointegration analysis, while only a very few identify short-term causal relationships. Third, none of the studies draw any conclusion regarding asymmetric relationships between oil and commodity prices.

In this paper we expand the range of methods employed in