Resource and Energy Economics 35 (2013) 599–617

Contents lists available at ScienceDirect

Resource and Energy Economics

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

The economics of oil, biofuel and food commodities☆

Eric Bahel[a,*], Walid Marrouch[b], Gérard Gaudet[c]

[a] Department of Economics, Virginia Tech, 3126 Pamplin Hall (0316), Blacksburg, VA 24061, United States
[b] Lebanese American University, Lebanon and CIRANO, Canada
[c] Département de sciences économiques and CIREQ, Université de Montréal, Canada

ARTICLE INFO

Article history:
Received 19 May 2011
Received in revised form 5 February 2013
Accepted 6 February 2013
Available online 14 March 2013

JEL classification:
Q30
Q24
Q42

Keywords:
Biofuel
Oil depletion
Demand growth
Energy price
Food price

ABSTRACT

We study the effects on the food price of introducing biofuels as a substitute for fossil fuel in the energy market. Energy is supplied by a price-leading oil cartel and a competitive fringe of farmers producing biofuel. Biofuel production shares a finite land resource with food production. A positive relationship results between energy and food prices. We establish that the equilibrium price of food will be growing as long as the oil stock is being depleted, and beyond if demand is growing. An analysis of the effects of the productivity of land use in either the food or the biofuel sectors is carried out. It is shown that, with a highly inelastic demand for food, an increase in the productivity of land in agriculture will decrease the price of food in the short-run, only to increase it in the long-run as the stock of fossil fuel is depleted.

1. Introduction

The recent food crisis has become a major concern for world leaders. In June 2008, the World Food Summit organized by the United Nations that took place in Rome raised many questions about the

☆ Bahel and Marrouch are the main coauthors of this paper; the project originated from them, as did the modeling of the problem. At their request, Professor Gaudet agreed be added as a coauthor, on the condition that his name would not appear in the usual alphabetical order. This is to acknowledge the fact that his advice and assistance throughout the research phase, as well as during the writing of the paper, were crucial and went well beyond the usual comments from a colleague.

* Corresponding author. Tel.: +1 540 231 4923; fax: +1 540 231 5097.
E-mail address: erbahel@vt.edu (E. Bahel).

0928-7655/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.reseneeco.2013.02.005

causes of this crisis and what to do about it. Indeed, since the year 2000, major food crop prices have increased for the first time since the 1970s. The prices of corn, rice, wheat as well as other crops reached record highs. According to a recent article by the Economist magazine,[1] food accounts in Botswana and South Africa for a fifth of the consumer price index; in Sri Lanka and Bangladesh it accounts for two-thirds. This might explain the violent clashes that took place in several developing countries (Haiti, Cameroon and Egypt, among others) in the wake of the sharp increase in crop prices that occurred in 2007 and 2008.

Against this backdrop, a number of explanations for this crisis have been proposed. First, a line of argument attributes the increase in major crop prices to the rising world demand for food, which has not been followed by adequate investments in the agricultural sector. The proponents of this view, namely the UN secretary general, declared that global food output must increase by 50% by 2030 in order to maintain 'food security'. However, such an argument suffers from a drawback. While the lack of investments in agriculture has been a long-term structural problem ever since the end of the 'first green revolution' of the 1960s and 70s, it is the case that the recent rise in crop prices has been sharp and dramatic. An alternative view considers that the recent development of the biofuel industry has a lot to do with the food crisis. Advocates of this view include a number of specialized NGOs and renowned international research organizations, like the International Food Policy Research Institute (IFPRI). According to the IFPRI, biofuels account for up to 30% of the increase in the price of agricultural commodities.

From 1999 until the summer of 2008, both global energy demand and fossil fuels prices have been steadily rising.[2] This has caused pressure for the development of biofuels as an alternative source of energy.[3] This was not the case during the 1990s, when the fossil fuel price was too low to allow for the economic viability of this renewable resource. This increase in the demand for biofuels has generated a 'crowding-out effect' in the agricultural sector. Many argue that scarce agricultural resources are being diverted away from food production towards the production of biofuels, which results in a reduction in global crop supplies.

The fact that the prices of oil and food commodities have both tumbled during a period of time following the last quarter of 2008 also suggests that, during recent years, both prices have become highly positively correlated. In this paper we investigate, within a reasonably tractable model, the mechanisms through which these two markets are linked and how the development of the biofuel industry has affected the correlation between energy and food prices. The model also allows us to look at the possible impacts on food and energy prices of measures to increase land productivity in either food or biofuel production.

Since the questions arising from the introduction of biofuels are relatively recent, the economic literature on this subject is limited. Moreover, as pointed out by Rajagopal and Zilberman (2007) in a World Bank policy survey, "the environmental literature is dominated by a discussion of net carbon offset and net energy gain, while indicators relating to impact on human health, soil quality, biodiversity, water depletion, etc., have received much less attention".[4] Chakravorty et al. (2009) point out that most of the literature focuses on life cycle assessment of biofuels, with the main conclusion being that they are not carbon neutral. There is also a small literature on 'food versus fuel' where the price of oil is exogenous.[5] For instance, Hochman et al. (2008) study the crowding-out effect of biofuels on the agricultural sector. They propose a two-country general equilibrium trade model with

[1] From The Economist print edition, June 5, 2008, p. 70.

[2] China and India's staggering growth rates account for a large part of that rise in prices.

[3] Not to mention environmental lobbying and political pressures that have led to an additional regulation induced demand. For instance, in 2010, the government of Canada imposed a mandatory 5% biofuel content in each liter of gasoline sold in the local market.

[4] See Rajagopal and Zilberman (2007), p. 2. They also point out that serious concerns about the carbon benefits of current biofuels can be raised, namely the fact that biofuels consume a significant amount of energy that is derived from fossil fuels. See as well (Giampietro et al., 1997; Lal, 2004; Pimentel and Patzek, 2005; Farrell et al., 2006). For an excellent analysis of the technical, economic and policy issues raised by the development of bioenergy in general and biofuels in particular, see Sinn (2012, chap. 3).

[5] Chakravorty et al. (2009) conclude that "most of them focus on the economics of biofuels supply and in particular address the issue of government policy and how that can affect biofuels production. A smaller sample of the models explicitly considers