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How biofuels policies affect the level of grains and oilseed prices: Theory, models and evidence

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ABSTRACT

This paper synthesizes and critiques three approaches to the analysis of the recent booms in food grains and oilseeds commodity prices: the 'perfect storm'; statistical time-series models; and models explaining how biofuels linked the fuel and agricultural markets, thus giving rise to a new era of commodity prices. We find that biofuel policies and corn markets were a key instigator of the sharp food commodities price rise in 2006 onwards. We argue that the price increase in the corn market had a spillover effect on the wheat market and caused policy responses and speculation, including hoarding, which caused rice prices to spike. We conclude that because of the sudden increase in commodity prices, the developing countries were unable to benefit from the higher prices even though they have comparative advantage in biofuels production.

1. Introduction

The literature on the role of biofuels policies on the level of grains and oilseeds prices takes very different approaches and reaches a wide range of conclusions. The purpose of this paper is to synthesize and critique these approaches and put the results in perspective by highlighting the importance of biofuels policies.

The most popular view is that the food grains price boom from 2006 on was due to a perfect storm of many factors with biofuels being merely one of them,[1] and that biofuel policies account for only a fraction of the biofuels' effect.[2] The following assessments are, perhaps, most revealing about this literature:

> *"The factors driving current food price increases are complex. We make no attempt to calculate what percentage of price changes are attributable to the many disparate causes, and, indeed, think it is impossible to do so…"* Abbott et al. (2008).

> *"Wisely, it does not attempt to apportion the total rise among the different drivers. So, given this complex maze of factors, can we say how much was due to [this, that and the other thing]…The answer is absolutely no…one cannot, with any precision, partition the effects."* Abbott et al. (2009) in Timmer (2008).

> *"Many possible causes have been identified, but their relative importance is uncertain…the result of a complex set of interacting factors rather than any single factor."* Headey and Fan (2010).

This literature argues many things happened coincidently, and it is impossible to attribute the role of biofuels, let alone of biofuels policy.

Another burgeoning literature analyzes the dynamic linkages between crop, biofuel and energy prices using statistical time-series models to determine the influence of higher energy prices on crop prices (see Zilberman et al., 2012; Serra, 2012 for surveys). But this is an imperfect test of biofuels impact and the results of this econometric approach on the role of biofuel and energy prices on crop prices are inconclusive. Regardless, this approach would provide little economic insight as to how specific policies impacted prices because it has so far been unable to control for the switch in regimes between a tax credit/tax exemption and a mandate (crop and oil prices are negatively related when a mandate is binding but positively related if crop prices linked directly to oil through a tax credit) or when prices are determined on world markets.[3]

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[1] See for example Abbott et al. (2008, 2009), Baffes and Haniotis (2010), Carter et al. (2011), FAO (2008), Gilbert (2010), Headey and Fan (2010), Headey (2011), McCalla (2009), OECD (2006), Roberts and Schlenker (2010), Stoeckel (2008) and Timmer (2008). These papers analyze the food grain commodity price increases through the lens of traditional economic analysis such as the effects of exchange rates, macroeconomic policies and shocks, speculation, commodity supply/demand trends and shocks, and the behavior of stockholders. See Table 1 in both Trostle (2008) and de Gorter and Drabik (2012b) for a summary of all the factors considered by the "perfect storm" literature and Trostle et al. (2011) for an update.

[2] Abbott et al. (2009) argue biofuels account for one-quarter of the total price increase in 2008, and biofuel policy only a quarter of that. Babcock and Fabiosa Jacinto (2011) argue that only 8% of the corn price increase between 2006 and 2009 was due to ethanol subsidies. They attribute the rest to market forces and other factors, such as droughts, floods, a severe US recession, and two general commodity price surges.

[3] It should also be noted that ethanol prices can float above and away from gasoline (oil) prices when mandates are binding for periods of time, temporarily de-linking corn and oil prices.

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The data in these reduced form time-series analyses begin well before 2006 and many studies end in either 2007 or 2008.[4] But Rausser and de Gorter (2012) show that the crop–biofuel price link was completely visible only in September 2007, when ethanol and corn prices continually move in the same direction. As a result, the time series analyses so far have not identified key periods in the process of biofuels policies linking corn (as well as oilseed and other grains) prices to energy prices.

A third strand of literature argues that biofuels policies play a much bigger role, using specialized models that take a close look at what biofuel policy is binding and the specific relations between the gasoline (diesel), biofuel and feedstock or crop prices domestically and internationally (Collins, 2008; de Gorter, 2008; de Gorter and Just, 2010b, 2012a,b; Cui et al., 2011).[5] This literature focuses on the new and unique role of energy and environmental policies that created a direct link between biofuel and crop prices. Biofuels policies are varied: biofuel consumption mandates; biofuel consumption subsidies (e.g., tax exemptions); production subsidies for both biofuels and feedstocks; environmental regulations; import tariffs and tariff-rate quotas; and binary sustainability standards requiring biofuels to reduce greenhouse gases relative to gasoline. Each of these biofuel policy categories has its unique impact on grain prices—some long run, some fleeting, and some large effects, especially in combination with other biofuel or agricultural policies within the country or across countries.[6]

Of course, many papers do a combination of approaches identified. For example, some studies emphasize the market dynamics of stock-holding and the role of a shift in demand for corn (and soybeans/rapeseeds) due to biofuels, while using methodologies in each of the literatures above (Timmer, 2008; Abbott et al., 2009; Hochman et al., 2011; Wright, 2011; Carter et al., 2012; Byrd, 2012).[7] Meanwhile, there is a literature that relies on qualitative analysis presented like, for example, Mitchell (2008), Timmer (2010), Tyner (2010), Rausser and de Gorter (2012) and Abbott (2012a). Some of these studies find that biofuels policy and their many interactions within and across countries play a major role in determining crop prices.

The remainder of this paper is outlined as follows. The next section outlines the key biofuels policies and summarizes briefly how each has affected grains and oilseed prices. Section 3 takes a close look at the actual development of grains prices and puts forth a proposition that biofuels policies were key (although allowing for the possibility of other factors playing a key role). The final section concludes and draws some implications for food security in developing countries.

2. Biofuel policies

Because the focus of this paper is the role of biofuels policies, it is instructive to summarize those that impacted the market. These policies include:

- Biofuel consumption subsidies, such as the US federal tax credit (implemented in 1978) that expired at the end of 2011, or tax exemptions at the fuel pump in most other countries (e.g. the European Union). The federal tax credit provides a per gallon subsidy to firms that blend biofuels with gasoline for end consumption and results in a higher biofuel price.
- Formal biofuel consumption blend mandates, such as that implemented by the US Energy Independence and Security Act of 2007. A blend mandate is a requirement that, at minimum, a certain percentage of fuel consumed be biofuels.
- Informal mandates for ethanol in the form of environmental regulations, for example, US environmental policy on air pollution and the ban on the use of the fuel additive, methyl tertiary butyl ether (MTBE). MTBE, although a low cost and close substitute to ethanol as a fuel oxygenator, pollutes water supplies.
- Production subsidies, for both biofuels and feedstocks (e.g., for corn).
- Import tariffs and tariff-rate quotas, such as the US 54 cent a gallon ethanol import tariff (implemented in 1980) that expired at the end of 2011.
- Binary 0,1 sustainability standards, such as the standard according to which one (energy-equivalent) gallon of corn–ethanol is required to reduce greenhouse-gas emissions by 20% relative to the gallon of gasoline it is assumed to replace or it cannot be counted as a biofuel in the context of other policies.

Each of these biofuel policy categories had an impact on food grain commodity prices. Some of them have had long run effects that continue to be observed. Others had short term impacts that may have been fleeting. Some of the policies (e.g., mandate) can have extremely large effects, while some (e.g., ethanol production subsidy), in unique combinations with other policies, can reverse the direction of the price effects relative to what would be normally expected. The magnitude and direction of these effects depend not only on the interactions with biofuel policies in the rest of the world, but also on the regime or situation determining the world price of ethanol and biodiesel. Some policies (e.g., blender's tax credit) only impact prices under certain circumstances, and thus have different effects in some time periods than in others. The full breadth of these interactions is spelled out in de Gorter and Just (2010a) with updated evidence provided in de Gorter and Drabik (2012a, b), Rausser (2012) and Abbott (2012a).

But the key takeaways are: (a) the impact of a change in the ethanol price on corn is very large—a one cent per gallon increase in ethanol prices results in a 4 cent per bushel increase in the price of corn, and (b) the ethanol price premium due to any of the policies listed earlier is very high—where the effects on corn prices are tempered somewhat by 'water' representing the distance by which the intercept of the ethanol supply curve is above the free market ethanol price. Drabik, (2011) provides the most recent theoretical and empirical analysis of these issues. Similarly, a one cent per gallon increase in the biodiesel price results in an $11 per metric tonne increase in the soybean oil price.

A tax credit (or exemption) with a binding mandate does the opposite of what would be expected—it subsidizes fuel consumption, most of which is gasoline (diesel). But if market price of the biofuel is determined outside the country, then a biofuel consumption subsidy in the form of a tax credit (as was the case in the United States) subsidizes the export of the biofuel (this does not happen if there were a tax exemption instead).[8]

[4] Balcombe and Rapsomanikis (2008) fail to recognize that Brazil's gasoline price is disconnected from world oil prices.

[5] The origins of this approach are found in de Gorter and Just (2008, 2009a, b) and extended, generalized and empirically verified in Drabik, (2011). See also Cui et al. (2011), Khanna et al. (2011), Chakravorty et al. (2010) and Lapan and Moschini (2012). de Gorter and Just (2010a) survey this literature up until the end of 2009.

[6] The latter literature argues 'water' exists in the price premium due to biofuels policies, implying no biofuels would be produced in a free market situation (see especially de Gorter and Just, 2008 and Drabik, 2011 for details).

[7] Others, like Dawe (2009), argue low stocks did not have a major impact on rice prices, indicating other factors were at play, such as developing country policy responses, instigated by broader forces like biofuels.

[8] US biodiesel prices up to mid-2008 and US ethanol prices after early 2010 were determined on world markets, where tax credits increased the domestic market price of biofuel (de Gorter et al. 2011, 2012a; de Gorter and Drabik, 2012a; Abbott, 2012a).