**Biofuel-Food Market Interactions: A Review of Modeling Approaches and Findings**

**Supplementary Material**

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Below, we provide more detail on each of the study reviewed in the main paper.

**1. Biofuel-Food Market Analyses with Structural Economic Models**

Hochman *et al.* [1] used a multi-market PE model to examine the food market implications of biofuels and the role of crop inventories. The multi-market analysis accounted for vertical (interactions along a crop’s supply chain) and horizontal (competition for inputs and markets among different crops). The numerical model includes four crops: corn, soybeans, rice and wheat, and three regions: US, China and rest of the world (ROW). Equations include crop supply, biofuel demand, storage demand and market clearing conditions. Simulations were performed to evaluate shocks to biofuel demand, food/feed demand due to income growth, exchange rate and energy prices, with and without crop inventories, over the period from 2002 to 2007. Shocks were implemented by setting the value of the shocked variable to its value in the base year (2001). Results showed that, relative to 2001 and without inventories, corn prices rose by less than 10% in 2007 under the biofuel shock, by 20% under the demand shock, by 9% under the exchange rate shock, and by 3%–4% under the energy price shock. Soybeans price responses were found to be similar to those for corn under all four shocks, except for the biofuel demand shock where the increase in price was only about half that for corn in 2007. For rice and wheat the demand shock simulations produced the largest increases in prices, but supply and exchange rate shocks also led to increases in prices, whereas the biofuel shock did not produce any price changes. Inventory was found to reduce the change in commodity prices from these shocks by as much as one-third. An alternative simulation of the biofuel and income growth shocks with lower supply and demand elasticities led to additional commodity price increases of up to 5%.

Ciaian and Kancs [2] extended the theoretical PE framework of Gardner [3] to account for the indirect linkages between food and fuel markets, and the direct competition between biofuels and food in the crop market. The model includes a single world market and two agricultural commodities, and accounted for fuel and other agricultural inputs. One commodity can be used for food and/or biofuels, and the other only for food. Biofuels and by-products were produced from biomass at constant yields and processing costs, and biofuel was assumed to be a perfect substitute for fossil fuels. Numerical simulations were calibrated to world agricultural and biofuel market data for 2007. According to this data, biofuels were produced using 1.6% of the world arable land, and the share of agriculture in global fuel consumption, as well as the share of biomass used for biofuels, was about 3.3% in 2007. The model was used to examine the price effects of fuel and agricultural shocks on prices, with and without biofuels. Simulations were also performed over a range of values for food and biomass demand elasticities, fuel demand elasticities for agriculture and non-agriculture uses, fossil supply elasticities, and land supply elasticities. The results were summarized as price transmission elasticities, defined as the ratio of percentage changes in the price of other commodities to the percentage change in the price of the shocked commodity. The price transmission elasticities of a non-agricultural fuel demand shock to food and biomass were positive, without and with biofuels. However, the transmission elasticities with biofuels were almost three times (0.8 to 1.3) those without biofuels (0.3 to 0.4). These estimates increase with the share of fuel input in agriculture and decrease with food demand and land supply elasticities. Price transmission elasticities from agricultural productivity shocks to the fuel market were found to be small, less than 0.1, without and with biofuels, but those with biofuel production were again about double those without biofuels.

Chakravorty *et al.* [4] specified a model which accounted for the scarcity of oil and land. The numerical model included two food commodities (cereal and meat) and fuel. Land was classified into three quality types: low, medium and high. Fuel was produced as a mix of gasoline and biofuels using constant elasticity of substitution functions. The world economy was divided into five regions based on income levels: US, European Union, Other High Income, Medium Income and Low Income. Demand functions for food and fuel were based on a Cobb-Douglas function, with population and income as exogenous drivers. Land use was based on the interaction between the shadow price on the land constraint and the cost of conversion. Simulations with the model, which was calibrated to 2005 and run in 5-year time steps from 2005 to 2205, found that the US and EU mandates have a small effect on food prices. Food prices rose by 13% in 2025 due to changes in population and consumption alone, and by an additional 5% when biofuel mandates were added. Thus, biofuels contributed only about a quarter of the total food price increase. The biofuel price rose from $3.1/gallon to $3.3/gallon, and the oil price decreased from $121/barrel to $119/barrel without and with the mandates in 2025, respectively. However, US food production and exports declined sharply by 25% and 75%, respectively, due to the diversion of 41 million hectares of land from food to biofuels production when the total size of the cropland was held constant in the US. The large diversion of land in the US was made up by expansion in the rest of the world. When mandates for second generation biofuels are removed, keeping total biofuel requirements the same, its production decreased from 21 billion gallons to 11 billion gallons, and the increase in food prices jumped from 18% to 30% in 2025. This implies an elasticity of the food price with respect to the change in corn ethanol production of about 0.18.

Results of simulations with full-scale PE and GE models also vary significantly. Zhang *et al.* [5] reviewed the agricultural impacts of biofuel growth from four PE and five GE models. The PE models projected increases of between 14% and 53% in global and US corn prices, with corresponding increases of between 2.9% and 18.9% in corn production. Similarly, sugarcane production was estimated to increase by between 1% and 7%, while prices increased by between 3.4% and 37%. For vegetable oil, the increase in price was 0.4% to 15%, and the increase in production was between 0.1% and 2.6%. The GE models estimated increases in corn price and production of 5% to 45%, and 4% to 53%, respectively. For oilseeds these were 6% to 63% increase in price and 4% to 95% increase in production in the EU. Sugarcane price in Brazil was estimated to increase by 2% to 84%, with production increases of 4% to 147%.

The US Government Accountability Office [6] also evaluated simulation results from a number of PE and GE models. The GAO summary implied that these studies estimated significant increases in corn and soybean prices and declines in the production of other traditional crops and livestock in response to biofuel production. However, the effects on retail food prices were found to be small. For example USDA [7] estimated that an increase in corn ethanol to 15 billion gallons and biodiesel to 1 billion gallons by 2016 would require production of 5.4 billion bushels of corn at a price of $3.61/bushel. Livestock production and acreage under soybean, wheat, cotton and rice declined. Retail prices for livestock products increased by between 4% and 6% and farm income rose by $2.6 billion. Tokgoz *et al.* [8] estimated that with the production of 22.4 billion gallons of ethanol in 2016–2017 corn production would increase by 11% and price by 20% from $3.15/bushel to $3.75/bushel. Wheat and soybean production declined, and prices increased by 9%. BRDB [9] found that with 15 billion gallons of ethanol and 1 billion gallons of biodiesel in 2016 corn production and price increased by   
3.6% and 4.6%, respectively.

Simulation results from more recent GE and PE studies are also mixed. Timilsina *et al.* [10] calculated the revenue neutral biofuel subsidy and petroleum taxes required to achieve announced biofuel targets in different countries by 2020 and evaluated the agricultural market implications. The results suggest an expansion of global agricultural output with corn, other grains, sugar, wheat, and oilseeds production increasing by 1%, 4.5%, 8.1%, 1.3%, and 2.4%, respectively. There were decreases in the production of rice, and other crops, while livestock production did not change. Corresponding changes in the price of corn, other grains, sugar, wheat, and oilseeds were 1.1%, 1%, 9.2%, 1.1%, and 1.5%, respectively. Al-Riffai *et al.* [11] similarly found that while the EU biofuel mandates lead to changes in agricultural production there were limited effects on food prices, ranging from 0.14% in Europe to 0.5% in Brazil. The results in Oladosu *et al.* [12] imply that the biofuel targets in the US would lead to less than a 1% increase in coarse grains and oilseed prices by 2022 relative to the baseline case. The global production of coarse grains, oilseeds, sugarcane and dairy increased by 1.5%, 0.9%, 0.7% and 0.1%, respectively, but there were slight declines in the production of cattle/ruminants and forestry products.

Mosnier *et al.* [13] performed simulations with the GLOBIOM PE model to evaluate the global effects of US biofuel policies from 2010 to 2030. Their simulations take the RFS2 as the baseline case. In this baseline, corn production rises from 124 million tons to 145 million tons and soybeans from   
18 million tons to 26 million tons between 2010 and 2030. The production of second generation biofuels used 430 million cubic meters of cellulosic feedstock in 2020, and approximately two-thirds were met by short rotation three plantations. US biofuels accounted for 12% of global corn production and 11% of global corn uses in 2030. The price of corn increased by 6% between 2010 and 2020, and then decreased by 20% between 2020 and 2030 under high productivity assumptions. Simulations of alternative RFS2 targets and biofuel mix were performed. Reducing (increasing) the RFS2 targets proportionally by 50% (RFS2 − 50%/RFS2 + 50%), while retaining the biofuel mix leads to a decrease (increase) of 14% in US corn production. Soybean production responds in the opposite direction driven by changes in DDGS production with a decrease of 11% under the RFS2 + 50% scenario and an increase of 7% under the RFS2 − 50% scenario. Adjustments in second generation biofuels under the alternative scenarios occurred mainly through changes in the imports of woody biomass. Under the RFS2 + 50% scenario the corn price increased by 9% in 2020 relative to the baseline case, soybean by 12%, wheat by 8%, cotton by 22% and sorghum by 12%. This implies an estimate of the elasticity of corn price with respect to increases in corn ethanol of about 0.2, which is close to the estimate of 0.18 based on the results of Chakravorty *et al.* [4]. If the proportion of corn ethanol is increased from 45% to 64% under the RFS2 + 50% scenario the price of corn increases by 11%, soybean by 14% and wheat by 12%. The RFS2 + 50% scenario produced a 1-3% decrease, and the RFS2 − 50% scenario a 3%–4% increase, in meat prices. Exports of corn, soybean and wheat to Latin America, Mid-East, North Africa, Sub-Saharan Africa and Japan were strongly affected, with decreases of 10% to 30% under the RFS2+50% case. World feed demand changed by between −7% to +5% across scenarios. Chen and Khanna [14] performed simulations with a national PE model for the US and estimated that corn and soybean prices would increase by between 20% and 50% in 2022 under three scenarios with different combinations of the RFS2, biofuel tax credits, and tariffs on ethanol imports.

A number of studies have examined the effects of waiving the biofuel mandates on ethanol use and corn prices in response to the 2012 drought in the US. Babcock and Tyner *et al.* [15,16] both concluded that a waiver of the RFS mandates would not produce significant reductions in ethanol production due a number of factors. A temporary waiver of the ethanol mandates is unlikely to motivate the ethanol industry to reduce ethanol blending significantly because the economics of ethanol blending are dictated mainly by oil and corn prices, given that the production capacity is already in place. A waiver would also reduce the price of corn, and increase the profitability of the produced ethanol, given the oil price. Thus, high oil prices, coupled with a slight reduction in corn prices, mean that a substantial portion of the current mandate would likely be profitable even under a waiver. Babcock [15] estimated that a no-mandate case (full waiver) would reduce ethanol production by only 1.9 billion gallons (or about 14% of the original mandate), and reduce corn and soybean prices by about 25% and 4%, respectively. However, a simulation accounting for the existing flexibility in the RFS2 due to accumulated RIN (renewable identification number) credits, without a waiver of the mandates, produced a reduction of 1.4 billion gallons in ethanol production and a 19% decline in the corn price. Thus, the existing flexibility in the administration of the US biofuel mandates represents almost 93% of the estimated reduction in corn price from a full waiver of the mandates. Since the effects of the existing flexibility and a waiver are not cumulative, a full waiver produces only an extra 7.4% reduction in corn prices. The estimated decrease in price in Tyner *et al.* [16] is similar at 5.6% after accounting for the accumulated RINs. These simulations are different from a mandatory ban on ethanol blending, which would require a fixed level of reductions, rather than reductions that are based on profitability as in the case of a waiver. The effects of a mandatory removal of ethanol from gasoline on corn prices would be larger, but Babcock [15] noted that there is no existing framework for an ethanol blending ban in the US.

Durham *et al.* [17], using the AGLINK-COSMO PE model, conducted simulations that are also relevant to the ongoing discussion on the role of biofuel policy in the 2012 US drought. The study evaluated the potential of “flexible” biofuel mandates to cope with periods of spikes in agricultural prices. Results suggested that flexible mandates, acting as a “virtual grain store”, could reduce a hypothetical spike in the price of coarse grains and wheat. The price spikes were simulated in 2011 and 2018 for coarse grains and wheat as the response to a 25% decrease in area harvested in the EU, leading to increases of between 70% and 150% in coarse grain and wheat prices. If the EU biofuel mandates and supports were removed at the beginning of the price spike it would reduce the increase in prices for coarse grains by 35% and wheat by 7% under a coarse grains shock. Under a wheat shock it would reduce the increase in coarse grains price by 7% and wheat by 35% in 2018. A similar policy removing 50% of the US biofuel mandate could also avoid about 40% of a hypothetical spike in prices. Note that these simulations do not account for the existing flexibility in the implementation of the US RFS2 through RIN credits as in Babcock and Tyner *et al.* [15,16].

There is little research on the household level effects of biofuels on food markets. De Hoyos and Medvedev [18] evaluated the effects of the 2006 to 2008 agricultural price increases on household welfare, as well as the role of biofuels. Welfare effects of increases in international food prices depend on: (1) degree of pass-through from international to domestic food prices, which in turn depends on government intervention, market access, domestic competition and trade barriers; (2) incidence and severity of poverty among net food producers *versus* net food consumers; (3) extent to which higher food prices translate into higher incomes for farmers. Only 7% of the total global food consumption is traded suggesting differences in the pattern of international and domestic prices, with the latter being more relevant to households. The cumulative 74% increase in international food price index between 2005 and 2007 was associated with a range of 2% to 60% increase in prices across the world. Impacts of the 2005 to 2007 spike in food prices were examined using the global income distribution dynamics (GIDD) database, which includes 73 countries. The average urban food price increase in the developing world was about 4.1%, with a range of −0.5% to 14%. Eastern Europe and Latin America fall in the lower end of this range, whereas Middle East and South Asia were in the upper end. The share of food in the household budget is between 40% and 68% among the urban poor. The estimated increase in the urban extreme poverty count was about 2.86%, with most of this in East Asia. For   
rural households, the net increase in poverty count was positive but smaller than in urban areas. The   
GIDD-based simulation was linked to a global GE model and solved recursively from 2004 to 2010 to evaluate the long-term poverty effects of the food price changes. In the baseline, agricultural prices rose modestly by nearly 5% between 2004 and 2010. Rising world biofuel production was met mainly by shifting resources from other agricultural activities. Global agricultural production increased by 2% in 2005 and 6% in 2010 but varied significantly across countries. Outputs of rice, other crops and livestock declined and returns to land increased substantially by between 4% in Japan to 40% in Brazil. World prices of agricultural goods increased by 10% in 2010 relative to 2004 and by 5.6% relative to the baseline. The price of wheat increased by 5.6%, sugarcane by 8.9%, oilseed by 15.2%, and other cereals by 9.6% relative to the baseline. Average consumer agricultural/food prices rose by 2.2%. The price increases were highest in sub-Saharan Africa and South Asia leading to an increase of 0.6% and 0.9% in the extreme poverty count, respectively. Changes in real incomes were negative throughout the world with an average of −0.6%. The average change in household income was −0.3%, but near zero in the US.

Bouet and Debuquet [19] illustrated the role of direct policy interventions in the context of a food crisis within the MIRAGE CGE model using wheat as an example. Their results found that the price of wheat increased by 11% due to a demand shock only, and by 27% when net exporters react by increasing export taxes to keep the domestic price of wheat constant. When net importers use subsidies to implement the same policy the increase in price was 38%, and a combination of the two policy interventions produced a price increase of 53%.

**2. Biofuel-Food Market Analyses with Non-Structural Economic Models**

Zhang *et al.* [20] examined the hypothesis that short-run volatility in food prices are due to a different set of factors than for long-run volatility. They used monthly data on ethanol, gasoline, crude oil, corn, rice, soybeans, sugar and wheat from March 1989 to July 2008. Although cointegration tests revealed long-run relationships within energy commodity prices, as well as within agricultural commodity prices, no long-run relationship between energy, including ethanol, and agricultural commodities prices were identified. Causality tests also suggested that there are no long- or short-run causality between energy and agricultural prices in general. However, sugar prices were found to cause oil and other agricultural prices, except rice, in the short-run. The latter result was interpreted as reflecting the role of sugar as a large input for world ethanol production, its competition with   
corn-based high fructose sugar, and the effect of recent economic growth on the demand for sugar. Forecast error decomposition analysis was used to estimate the impact of shocks to each price series on own and other prices. In general, own price changes contributed more than 75% of the variation in prices, except for gasoline (16%) and soybeans (57%). Oil price shocks contributed 78% and 15% to the variation in gasoline and ethanol prices, respectively. Ethanol price shocks contributed less than 0.05% to the variation in agricultural prices. Corn price shocks contributed 24% and 12% of the variation in soybean and wheat prices, and sugar price shocks contributed 11% of the variation in soybean prices.

Cha and Bae [21] used a Bayesian VAR model with sign restrictions to examine the dynamic role of oil price shocks on corn demand for ethanol production, feed demand and exports, as well as average corn prices in the US. They used monthly data from 1986 to 2008. Simulation of a one standard deviation shock in the log of oil prices produced a statistically significant increase in the corn price in the short run but the effect on ethanol was long-lived. The effect of oil prices on corn demand for feed and exports were significant only for two to three quarters. A corn export demand shock also produced a statistically significant increase in corn prices but only in the quarter of the shock, whereas the demand for corn for ethanol and feed declined for up to four quarters. Forecast error decomposition analysis implied that oil price shocks were the most significant drivers of changes in the use of corn for ethanol and feed, and corn prices. The oil price shock explained 66% of the variability in corn use for ethanol. Similarly, the oil price and corn export demand shocks contributed about 38% and 24% of the variability in corn prices, respectively. An historical decomposition over the period from 2007 to 2008 showed that the oil price and export demand shocks each explained only a small part of the forecast error in the corn price over this period. However, a combination of the two shocks explained about   
36% of the unconditional forecast error compared with 14% explained by the individual shocks.

Ciaian and Kancs [2] complemented their PE model with a co-integrated VAR analysis of weekly global crude oil prices and nine agricultural commodities using data from 1994 to 2008. The objective was to identify short- and long-run relationships, and test for causality among prices. The data was divided into three equally spaced periods: 1994 to 1998; 1999 to 2003; 2004 to 2008. Pair-wise cointegration tests were conducted between each of the nine agricultural prices and the crude oil price. A long-run relationship was rejected for all pairs during the first period, whereas the corn/oil and soybeans/oil price pairs showed long-run relationships in the second period. In the third period, all nine price pairs indicated a long-run relationship based on one of two tests and the other test rejected a long-run relationship for only three price pairs: rice/oil, cotton/oil and banana/oil. These long-run relationships were interpreted as indicating a role for biofuels in food markets through the direct price transmission channel because of the use of corn and soybeans for biofuel production. However, only a long-run, uni-directional causality from the oil price to agricultural prices was confirmed by causality tests. Impulse response functions were used to evaluate price transmission elasticities from oil to agriculture commodities, and vice versa. For oil to agriculture, the price transmission elasticities were 0.15 for corn and wheat, 0.28 for sugar, 0.17 for soybean, and less than 0.06 for all other commodities. Price transmissions from agricultural prices to oil prices were generally one-order lower and negative for cotton and tea.

Qui *et al.* [22] used a structural VAR model to evaluate the role of demand/supply shocks on food and fuel markets. Their results suggested that although corn prices rise in response to an ethanol demand shock the effects dissipate quickly, so that there are no long-run effects. Forecast error variance decomposition implied that an ethanol demand shock accounted for only 4% of the variation in corn prices in both the short- and long-run, whereas a corn demand shock accounted for about 94% in the short-run and 60% in the long-run (about 5 years). Impulse response functions also suggested that a shock to real economic activity would produce a positive short- and long-run increase in corn prices. However, forecast error decomposition showed that real economic activity contributes only about 0.3% to variation in corn prices in the short run and about 2.7% in the long-run.

The studies by Nazlioglu and Soytas, Natanelov *et al.*, Nazlioglu and Harri *et al.* [23–26] examined the relationship between oil, exchange rate and agricultural commodities. Although biofuels were not included in these studies the findings are relevant to biofuel-food market interactions because of the link between the oil, agricultural and biofuel markets. Nazlioglu and Soytas [23] conducted a panel cointegration and causality analysis of the effects of oil prices and the exchange rate on twenty-four agricultural commodities using monthly data from January 1980 to February 2010. Cointegration analysis suggested positive long-run oil price effects, and negative long-run exchange rate effects on agricultural prices. Causality analysis indicated bi-directional short-run causality between oil price and agricultural prices, and similarly between the exchange rate and agricultural prices. However, long-run causality tests suggested that while oil prices and the dollar cause agricultural prices, and oil and agricultural prices cause the dollar, oil prices are not caused by either agricultural prices or the dollar. Natanelov *et al.* [24] investigated pair-wise cointegration and causality analysis of prices for oil with gold and eight agricultural commodity prices using the nearest month futures data from July 1989 to February 2010. The analysis was conducted for the full sample, as well as two sub-samples from 1989 to 2002 and from 2003 to 2010 to indicate a structural break in 2002. Cointegration results identified a long-run relationship with the oil price for only cocoa, wheat, gold and coffee prices in the full and second sub-sample. However, in the first sub-sample there were long-run relationships with soybeans, soybean oil, wheat and corn prices. Interestingly, tests for long-run causality indicated a unidirectional causality from these agricultural futures prices to crude oil futures prices, with bi-directional causality only between crude oil and soybean prices. Threshold cointegration analysis was conducted for   
the relationship between oil and corn, soybeans, and soybean oil. Threshold cointegration implies   
non-linear co-movement in which adjustments to deviations from equilibrium occur only after the deviation exceeds a certain threshold. Threshold cointegration was found only for the crude oil/corn relationship in mid-2006, when oil futures prices surpassed $75/barrel.

Nazlioglu [25] conducted both linear and non-linear causality tests of the relationship among the world oil price and prices for corn, soybeans and wheat using weekly data from the 1st week of 1994 to the 29th week of 2010. The analysis was conducted for the full sample and four sub-periods. Cointegration results indicated a long-run relationship for corn and soybeans with oil, but not between corn and soybeans, over the full and first three sub-samples. Corn and soybean prices were found to be cointegrated with oil prices over the fourth sub-sample from week 38 of 2008 to week 29 of 2010. Wheat was also found to be cointegrated with oil prices for all sample periods, except for the 1998 to 2004 sub-sample. Residual-based cointegration tests also supported the long-run relationship between corn and oil, with an endogenous structural break date of April 2002, and between wheat and oil with a break date of July 2007. No long-run relationship between soybean and oil prices was found using this test. Linear causality tests suggested a neutral relationship between oil and agricultural commodity prices, whereas a non-liner causality test indicated a persistent unidirectional causality running from oil prices to corn and soybean prices. Harri *et al.* [26] investigated cointegration and causality among the oil price, dollar exchange rate and corn price. They found two cointegration relationships, which were interpreted as that between the corn price and the other two variables, and that between the oil price and the exchange rate. Their VECM estimation results found that the oil price is weakly exogenous within the 3-equation system, implying that it Granger causes corn prices and the exchange rate, whereas the latter two do not Granger cause the oil price.

Gilbert [27] emphasized the role of common (*i.e.*, macroeconomic and monetary) demand-side factors in explaining the increase in commodity prices from 2003 to 2008 and pointed to parallels with the 1973 to 1974 commodity boom. The two episodes include a general rise in commodity prices, sharp increases in oil prices, enormous world liquidity, strong increases in metal prices, but not in cocoa and coffee, and a sudden end to the boom followed by a deep recession. Differences between the two booms include a shorter duration in 1973 to 1974 than in 2003 to 2008. Also, grains led the commodity boom in the 1973 to 1974 episode, whereas energy and metals led the 2003 to 2008 episode. Gilbert [27] estimated a multi-equation model including the food price index, oil price and futures investment index as endogenous variables, with the dollar exchange rate, Chinese industrial production, stock market indices (China and US) and a post-Lehman dummy as exogenous variables. Results suggested that the futures market was the “preponderant” channel through which the fundamental causal effects (*i.e.*, economic growth, dollar depreciation and other macroeconomic factors) affected food prices during the 2006 to 2008 period. The exchange rate variable was found to contribute about 15% of the change in food prices. von Braun and Tadesse [28] performed seemingly unrelated regressions (SUR) of price returns for four crops (corn, wheat, soybeans and rice) against production shocks, excessive speculation (defined as the difference between net non-commercial and net commercial futures positions per marketing day) and crude oil price. They found that excessive speculation and the oil price have significant impacts on price returns.

Irwin and Sanders [29] have conducted a comprehensive review of the literature on the role of commodity index trades (CIT) in the recent commodity price spikes. Their review showed that there are an almost equal number of empirical studies that found significant and insignificant effects of CIT on commodity prices. In addition, they highlighted several factors that weigh against the notion that index funds fueled a bubble in commodity prices. First, studies that identify a significant relationship between CIT and food prices fail to establish a definite causal link. Thus, at best these findings can be interpreted as showing that CIT was a major channel, rather than the cause, by which the effects of the fundamental causes of the food price spikes were transmitted to the market. Gilbert [27] interpreted his own results in the same way. Irwin and Sanders [29] also noted the tendency to interpret index investments as entirely speculative and the popular application of the term bubble to “any market that makes a large advance quickly and then makes an equally hasty retreat”. In contrast, a bubble occurs when an asset price exceeds its fundamental value and the trading motive is unrelated to the fundamentals. Irwin and Sanders [29] also pointed to inconsistencies between observations and the predictions of a bubble induced food price spike including: (1) commodity inventories were declining through most of 2006-2008 rather than increasing as would be suggested by a bubble; (2) speculation activity was not excessive relative to hedging behavior; (3) the effects of index funds were found to have differential, instead of similar effects, across markets.

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