Volume 51
Number 2 *Symposium: Continuing to Fight Today's Environmental Challenges: Climate Change, Health Concerns, Energy, and Food Supply*

pp.375-404

Symposium: Continuing to Fight Today's Environmental Challenges: Climate Change, Health Concerns, Energy, and Food Supply

The Gift that Keeps on Giving: Price Overhang Damages in Commodity Crop Cases

Adam J. Levitt

Russell L. Lamb

THE GIFT THAT KEEPS ON GIVING: PRICE OVERHANG DAMAGES IN COMMODITY CROP CASES

Adam J. Levitt* **and Russell L. Lamb****

CONTENTS

* Founding Partner, DiCello Levitt & Casey LLC.
** President, Monument Economics Group. The authors thank Oktay Akkus, Edmund S. Aronowitz, Catherine J. Ó Súilleabháin, and Raymond F. Schuenemann III for their helpful comments and suggestions.

I. INTRODUCTION

The distribution and mishandling of unapproved or otherwise restricted genetically-engineered ("GE") crops can result in serious financial losses for commodity crop market participants.[1] These losses can be long-lasting and severe for commodity crop producers (i.e., farmers).[2] Since litigation involving GE crop contamination began appearing in U.S. courts around the year 2000, judges, lawyers, and economists have grappled with how to appropriately measure producers' damages based on sound econometric and economic analysis so that they can be compensated for both the immediate and the future economic losses caused by the contaminators' allegedly tortious acts.[3] Incidents of GE crop contamination have a continuing effect on commodity crop pricing long after the contaminator has ceased its allegedly wrongful conduct.[4] Harm to producers and other market participants will continue into the indefinite future for a variety of reasons, such as the self-replicating process and persistence in plant genetic material of GE crops, possibly indefinitely, as well as the strict limits, including down to zero-tolerance of unapproved GE traits set by commodity crop purchasers.[5]

To account for producers' future economic loss from the present, allegedly unlawful, GE crop contamination, the damages model must include losses arising from the "price overhang."[6] Price overhang refers to the phenomenon in which the price of a commodity, stock, product, or

---

1 *See* George A. Kimbrell & Aurora L. Paulsen, *The Constitutionality of State-Mandated Labeling for Genetically Engineered Foods: A Definitive Defense*, 39 VT. L. REV. 341, 344 (2015) (stating the contamination of non-genetically-engineered ("GE") crops has caused U.S. farmers billions of dollars in market losses).

2 *See generally* Hilary Weiss, *Genetically Modified Crops: Why Cultivation Matters*, 39 BROOK. J. INT'L L. 875, 877–79 (2014) (expressing that the economic losses resulting from the *StarLink* scandal still have an effect on corn producers around the world today).

3 *See* Stephen M. Scanlon, *Should Missouri Farmers of Genetically Modified Crops Be Held Liable for Genetic Drift and Cross Pollination?*, 10 MO. ENVTL. L. & POL'Y REV. 1, 10 (2003) (introducing ways—under the law of nuisance, law of trespass, the dimensional test, and the modified dimensional test—that farmers are able to recover for damages caused by genetic contamination).

4 *See generally* Soil Association, UK, *GE Crops Are Economic Disaster Shows New Report*, PSRAST (Sept. 25, 2016), http://www.psrast.org/geecondisast.htm [https://perma.cc/2WXE-VR7M] (discussing a report concluding that GE crop contamination is the major cause of the agricultural economy's collapse).

5 *See* Adam W. Jones, *What Liability of Growing Genetically Engineered Crops?*, 7 DRAKE J. AGRIC. L. 621, 627 (2002) (providing that Robert Frost's quote "good fences make good neighbours" does not apply to farmers because of the many ways crops can become contaminated with GE crop material).

6 *See generally* Carl F. Jordan, *Genetic Engineering, the Farm Crisis, and World Hunger,* 52 BIOSCIENCE OXFORD J. 523, 523 (2002) (explaining that the more farmers produce, the lower the prices are driven, which leads to large financial losses).

other asset remains consistently below its previous price level following the contamination event and long after the contaminator's cessation of its wrongful conduct.[7] Inclusion of the price overhang effect in damages calculations in GE crop contamination cases has gained increased legitimacy and acceptance.[8]

This Article begins with an overview of major GE crop contamination cases from 2000 through the present.[9] Next, the Article covers the general damages concepts related to market loss in GE crop contamination cases.[10] The Article concludes with a detailed discussion of the price overhang effect from an econometric perspective, demonstrating this effect, and confirming the thesis that for major contamination events, post-contamination prices have remained below the pre-contamination price levels for several years.[11]

II. Overview of GE Crop Contamination Cases

This Part reviews three significant GE crop contamination cases demonstrating the slow, but steadily increasing, acceptance of the inclusion of price overhang in damages models in these types of crop contamination situations.[12]

A. In re StarLink Corn Products Liability Litigation

Originally filed in 2000, *In re StarLink Corn Products Liability Litigation* ("*StarLink*") was the first instance of private tort litigation involving GE crop contamination.[13] *StarLink* illustrates not only the appropriateness of

---

7 *See generally Market Overhang*, INVESTINGANSWERS, http://www.investinganswers.com/financial-dictionary/stock-market/market-overhang-3913 [https://perma.cc/5V47-ANQZ] (defining market overhang as a phenomenon where investors put off buying shares of stock due to a belief that the stock's price will continually decline).

8 *See, e.g.*, Monsanto Co. v. Geertson Seed Farms, 561 U.S. 139, 155 (2010) (including the price overhang effect in the damages calculation).

9 *See infra* Part II (discussing the relevant GE crop contamination cases); *see also In re* StarLink Corn Prods. Litig., 212 F. Supp. 2d 828 (N.D. Ill. 2002); *In re* Syngenta AG MIR 162 Corn Litig., 131 F. Supp. 3d 1177 (D. Kan. 2015); *In re* Genetically Modified Rice Litig., 251 F.R.D. 392 (E.D. Mo. 2008).

10 *See infra* Part III (expanding on three economic concepts—price function, market loss, and market efficiency—that can lead to damages to market participants resulting from a GE contamination).

11 *See infra* Part IV (providing econometric models that illustrate the price overhang effect).

12 *See infra* Parts II.A–C (analyzing three important GE cases).

13 *See* 212 F. Supp. 2d at 833 (discussing the fact that fifteen separately filed class action cases were consolidated into this multidistrict litigation arising from the discovery of GE StarLink corn in the U.S. food corn supply).

expanding damages models to include the price overhang effect for commodity market participants harmed financially by GE crop contamination, but also the need to do precisely that if market participants (i.e., farmers) are to be made financially whole from the harm arising from the alleged misconduct.[14] Damages models that include the price overhang effect are the standard for an appropriate damages analysis that is well-established in both the law and economic analyses.[15]

StarLink is the brand name of a genetically-engineered corn seed that expresses a protein known as Cry9C. Cry9C is toxic to certain types of insects, and thus functions as a GE alternative to chemical pesticides.[16] Indeed, the developmental goal of Cry9C was to engineer a protein that could replace the need for chemical pesticides in treating crops.[17]

Aventis AgroScience, Inc. ("Aventis"), together with Aventis CropScience USA Holdings, Inc., genetically-engineered the corn seed and applied for federal approvals of StarLink under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") and the Federal Food, Drug, and Cosmetic Act ("FDCA").[18] In 1998, the U.S. Environmental Protection Agency ("EPA") approved StarLink for commercial use only.[19] That is, all grain grown from StarLink seeds could be used *only* for domestic animal feed or for industrial purposes, and importantly, could not be used as a human food source.[20]

The EPA, as a condition of its approval, required special procedures to prevent StarLink from commingling with, and thus contaminating, the remainder of the commodity corn supply.[21] Ordinarily, corn varieties produced by thousands of farms are regularly commingled through harvesting, storage, and shipment to grain elevators and, ultimately,

---

14 *See id*. at 838 (holding the plaintiffs could proceed in the lawsuit on the grounds of negligence per se, public nuisance, and private nuisance).

15 *See* ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS 368 (4th ed. 2004).

16 *See StarLink Corn Regulatory Information*, U.S. ENVTL. PROTECTION AGENCY (Apr. 2008), https://www3.epa.gov/pesticides/chem_search/reg_actions/pip/starlink_corn.htm [https://perma.cc/6EU7-4KVK] (noting that Cry9C is in a variety of StarLink's GM corn seed that acts as a plant-incorporated protectant).

17 *See id*. (stating that Cry9C acts as a pesticide).

18 *See id*. (reiterating that Aventis submitted data to the Environmental Protection Agency ("EPA") and applied for safety approvals of StarLink under the Federal Food, Drug, and Cosmetic Act ("FDCA") and Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA").

19 *See id*. (stating that the EPA registered StarLink for commercial use only, given that grain derived from StarLink was directed to industrial use or domestic animal feed).

20 *See In re* StarLink Corn Prods. Liab. Litig., 212 F. Supp. 2d 828, 834 (N.D. Ill. 2002) (explaining that the EPA found several attributes of Cry9C similar to common human allergens, resulting in limited registration that prohibited its use for human consumption).

21 *See id.* (restating that the EPA required StarLink to follow special procedures despite general practices in the corn industry).

processors, which do not necessarily segregate specific corn varieties.[22] Indeed, the ability to segregate GE seeds through identity preservation of GE varieties is a costly and time-consuming requirement of properly handling GE crops.[23] Additionally, corn varieties within a farm regularly cross-pollinate, unless specific steps are taken to prevent such cross-pollination, as corn pollen has the ability to travel considerable distances to other farms and crops, owing to various environmental factors.[24] Therefore, to prevent StarLink from working its way into the commodity corn supply chain, the EPA required special segregation procedures for StarLink cultivation, harvest, storage, and transport, and also required a vast "buffer zone" around StarLink corn crops to prevent potential cross-pollination with non-StarLink corn.[25] The EPA also required Aventis to inform farmers of the special procedures regarding segregation, use, storage, and disposition of StarLink corn and to accept responsibility for ensuring StarLink purchasers' written agreement to such terms.[26]

Despite the mandates and precautions, in the year 2000, StarLink corn was found in food intended for human consumption.[27] This event resulted in many food producers halting their domestic use of U.S. corn entirely and replacing it with imported corn or corn substitutes.[28] Additionally, major importers of U.S. corn, such as South Korea and Japan, followed suit and either terminated or limited U.S. corn imports.[29] These occurrences had a direct and obvious negative affect on U.S. corn markets.[30] In turn, U.S. corn growers filed numerous lawsuits that were

---

[22] *See id.* (providing common practices of farmers that do not have to segregate specific corn varieties).

[23] *See* Raymond Massey, *Identity Preserved Crops*, IOWA ST. U. (Aug. 2002), https://www.extension.iastate.edu/agdm/crops/pdf/a4-53.pdf [https://perma.cc/3P6W-R8WW] (expressing that the identity preservation grain production requires a different process that will require a higher standard of quality).

[24] *See In re StarLink Corn Prods. Liab. Litig.*, 212 F. Supp. 2d at 834 (stating that corn pollen can drift long distances, resulting in corn varieties cross-breeding with neighboring farms regularly).

[25] *See id.* (listing the special procedure requirements that the EPA required StarLink to follow regarding segregation, use, storage, and disposition of corn).

[26] *See id.* (explaining that StarLink had to inform farmers of the special procedure requirements set forth by the EPA).

[27] *See id.* at 835 (discussing the fact that multiple reports of human food products that tested positive for Cry9C led to a wave of manufacturers issuing recalls for products containing corn).

[28] *See id.* (reiterating that Aventis's application to cancel the limited registration of StarLink products and fear of contamination led to U.S. food producers replacing U.S. corn with imported corn or corn substitutes).

[29] *See id.* (stating both Japan and South Korea, along with other foreign countries, have either terminated or limited imports of U.S. corn).

[30] *See* Ricardo C. Gazel & Russell L. Lamb, *Will the Tenth District Catch the Asian Flu?*, 83 ECON. REV.–FED. RES. BANK OF KANSAS CITY 9, 24 (1998) (expressing that Asia's economic

ultimately transferred by the Judicial Panel for Multidistrict Litigation ("JPML") in the U.S. District Court for the Northern District of Illinois for consolidated or coordinated pretrial proceedings pursuant to 28 U.S.C. § 1407.[31]

Defendants Aventis and the Advanta Group, which had acquired Garst Seed Company, a licensee that produced and distributed the seeds, moved to dismiss the growers' claims for negligence per se, public nuisance, private nuisance, and conversion.[32] Ultimately, the court denied defendants' dismissal motion as to all tort claims except conversion, and ruled that plaintiffs could "proceed on the theory that defendants (1) violated duties imposed by the limited registration [of StarLink]; (2) made representations to StarLink growers that contradicted the EPA-approved label; and (3) failed to inform parties handling StarLink corn downstream of the EPA-approved warnings."[33] The court recognized that defendants had a duty to ensure that StarLink did not enter the human food supply and observed that liability would arise if plaintiffs established that Aventis's breach of that duty caused plaintiffs' corn to be contaminated.[34]

Notably, the court cautioned that although plaintiffs alleged that the defendants contaminated "the entire [U.S.] corn farming and production chain," recovery by any plaintiffs pursuant to a tort would depend on their ability to prove "direct harm" to their own crops.[35] The court also

---

crisis will have a negative impact on the U.S. economy because Asia is responsible for more than one-third of U.S. corn exports).

31 *See In re StarLink Prods. Liab. Litig.*, 212 F. Supp. 2d at 833 (stating that there were fifteen separately filed cases consolidated for pretrial purposes); *see also* 28 U.S.C. § 1407 (2012) (describing the procedures for consolidated or coordinated pretrial proceedings).

32 *See In re StarLink Prods. Liab. Litig.*, 212 F. Supp. 2d at 852 (stating that the defendants' motion to dismiss was granted in regards to the claims for conversion and the violations of the North Carolina Unfair and Deceptive Trade Practices Act, but denied for the claims of negligence per se, public nuisance, and private nuisance).

33 *Id.* at 838.

34 *See id.* at 843 (acknowledging that Aventis's duty to ensure StarLink did not enter the human food supply was breached, causing the plaintiffs' corn to be contaminated).

35 *Id. See also id.* at 842–43 (providing that although the defendants argued that the plaintiffs had alleged only a market-wide harm, the court gave plaintiffs the benefit of the ambiguity and "read the complaint to allege direct harm to plaintiffs' corn, . . . a set of facts that is consistent with plaintiffs' allegations about the impact on the corn system as a whole"). Given the market reality that cross-contamination affects or touches all crops within a given crop market, tort theory should be construed to recognize the fact that harm to the market establishes a direct harm to the producer. *See* Adam J. Levitt & Nicole Negowetti, *Agricultural "Market Touching": Modernizing Trespass to Chattels in Crop Contamination Cases*, 38 U. HAW. L. REV. 409, 409 (2016) (discussing the need to expand the trespass to chattels tort, in the face of modern commodity market realities, to include "virtual touching" of crops arising from market-wide contamination incidents that systemically affect crop values).

expressly declined to determine whether defendants' alleged acts could also give rise to consequential damages.[36]

Not long after the motion to dismiss was largely denied, the farmer class settled for over $110 million.[37] Significantly, *StarLink* marked the first time that plaintiffs' lawyers working in tandem with their lead economist—(in this case, Dr. Colin Carter, of the University of California, Davis)—asserted agricultural market loss theories as the basis of their damage modeling.[38]

Specifically, in *StarLink*, Dr. Carter used the efficient market hypothesis in the commodity crop context, which enabled him to quantify the market impact of the contamination on U.S. corn farmers.[39] Dr. Carter's analysis documented and assessed the flow of negative market information to and from traders resulting from the StarLink contamination and measured its impact on the futures pricing mechanism that affects all U.S. corn farmers.[40] Dr. Carter, as well as other researchers he cited in his declaration, characterized the "U.S. corn market as an efficient market," noting that its "pricing is sensitive to information on supply and demand" and that its "cash and . . . futures prices are highly correlated through time."[41] Based on his analysis of the flow of StarLink-related market information, he was able to conclude that U.S. "corn futures prices were depressed because of the risk of contamination in any shipment originating in the United States[,] [and] [i]n turn, the[] lower future prices would result in lower cash price quotes within the United

---

36 *See In re StarLink Prods. Liab. Litig.*, 212 F. Supp. 2d at 843 (stating that the determination of consequential damages would be left for another day).

37 *See* Paul Elias, *Biotech Firms Will Pay $110 Million to Settle StarLink Corn Lawsuit*, ASSOCIATED PRESS (Feb. 7, 2003), http://cjonline.com/stories/020703/usw_biotech.shtml#.V-ceKfkrLcu [https://perma.cc/3K84-YPMD] (providing that contemporaneously with the StarLink corn farmers' settlement, the defendants in that action also settled a smaller consumer class action case brought on behalf of purchasers of food products containing StarLink corn and those who may have been exposed to potential allergens therein, for $9 million).

38 *See* Decl. of Colin A. Carter at 9–10, *In re* StarLink Prods. Liab. Litig., 212 F. Supp. 2d 828 (N.D. Ill. 2002) (No. 1403) (introducing Dr. Colin Carter's technique of the "price-quantity" as an alternative agricultural market theory to estimate damages in the StarLink situation).

39 *See generally* Ian Ayres & Stephen Choi, *Internalizing Outsider Trading*, 101 MICH. L. REV. 313, 318 n.18 (2012) (explaining the efficient market hypothesis—a market theory proposed by economist Eugene Fama—which assumes that securities price trading in a liquid market reflect all available information (positive and negative) at any given time, and are thus perfectly priced based on that information).

40 *See* Decl. of Colin A. Carter, *supra* note 38, at 1 (expressing that the prices paid to growers for U.S. corn are determined by the commodity's futures price—as established by the Chicago Board of Trade—plus or minus the local basis).

41 *Id.* *See also* Philip Garcia et al., *The Value of Public Information in Commodity Futures Markets*, 32 J. OF ECON. BEHAV. & ORG. 559, 563–64 (2006) (finding that corn future prices are "efficient" and that they react quickly to news events).

States and reduced prices paid . . . to growers in the U.S. corn belt."[42] Notably, in addition to identifying the immediate and direct effect on the prices U.S. farmers were able to receive for their corn crops, Dr. Carter also concluded that "[t]here is little doubt that actual damages . . . lingered . . . and were most likely spread out over several months."[43]

B. In re Genetically Modified Rice Litigation

In 2006, another substantial crop contamination event occurred in the U.S., giving rise to *In re Genetically Modified Rice Litigation* ("*GM Rice*"), wherein thousands of U.S. rice producers and dozens of rice-related businesses brought claims against Bayer AG and several of its foreign and domestic subsidiaries.[44] The plaintiffs, in similar fashion to those in *StarLink*, alleged that "the defendants contaminated the U.S. rice supply with non-approved genetically modified strains of rice, thereby affecting the market price for plaintiffs' crops."[45] The rice strain at issue was a long-grain rice known as LLRICE 601 and was designed by Bayer to be resistant to an herbicide trademarked as Liberty Link. This modification allowed post-emergent treatment of LLRICE 601 rice fields with Liberty Link, thus enhancing its efficacy as an herbicide.[46] The rice strain was developed in Europe and field-tested in the United States.[47] Not only was LLRICE 601, like the corn in *StarLink*, not approved for human consumption, but it was not approved for any sort of commercial use or dissemination.[48]

On August 18, 2006, the U.S. Department of Agriculture announced that trace amounts of LLRICE 601 had been detected in the U.S. rice supply.[49] In the days that followed, certain major importers of U.S. rice, such as Japan and other Asian countries, reacted by banning the importation of all long-grain rice produced in the United States.[50] Other

---

42 Decl. of Colin A. Carter, *supra* note 38, at 7.

43 *Id.* at 11.

44 *See* 251 F.R.D. 392, 393 (E.D. Mo. 2008) (stating that this multidistrict litigation aggregated, for pretrial purposes, pursuant to 28 U.S.C. § 1407, numerous, separately filed class action cases arising out of the alleged LLRICE 601 and 604 contamination incidents, each naming as defendants Bayer CropScience LP and numerous other Bayer entities).

45 *Id.* at 393.

46 *See id.* (noting that LLRICE 601 is a rice seed developed by Bayer CropScience designed to be resistant to Liberty Link).

47 *See id.* (specifying that Bayer created LLRICE 601 through research in Europe and later conducted field testing of the rice in the United States).

48 *See id.* (stating that at the time of contamination, LLRICE 601 was not approved for human consumption).

49 *Id.*

50 *See In re Genetically Modified Rice Litig.*, 251 F.R.D. at 393 (stating on August 20, 2006, Japan announced it would no longer import U.S. rice).

countries, such as Russia, Canada, and Taiwan, imposed restrictions on U.S. rice imports, while the European Union announced it would require U.S. rice to be tested and certified as free of genetically modified traits.[51] Accordingly, the export market for U.S. rice was substantially affected.[52]

Building upon the damages theory first devised and introduced in *StarLink*, the plaintiffs in the *GM Rice* litigation alleged that "the defendants' activities caused a market loss injury to the U.S. rice market" and, in support, pointed to the dramatic price drop that negatively affected U.S. rice producers immediately after the Department of Agriculture's announcement.[53] Significantly, this negative price impact, in addition to harming the 2006 commodity rice crop, continued into the 2007 crop.[54]

Like Aventis in *StarLink*, Bayer tried to knock out plaintiffs' claims in *GM Rice* through a dismissal motion, but, like in *StarLink*, Bayer's dismissal motion failed and plaintiffs' claims survived.[55] The *GM Rice* litigation then took an unusual procedural turn that, in hindsight, proved to be in significant tension with the case's ultimate resolution.[56] The judge presiding over *GM Rice* denied class certification based on her determination that "[i]ndividual circumstances affecting the calculation of individual plaintiffs' damages predominate over the common issues presented in plaintiffs' claims."[57] In many cases, denial of certification results in the death of the action as a whole, but not here.[58]

Based on the strong merits of the case and substantial damages suffered by individual plaintiffs, *GM Rice* transformed from a class action

---

51 *See id.* (reiterating that three days after Japan's announcement, the European Union declared a new requirement that all incoming U.S. rice had to be tested and certified as free of genetically modified traits).

52 *See id.* at 394 (furthering that shortly thereafter, it was disclosed that the LLRICE 604 trait had also been detected in the U.S. supply, therefore, increasing the scope of the contamination and the damages arising).

53 *See id.* (acknowledging that the plaintiffs alleged the LLRICE contamination announcement and the defendants' actions caused the dramatic price drop).

54 *See id.* (noting that any rice producer who priced his or her 2006 or 2007 crop after August 18, 2006, encountered economic harm throughout 2007).

55 *See* Amanda L. Kool, *Halting Pig in the Parlor Patents: Nuisance Law as a Tool to Redress Crop Contamination*, 50 JURIMETRICS 453, 477 (2010) (analyzing that despite losing two claims, the plaintiffs' claims for negligence and private nuisance survived summary judgment).

56 *See In re Genetically Modified Rice Litig.*, 251 F.R.D. at 400 (denying the plaintiffs' class certification motion).

57 *Id.*

58 *See* Geoffrey P. Miller, *Review of the Merits in Class Action Certification*, 33 HOFSTRA L. REV. 51, 51 n.4 (2005) (noting the certification of a class action is crucial in determining the success or failure of the litigation); *but see* Kool, *supra* note 55, at 477 (providing that the first two of five prescheduled test trials pertaining to LLRICE 601 contamination resulted in verdicts without published opinions in which three plaintiffs were awarded approximately $1.5 million).

case into a mass tort case.[59] Following a series of bellwether trials, each of which resulted in either a plaintiff's verdict or midtrial settlement—as well as several state court trial victories—the Bayer defendants and the *GM Rice* mass tort plaintiffs reached a $750 million settlement.[60] Further, settlements in related state court actions brought the aggregate settlements in all LLRICE contamination litigation close to $1.1 billion, making the *GM Rice* litigation the largest and most successful GE crop contamination case to date.[61]

C. In re Syngenta AG MIR Corn Litigation

Most recently, in the litigation styled *In re Syngenta AG MIR 162 Corn Litigation* ("*Syngenta*"), various groups of corn market participants brought claims against multiple Syngenta entities alleging that they suffered significant losses because of Syngenta's release of a GE corn trait known as MIR 162 into the U.S. commodity corn system.[62] Some corn growers that did not use Syngenta's product were infected with the GE

---

59 The primary difference between class action and mass tort litigation is that class action litigation is representative litigation, while mass tort litigation is the aggregation and coordination of hundreds—if not thousands—of individual cases. *See generally NFL Concussion Litigation*, PAUL D. ANDERSON CONSULTING, LLC (Mar. 29, 2012), http://nflconcussionlitigation.com/?p=406 [https://perma.cc/U2QB-L8WV] (analyzing the different doctrines). One instance where litigation may proceed as a mass tort rather than a class action is when the damages being sought are inherently individualized in nature, and thus may not readily satisfy the "predominance" requirement of Federal Rules of Civil Procedure 23(b)(3) needed for certification as a class action. *See* Advisory Committee Note to 1966 Amendment to Fed. R. Civ. P. 23(b)(3) ("A 'mass accident' resulting in injuries to numerous persons is ordinarily not appropriate for a class action because of the likelihood that significant questions, not only of damages but of liability and defenses of liability, would be present, affecting the individuals in different ways.").

60 *See* Andrew Harris & David Beasley, *Bayer Will Pay $750 Million to Settle Gene-Modified Rice Suits*, BLOOMBERG (July 1, 2016), http://www.bloomberg.com/news/articles/2011-07-01/bayer-to-pay-750-million-to-end-lawsuits-over-genetically-modified-rice [https://perma.cc/R2UH-FTRN] (reporting that Bayer AG resolved claims with about 11,000 U.S. farmers, agreeing to a $750 million settlement).

61 *See* A. Bryan Endres & Nicholas R. Johnson, *$750 Million Settlement in GM Rice Contamination*, FARMDOC DAILY (July 8, 2011), http://farmdocdaily.illinois.edu/2011/07/750-million-settlement-in-gm-r.html [https://perma.cc/WTA7-NYL9] (providing that the $750 million voluntary settlement was an attempt to end future threat of litigation).

62 *See* Alison Rice, *Corn Farmers Sue Syngenta over MIR 162 Corn,* FARM J. (Sept. 25, 2016), http://www.agweb.com/article/corn-farmers-sue-syngenta-over-mir-162-corn-/ [https://perma.cc/GJ5J-RNDT] (stating MIR 162 was commercially known as Agrisure Viptera and was intended to make corn crops more resistant to certain pests); *see also In re* Syngenta AG MIR 162 Corn Litig., 131 F. Supp. 3d 1177, 1185–86 (D. Kan. 2015) (stating that the three groups of plaintiffs who sued Syngenta were corn producers, non-producer corn sellers, and milo producers).

corn trait through cross-pollination from nearby fields.[63] In addition, the MIR 162 corn commingled with GE-free corn in grain elevators and storage facilities, ultimately leading to an infiltration of the general U.S. commodity corn supply.[64]

At the time, one of the United States's primary corn importers, China, had yet to approve the use of MIR 162 and had in force a zero-tolerance policy for unapproved GE traits.[65] Accordingly, the contamination of the U.S. commodity corn supply chain led to China's essentially banning the importation of all U.S. corn.[66] The complete disruption of corn trade with China lasted for over a year.[67] Furthermore, the contamination caused trade disruptions that led to U.S. corn supply back-ups. The net effect of the trade disruption was lower prices for all U.S. commodity corn, which negatively affected corn producer income and profits.[68]

In S*yngenta*, the plaintiffs alleged that Syngenta's liability arose from its misleading statements regarding the importance of the Chinese market to U.S. corn farmers—China was one of the top importers of U.S. corn—and the prospects of Chinese approval of MIR 162, as well as from Syngenta's failure to ensure proper stewardship and channeling measures that would have prevented the contamination of the U.S. corn supply with MIR 162 before Chinese approval of the trait.[69]

As expected, Syngenta moved to dismiss all claims.[70] In largely sustaining the plaintiffs' claims in the face of the defendants' dismissal motions, the Honorable John W. Lungstrum—the JPML transferee judge for the litigation—took the significant step of recognizing, and in part

---

[63] *See In re Syngenta AG MIR 162 Corn Litig.*, 131 F. Supp. 3d at 1186 (reiterating the corn of farmers who did not use Syngenta's products gradually became contaminated with MIR 162 through cross-pollination).

[64] *See id.* (establishing that both "Viptera- and Duracade-grown corn was commingled with other [GE-free] corn in grain elevators and other storage facilities," which led to the infiltration of the general domestic corn supply).

[65] *See id.* (showing that China had not yet approved the MIR 162 trait).

[66] *See id.* (discussing the ban on all U.S. corn in China).

[67] *See id.* at 1208 (demonstrating that the ban lasted over a year); *see also* Paul Minehart, *Syngenta Receives Chinese Import Approval for Agrisure Viptera® Corn Trait*, SYNGENTA (Dec. 22, 2014), http://www.syngentacropprotection.com/news_releases/news.aspx?id=187482 [https://perma.cc/7EJV-RF64] (announcing the Chinese approval of the MIR 162 trait in 2014).

[68] *See In re Syngenta AG MIR 162 Corn Litig.*, 131 F. Supp. 3d at 1186 (discussing the economic impact of losing the Chinese market).

[69] *See id.* (describing the nature of the complaint). To be clear, the fact that the *Syngenta* litigation is largely premised on allegations arising from Syngenta's misleading statements relating to the status of Chinese approval of MIR 162 corn, renders that case is far more akin to a securities fraud or a market manipulation case than to a crop contamination case such as *StarLink* or *GM Rice*. For purposes of the damages analyses and related discussions set forth in this Article, however, there is no material difference.

[70] *See id*. at 1187 (showing that Syngenta moved to dismiss all claims).

focusing on, the "relationship between the parties in an interconnected market" and the effects of that interconnected market on the viability of the plaintiffs' claims.[71] This recognition of an interconnected market underscored the merits of the market loss damages theory first proposed by the attorneys and expert in *StarLink*, because it established that, even though corn farmers could not prove their own corn was contaminated with the MIR 162 trait, the negative consequences from contamination of the commodity supply chain still directly harmed them.[72] The *Syngenta* action remains pending.[73]

III. GENERAL ECONOMIC CONCEPTS RELEVANT TO GE CROP CONTAMINATION CASES

The modern market reality is that introducing a restricted or unapproved GE trait into a U.S. crop market, whether by cross-pollination or commingling along the supply chain, results in a market-wide price effect on the particular crop at issue. Such market-wide price effect results in significant financial losses on market participants, particularly farmers, *whether or not they have ever produced GE varieties or have suffered contamination from GE varieties*.[74] That is, because of the inherent *commodity* nature of the products at question, market prices fall across the board, and the loss of markets, especially export markets, is necessarily widespread across all producers.[75] Three core economic concepts—price function,

---

71 *See id.* at 1192 (reiterating the plaintiffs' alleged facts).

72 *See id.* at 1189 (describing the relationship of the parties in that "[t]he parties were not strangers, but rather were part of an inter-connected industry and market, with expectations on all sides that manufacturers and growers and sellers would act at least in part for the mutual benefit of all in that inter-connected web"); *see also In re* StarLink Prods. Liab. Litig., 212 F. Supp. 2d 828, 838–43 (N.D. Ill. 2002) (discussing the economic loss doctrine).

73 *See generally In re* Syngenta AG MIR 162, No. 14-md-2591-JWL, 2016 WL 4705620, at *1 (D. Kan. Sept. 8, 2016) (observing the litigation is ongoing); *see also In re StarLink Corn Prods. Liab. Litig.*, 212 F. Supp. at 838–43 (exploring the economic loss doctrine). During the pendency of this Article, Judge John Lungstrum certified a nationwide Lanham Act class, as well as several statewide classes. In April 2017, he granted summary judgment in defendants' favor on the Lanham Act claim. The initial Syngenta MDL bellwether trial is scheduled to commence in June 2017, while the initial bellwether trial in the Syngenta state court actions pending in Minneapolis is scheduled to commence prior to that.

74 *See generally In re Syngenta AG MIR 162 Corn Litig.*, 131 F. Supp. 3d at 1236 (mentioning the market-wide decrease in the price of corn); *see also Compensation Is Not Protection from GE Contamination: CFS Comments to USDA Advisory Committee on Biotechnology and 21st Century Agriculture*, CTR. FOR FOOD SAFETY 56 (Aug. 23, 2012), http://www.usda.gov/documents/perrone-seiler-comments-behalf-oneil-cfs-82712.pdf [https://perma.cc/4GHK-T7WM] (discussing the economic and social impact of GE and non-GE contaminated items).

75 *See What Drives Commodity Price Changes?*, COMMODITY FACT (2016), http://www.commodityfact.org/#issue1 [https://perma.cc/KX6Z-CBC9] (discussing the market price trends of commodities).

market loss, and market efficiency—explain how an incident of GE contamination can cause all market participants, including farmers, to incur damages.[76]

A. Price as a Function of Supply and Demand

Generally speaking, "[p]rice in [commodity markets] is derived by the interaction of supply and demand."[77] That is, the "market price is dependent upon both of these fundamental components of a market."[78] Therefore, when supply or demand changes, from whatever causes and no matter in which direction, so too will price.[79] For example, lower demand for a commodity product leads to a surplus of the commodity in the marketplace in the short run and results in lower prices for that product to allow the producers to clear the market of the excess supply.[80] Accordingly, when a U.S. crop commodity's demand reduces, it leads to lower market prices for that particular crop variety.[81] While there are always slight shifts in the supply and demand for commodities, GE crop contamination in a U.S. crop commodity market can substantially reduce demand resulting in a corresponding drop in price for the entire U.S.

---

76 *See infra* Part III.A (discussing price function and supply and demand); *see also infra* Part III.B (exploring market loss); *infra* Part III.C (discussing market efficiency).

77 *How Supply and Demand Determine Commodities Market Prices*, TRADINGCHARTS.COM, http://futures.tradingcharts.com/learning/supply_and_demand.html [https://perma.cc/AYJ4-AME6]. More specifically, "[c]orn prices throughout the United States are tied to the Chicago Board of Trade Futures (CBOT) through the 'basis' (defined as the futures price minus the local cash price)." Non-Producer Plaintiffs' Amended Class Action Master Complaint, at 80, *In re* Syngenta AG MIR 162 Corn Litig., (D. Kan. May 29, 2015) (No. 14-md-2591-JWL-JPO). Further, the "U.S. corn market is spatially integrated and informationally efficient. Basis levels for separated markets are also closely linked. Events like trade disruptions that affect the CBOT corn prices directly affect the price that U.S. corn farmers receive for their corn." *Id.*

78 *How Supply and Demand Determine Commodities Market Prices*, *supra* note 77.

79 *See id*. (describing the principle of supply and demand); *see also What Drives Commodity Price Changes?*, *supra* note 75 (exemplifying the effect of supply and demand). Scholars in the area have commented as follows:

> As the G20 Study Group on Commodities noted: The large change in physical supply and demand conditions provide plausible explanations for commodity price swings . . . Moreover, the prices of commodities that are only traded OTC . . . have risen as much as major commodity index components. This may suggest that changes in physical demand and supply, rather than growing financial investments, have been the main drivers of commodity prices.

What Drives Commodity Price Changes?, *supra* note 75 (internal quotation marks omitted).

80 *See generally id.* (discussing the effect of supply and demand on commodity market prices).

81 *See generally id.* (applying the principle of supply and demand to commodity prices).

Valparaiso University Law Review, Vol. 51, No. 2 [2017], Art. 3

market of the affected crop variety.[82] Such was the case after the StarLink incident when U.S. corn market demand, and inherently price, plummeted.[83] One commodities market analyst, for example, recognizing the "major impact" that StarLink had on demand for U.S. corn, noted:

> While increased production elsewhere in the world can reduce U.S. export demand slightly, it does not have a major impact *unless* it is due to quality or other issues. One such issue in 2000/01 was StarLink. StarLink contamination shifted demand to other countries not due to price but due to concerns that food products made from U.S. supplies could be contaminated with StarLink with an eventual need to be recalled from the market.[84]

This unfortunate reality results in all U.S. crop market participants incurring reduced prices for their crops due to the reduced demand and backed-up supply.[85]

B. Market Loss

U.S. crop markets are commodity-based structures that include millions of participants, all of which interconnect in a chain-like fashion.[86] Therefore, when GE crop contamination occurs in a particular U.S. crop variety, all of the market participants that deal in the affected variety incur real and significant economic damages in the form of lost market opportunities, in addition to lower price.[87] In GE contamination cases, U.S. producers experience market loss harm in two primary ways: (1) the GE contamination attaches a stigma to the entire market of the U.S. crop at issue, resulting in a dilution of global confidence in its integrity and causing a drop in demand for the U.S. crop; and (2) an associated reallocation of market share occurs in which competitors begin to occupy the market share positions that were held by U.S. producers before the GE

---

[82] *See, e.g.*, Decl. of Colin A. Carter, *supra* note 38, at 1–2 (illustrating the effect of GE contamination on commodity future prices).

[83] *See id.* at 1 (showing the impact of contamination on the U.S. corn market).

[84] *Id.* at 6 (emphasis added).

[85] *See generally id.* (describing the resulting impact of the contamination).

[86] *See* Jorge Fernandez-Cornejo, *The Seed Industry in U.S. Agriculture: An Exploration of Data and Information on Crop Seed Markets, Regulation, Industry Structure, and Research Development*, U.S. DEP'T AGRIC., Agriculture Information Bulletin No. 786 at 26–27 (2004), http://www.ers.usda.gov/media/260729/aib786_1_.pdf [https://perma.cc/P97E-JLCR] (providing an example of commodity-based structures in the modern history of the U.S. seed industry market).

[87] *See* Decl. of Colin A. Carter, *supra* note 38, at 1 (discussing the damages to U.S. corn producers).

contamination.[88] Once stigma attaches and the market is lost to competitors, that market share is neither easily nor immediately regained.[89]

1. Stigma and Tainted Reputation Leading to Lower Demand

Unfortunately for some commodity market participants, the decreased demand and market loss that necessarily results from the stigma attached to a U.S. commodity crop variety after an incident of GE contamination can be extensive and long in duration, resulting in a price overhang effect (i.e., reduced demand and price over time) for producers.[90] In the case of *StarLink*, for example, the price overhang effect caused by the reduction in demand, and thus price, continued long after the incident.[91] Japan, which at the time was the largest single foreign purchaser of U.S. corn, not only took immediate action to restrict U.S. corn from coming into the country after the initial StarLink contamination announcement, reducing both demand and price for U.S. corn in the short term, but also continued testing U.S. corn imports nine years after the contamination incident.[92] This continued testing substantially tainted the reputation and added certain costs to the entire U.S. corn market over that time period—*despite the fact that "StarLink was planted on less than 1% of the U.S. corn acreage*."[93] Likewise, in *GM Rice*, the U.S. rice market immediately sustained reduced demand, which, in turn, led to lower prices, with the lower demand and prices continuing for many years after the original incident.[94] The plaintiffs' expert in that case opined that "[f]rom the perspective of the U.S. rice farmer, it could be ten years or more before the stigma of the LLRICE contamination is ever removed."[95]

---

88 *See In re* Syngenta AG MIR 162 Corn Litig., 131 F. Supp. 3d 1177, 1223 (D. Kan. 2015) (listing the two types of harm as reputational and decrease in sales). Competitors are typically foreign competitors or companies providing product substitutes. *World Corn Trade*, USDA (2016), http://www.ers.usda.gov/topics/crops/corn/trade.aspx#world [https://perma.cc/AD4R-YB79].

89 *See In re Syngenta AG MIR 162 Corn Litig.*, 131 F. Supp. 3d at 1223 (addressing the effects of reputational injury).

90 *See Market Overhang*, *supra* note 7 (explaining the principle of market overhang as it applies to stock prices).

91 *See* Decl. of Colin A. Carter, *supra* note 38, at 13 (expressing the price overhang effect in *StarLink*).

92 *See id.* at 4 (showing the reduction of corn prices).

93 Supplemental Report of Colin A. Carter, at 10, *In re* Genetically Modified Rice Litig., 251 F.R.D. 392 (E.D. Mo. 2008) (No. 1564-4) (emphasis added).

94 *See* 251 F.R.D. 392, 395 (E.D. Mo. 2008) (mentioning the effects through supply and demand).

95 Supplemental Report of Colin A. Carter, *supra* note 93, at 9.

2. Market Share Loss to Competitors Leading to Lower Demand

The price overhang effect also occurs when foreign competitors of U.S. crop markets increase their share of the market by selling to countries that, before the GE contamination, were buying from U.S. producers.[96] In a commodities market, because of the country-specific regulatory controls involved, new customers or importers do not necessarily formulate as frequently as they may in other markets.[97] Generally speaking, the primary manner for a market participant to gain market share is to do so by shifting demand at the expense of a competitor.[98] For example, as seen in *StarLink*, after the GE contamination announcement, world demand for U.S. corn decreased because corn demand shifted to other countries.[99]

Regaining this lost market share and recovering the demand that goes with it in a previously affected U.S. crop variety is an uphill battle that can take significant effort and considerable time.[100] Shifts in demand due to GE contamination are atypical in that they last much longer than those based on typical economic factors, and thus the harm incurred by producers is more extensive and longer in duration than for ordinary market disruptions.[101]

Accordingly, it is paramount that such price overhang effects be considered and included in GE crop contamination damages models to fully compensate market participants for the market losses they experience by way of either the stigma attached to the U.S. crop market at issue or the market share lost to competitors as a result of the GE contamination.[102] Damages models would do this by measuring the reduction in price over the time period affected.[103] Since both the stigma harm and the market loss harm result in lower demand and in turn lower prices over time, such a measurement would properly allow for producers

---

96 *See generally In re Genetically Modified Rice Litig.*, 251 F.R.D. at 397 (describing the conditions of the market-loss subclass).

97 *See generally International Trade: An Overview*, NAT'L AGRIC. LAW CTR., http://nationalaglawcenter.org/overview/international-trade/ [https://perma.cc/5RHS-K8R3] (providing a general background on international agriculture trade).

98 *See In re Genetically Modified Rice Litig.*, 251 F.R.D. at 393 (illustrating a shift in demand).

99 *See id.* (reiterating contamination impact); *see also In re* StarLink Prods. Liab. Litig., 212 F. Supp. 2d 828, 835 (N.D. Ill. 2002) (discussing global market impact due to U.S. corn contamination).

100 *See generally* Decl. of Colin A. Carter, *supra* note 38, at 5, 10 (showing the prolonged extent of damages).

101 *See* Supplemental Report of Colin A. Carter, *supra* note 93, at 2 (reflecting the price overhang effect from 2002–2010).

102 *See* Decl. of Colin A. Carter, *supra* note 38, at 10 (illustrating the price overhang effect).

103 *See id.* at 10–11, 13 (assessing the extent of the damages).

to recover damages pursuant to the price overhang effect to which they continue to be subjected.[104]

C. Market Efficiency

A final important concept that is necessary to support a damages model that addresses price overhang is market efficiency.[105] "The concept of efficiency as applied to commodity markets is . . . [similar to] the concept . . . [referred] to [in] any other asset market. . . ."[106] In short, market efficiency implies that asset and futures prices incorporate all relevant information available.[107] As Algieri and Kalkuhl have summarized:

> Specifically, a market is efficient if it uses all of the available information in setting futures prices so that there is no opportunity for agents to profit from publicly known information. The idea behind the concept of efficiency is that investors [i.e., market participants] process the information that is available to them and take positions in response to that information, as well as to their specific preferences. The market aggregates all the information and reflects it in the price so that it is impossible for agents to make economic profits [on average over time] by trading on the basis of the existing information set.[108]

As previously noted, U.S. crop markets are efficient markets in which pricing is sensitive to information on supply and demand, and in which cash and futures prices are highly correlated through time.[109] Accordingly, if markets are active, commodity-related information quickly disseminates "among market participants who, upon trading, determine a fair price."[110] Commodity market prices reflect changes and

---

[104] *See id.* at 10 (reflecting the persistent nature of the damages).

[105] *See* Bernardina Algieri & Matthias Kalkuhl, *Back to the Futures: An Assessment of Commodity Market Efficiency and Forecast Error Drivers*, U. OF BONN, ZEF Discussion Papers on Dev. Pol'y No. 195 at 3 (2014), http://www.zef.de/uploads/tx_zefnews/zef_dp_195.pdf [https://perma.cc/99MV-4FC6] (discussing the principle of market efficiency).

[106] Graciela Kaminsky & Manmohan S. Kumar, *Efficiency in Commodity Futures* 2 (Int'l. Monetary Fund, Working Paper, No. 89/106, 1989).

[107] *See id.* at 12 (discussing the "semi-strong" form of the test).

[108] Algieri & Kalkuhl, *supra* note 105, at 3.

[109] *See* Decl. of Colin A. Carter, *supra* note 38, at 1, 7 (reiterating the role of supply and demand).

[110] Nikolaos Milonas, *The Effects of USDA Crop Announcements on Commodity Prices*, 7 J. OF FUTURES MKTS. 571, 571 (1987).

take into account both underlying market fundamentals and market events.[111] In this regard, the GE contamination of a U.S. crop market would be considered a market event.[112]

IV. PRICE OVERHANG DAMAGES MODELING AND ECONOMETRIC ANALYSES

This Part presents illustrative examples of econometric models to measure damages to crop growers caused by crop contamination from GE material.[113] These models specifically allow for empirical measurement of the damages arising to crop growers and potentially other market participants—including the damages that persist years after the actual contamination as a result of the price overhang.[114] In the economics and finance literature, one of the commonly used methodologies to assess such damages is the "event study."[115] This methodology identifies the amount of changes in crop prices as a result of specific events by using the relationship between the crop price series and a yardstick price series and the timing of those events in question.[116] If choice of the yardstick series is made correctly, this yardstick price series and the crop price series should be *cointegrated*, to put it another way, they should move together over time as a result of either the yardstick price series or the crop price series being influenced by common market forces that affect cost and demand factors, as well as changes in macroeconomic factors, such as interest rates and inflation.[117] For example, by using an event study, one can assess the changes in rice future prices as a result of a contamination of LLRICE by using the relationship between rice future prices and a price index that incorporates future prices of various grains.[118]

---

111 *See id.* (equating scheduled and non-scheduled economic announcements as market events).

112 *See id.* (exemplifying crop announcements as market events).

113 *See infra* Part IV (discussing the Augmented Dickey-Fuller ("ADF") test).

114 *See infra* Part IV (examining the results of the author's ADF test).

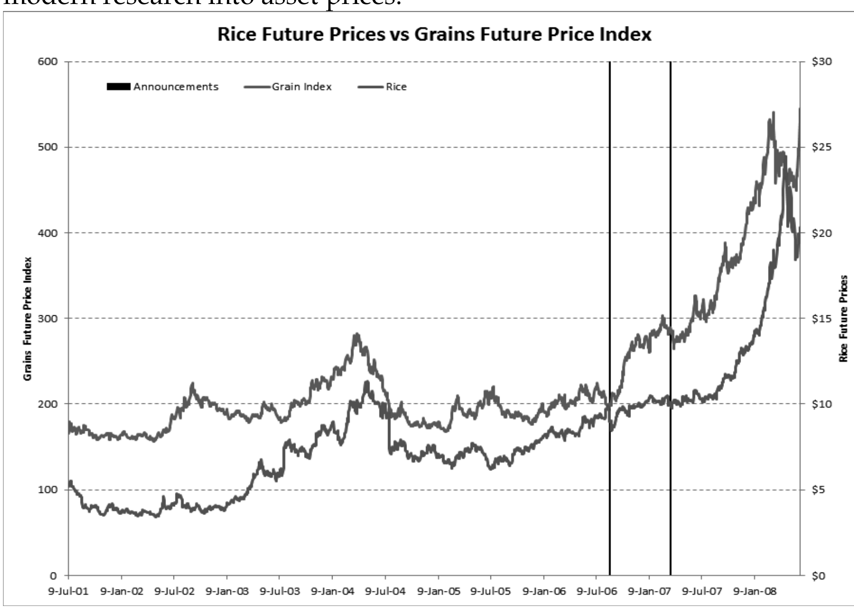
115 *See* Milonas, *supra* note 110, at 578 (discussing the methodology of event studies); *see also generally* S.P. Khotari & Jerold B. Warner, *Econometrics of Event Studies* 2, 4, 5 (Ctr. for Corp. Governance Tuck Sch. of Bus. at Dartmouth, Working Paper, 2006), http://www.bu.edu/econ/files/2011/01/KothariWarner2.pdf [https://perma.cc/K93A-HDYN] (explaining background information on how an event study operates).

116 *See* Milonas, *supra* note 110, at 578 (explaining the relation of price behavior to the event study methodology).

117 *See* Rodney G. Robenstein & Walter N. Thurman, *Health Risk and the Demand for Red Meat: Evidence from Futures Markets*, 18 REV. OF AGRIC. ECON. 629, 632 (1996) (discussing the influence of interest rates and inflation); *see also* C. Alexander, *Optimal Hedging Using Cointegration*, PHIL. TRANS. R. SOC. LOND. A 2039–41 (1999), http://www.carolalexander.org/publish/download/JournalArticles/PDFs/PhilTrans_357_1758.pdf [https://perma.cc/X9D7-2SF5] (providing a definition of cointegration).

118 *See, e.g.*, Robenstein & Thurman, *supra* note 117, at 633 (conducting an analogous study using red meat prices).

One requirement of conducting an event study is that the rice futures prices should be non-stationary; in other words, the LLRICE contamination has a permanent effect on the rice future prices.[119] Similarly, the grain future price index should also be non-stationary, as well as *cointegrated* with the rice future prices.[120] This means that any common factors that would impact these two series should have a permanent effect in both.[121] This statistical property is tested for using standard statistical software, and these tests are the backbone of much modern research into asset prices.[122]



To confirm that the rice future prices and the grains future price index series are non-stationary, we conducted the Augmented Dickey-Fuller ("ADF") test, which is one of the standard tests for stationarity of a time

119 *See* Milonas, *supra* note 110, at 578 (finding future prices to be non-stationary).

120 *See generally id.* (exemplifying how commodity prices are non-stationary in event study tests).

121 *See* Shu-Ling Chen et al., *What Drives Commodity Prices?* (Auburn U. Dept. of Econ., Working Paper No. 2010-05, 2010), http://www.cla.auburn.edu/econwp/archives/2010/2010-05.pdf [https://perma.cc/D9EW-562E] (illustrating the role of multiple factors in cointegration tests).

122 *See, e.g.*, Eugene F. Fama et al., *The Adjustment of Stock Prices to New Information*, 10 INT'L ECON. REV. 1, 2–3 (1969) (discussing stock dividends); *see also* John J. Binder, *The Event Study Methodology Since 1969*, 11 REV. OF QUANTITATIVE FIN. & ACCT. 111, 126 (1998) (summarizing the use of statistical methodologies); Robenstein & Thurman, *supra* note 117, at 630 (discussing red meat future prices).

series.[123] The null hypothesis in this case is that each one of the rice future price series and the grains future index series is non-stationary.[124] We calculated the ADF test statistic for the rice future prices to be 1.859 and for the grains future index to be 2.965, each of which is greater than the 5 percent critical ADF value of -2.876, indicating that we cannot reject the null hypothesis of non-stationarity for either of these price series.[125]

To test whether the rice future prices and grains future price index are cointegrated, we conducted the Johansen's Maximum Likelihood test.[126] The results of this test suggest that the null hypothesis of no cointegrating vector should be rejected at the 5 percent level of significance (since the trace statistic is 26.884, which is greater than the 5 percent critical value of 15.41), whereas the null hypothesis of one cointegrating vector should not be rejected at the 5 percent level of significance (since the trace statistic is 2.95, which is less than the 5 percent critical value of 3.76).[127] Therefore, these two series are cointegrated; in other words, they move together and do not diverge from each other too much in the long run.[128]

---

[123] *See* Levitt-Lamb, *Rice Future Prices vs. Grains Future Price Index* (showing the results of the author's ADF test). This graph is an original adaptation of data from the Chicago Board of Trade and the Commodity Research Bureau. *See also Rough Rice (Globex) Futures Charts*, TRADINGCHARTS.COM, http://futures.tradingcharts.com/chart/ZR/M?anticache=1477410208 [https://perma.cc/J4RA-5WE6] (citing to the rough rice future price index spanning from 2008–2016); *Grains Future Price Index*, U.S. CENSUS BUREAU, http://ftp.census.gov/library/publications/2011/compendia/statab/131ed/tables/12s0735.pdf [https://perma.cc/JB36-FDS2] (reflecting the grains and oilseeds futures price index spanning from 1990–2010); *What's the Augmented Dickey-Fuller Test?*, ABOUT, INC. (July 8, 2015), http://economics.about.com/cs/economicsglossary/g/augmented.htm [https://perma.cc/66NG-HXX2] (clarifying the definition of the ADF test).

[124] *See* Levitt-Lamb, *supra* note 123 (hypothesizing the grains future price index to be non-stationary). In statistical terms, the statement being tested is called the "null hypothesis." *See* Martyn Shuttleworth, *Null Hypothesis*, EXPLORABLE, https://explorable.com/null-hypothesis [https://perma.cc/MF87-V4F5] (explaining the concept of a null hypothesis). In this case, the statements being tested are whether each one of the rice future price series and the grains future index series is non-stationary. *See* Levitt-Lamb, *supra* note 123 (providing statistical representation of a future price index). In general, this tests whether any external shocks, such as contamination announcements, will have a permanent effect in rice future prices and grains future index series. *Id.*

[125] *See* Levitt-Lamb, *supra* note 123 (showing the rice and grains future price indices).

[126] *See* Erik Hjalmarsson & Par Osterholm, *Testing for Cointegration Using Johansen Methodology When Variables Are near-Integrated* 5–6 (Int'l Monetary Fund, Working Paper No. 07/141, 2007) (discussing how the Johansen's Maximum Likelihood test involves multiple statistical tests, which start with the null hypothesis of having no cointegrating factor between the rice future prices and grains future price index series). If this null hypothesis is rejected, the next test is performed with the null hypothesis of having one cointegrating factor. *Id.* If this null hypothesis cannot be rejected, it can be concluded that the rice future prices and grains future price index series are cointegrated. *Id.*

[127] *See* Levitt-Lamb, *supra* note 123 (showing the authors' conclusions).

[128] *See id.* (drawing a conclusion based on the authors' findings).

The ADF test was also conducted to determine whether the one-week returns of the rice future prices and the one-week returns of the grain future price index are non-stationary.[129] If the one-week returns of each of these two series are stationary, that is to say they have constant mean and variations over time, we can run a regression to explain rice future prices with grain future prices, using these stationary series to avoid the potential problem of overfitting.[130] Based on this analysis's calculations, we determined that the ADF test statistic for the one-week returns of the rice future prices was -15.672, and for the one-week returns for the grains future index was -15.033—each of which is less than the 5 percent critical ADF value of -2.876, indicating that we should reject the null hypothesis of non-stationarity for the one-week return series for rice future prices and grains future price index.[131] Therefore, the one-week returns of the rice future prices and the one-week returns of the grain future price index are stationary, meaning that they have a constant mean and variance, so that any disturbance to the series, such as the presence of GE contamination and the resulting drop in demand, and thus price, has only a temporary effect on the one-week return series, meaning the series reverts back to their means after the disturbance.[132] Even though these one-week return series will revert back to their means, the disturbance will have a permanent effect on the non-stationary series of the levels of rice future prices and the grain future price index.[133]

After verifying that the rice future prices and grains future price index series are non-stationary and cointegrated, and the one-week return series for both of these prices are, in turn, stationary, the relationship was estimated between the two to understand how GE events affect the one-

---

[129] *See infra* Part IV (providing the authors' ADF findings); *see also* Levitt-Lamb, *supra* note 123 (depicting the authors' outcomes).

[130] *See infra* Part IV (discussing the authors' results). Overfitting can result in regressions of non-stationary series on each other. *See Overfitting*, INVESTOPEDIA (2016), http://www.investopedia.com/terms/o/overfitting.asp [https://perma.cc/P33U-LQ2Z] (defining overfitting). Such regressions are called spurious regressions in the econometrics literature. *See* David E. A. Giles, *Spurious Regressions with Time-Series Data: Further Asymptotic Results*, U. OF VICTORIA, B.C., DEP'T OF ECON. 1, http://web.uvic.ca/~dgiles/blog/spurious.pdf [https://perma.cc/9D7M-JLNJ] (exploring spurious regressions).

[131] *See* Levitt-Lamb, *supra* note 123 (showing the results of the ADT test).

[132] *See* Jeffrey Parker, *Regression with Nonstationary Variables* 65 (2015) (unpublished manuscript) (on file with Reed College) (Sept. 29, 2016), www.reed.edu/economics/parker/312tschapters/S13_Ch4.pdf [https://perma.cc/9VJQ-73DN] (stating the tendency of a stationary variable is to revert back to its means after a disturbance).

[133] *See Trend-Stationary vs. Difference-Stationary Process*, MATHWORKS, https://www.mathworks.com/help/econ/trend-stationary-vs-difference-stationary.html [https://perma.cc/6W4D-UMVV] (explaining that time series with stochastic trends have permanent effects from a shock).

week returns of rice future prices in the market by running the following log-log regression model:

$$Log(ReturnRice) = \beta_0 + \beta_1 Log(ReturnGrains) + \delta_1 D_{Aug2006} + \delta_2 D_{Mar2007}.$$[134]

The parameter β_1 measures the relationship between one-week returns in rice future prices and one-week returns in the grains future index. The variables $D_{Aug2006}$ and $D_{Mar2007}$ take the value of one during the weeks of the announcements of LLRICE contamination in August 2006 and March 2007, respectively; otherwise these indicator variables take the value of zero. The parameters of interest in this event study are δ_1 and δ_2, which measure the effects of contamination announcements on the returns of rice future prices.

The results of the regression estimating the effects of the contamination announcements on the returns of rice future prices are reported in the table below.[135]

---

[134] *See* A. Joseph Guse, *Log-Level and Log-Log Transformations in Linear Regression Models* (2012), http://home.wlu.edu/~gusej.econ398/notes/logRegressions.pdf [https://perma.cc/R7B3-Q34K] (showing the log-log regression model used). A model is characterized as "log-log" if both the dependent variable and the independent variables or regressors are measured as logarithms of the variable of interest. *Id.* This means that the coefficients on the independent variables may be interpreted as the effect, in percentage terms, on the dependent variable from a one percent change in the regressors. *See Interpreting Coefficients in Regression with Log-Transformed Variables,* CORNELL STAT. CONSULTING UNIT (June 2012), https://www.cscu.cornell.edu/news/statnews/stnews83.pdf [https://perma.cc/G33B-NE4G] (explaining how regression equations can change). Economists refer to such coefficients as elasticities. Reem Heakal, *Economics Basics: Elasticity,* INVESTOPEDIA, http://www.investopedia.com/university/economics/economics 4.asp [https://perma.cc/HU7Q-MWFS] (defining elasticity). Elasticities are "unit free," meaning that they express a relationship that is independent of the units of measure. *See* John Black et al., *A Dictionary of Economics: Unit-free Measure* (3d ed. 2009), http://www.oxfordreference.com/oso/viewentry/10.1093$002facref$002f9780199237043.001.0001$002facref-9780199237043-e-3255 [https://perma.cc/R73Y-JQE5] (furthering the idea of "unit-free" measure).

[135] Rice Regression Results (table).

Rice Regression Results

Parameters[1]	Coefficient	Std. Error	t-Value
Return in Grains Future Price Index	0.246	0.075	3.260
Announcement indicators			
August 2006	-0.073	0.035	-2.060
March 2007	-0.019	0.035	-0.540
R^2			0.04
F-Statistic			3.79
Number of Observations			360
Date Range	July 2001 through June 2008		

Notes:
[1] The coefficient estimate for the intercept is not shown in the table.

These results suggest that there is a positive and statistically significant relationship between returns in the grains future price index and returns in rice future prices. The coefficients on the announcement indicator variables measuring the effect of these announcements on returns in rice future prices are important results from this regression. If these coefficients are statistically significant and negative, they indicate that returns in rice future prices are lower as a result of the effects of these announcements than would have been predicted in the absence of these announcements. Of these two indicator variables, only one is statistically significant and negative, at -0.073, indicating that returns in rice future prices were 7.1 percent lower due to the contamination announcement of LLRICE in August 2006.[136] The March 2007 indicator coefficient is negative; however, it is not statistically significant. Therefore, the rice future prices went down by 7.1 percent in one week after the contamination announcement on August 18, 2006. Since the rice future price series is non-stationary, this 7.1 percent decrease in the series will not be recovered in the long run until another shock results in a statistically significant disturbance in the series. This 7.1 percent price decline is the measure of the price overhang resulting from the statistical analysis presented here.

In the second example, an event study was implemented to measure the reduction in corn prices after the *Washington Post*'s September 18, 2000

[136] This interpretation is subject to a slight adjustment due to the logarithmic form of the returns in rice future prices used in the regression model: -7.1 percent is calculated by exp(-0.73-(0.5*0.035^2))-1. *See* Peter E. Kennedy, *Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations*, 71 AM. ECON. REV. 801, 081 (1981).

report that StarLink had been detected in taco shells.[137] In this case, we only had access to the Producer Price Index ("PPI") series for corn.[138] Instead of using the grains future price index as was used for the LLRICE case, the PPI series was used for sorghum, which is a close substitute for corn.[139] Therefore, the sorghum PPI series is used as a yardstick PPI series for corn.[140] As shown in the chart figure below, the PPI series for corn and sorghum are very similar.[141] Indeed, the correlation coefficient for these series is ninety-eight percent.[142]

---

[137] *See* Marc Kaufman, *Biotech Critics Cite Unapproved Corn in Taco Shells,* WASH. POST (Sept. 18, 2000), https://www.washingtonpost.com/archive/politics/2000/09/19/biotech-critics-cite-unapproved-corn-in-tacho-shells/e7973551-d51 [https://perma.cc/49WE-RBRU] (providing the group that had the taco shells tested asked the FDA to recall the products immediately).

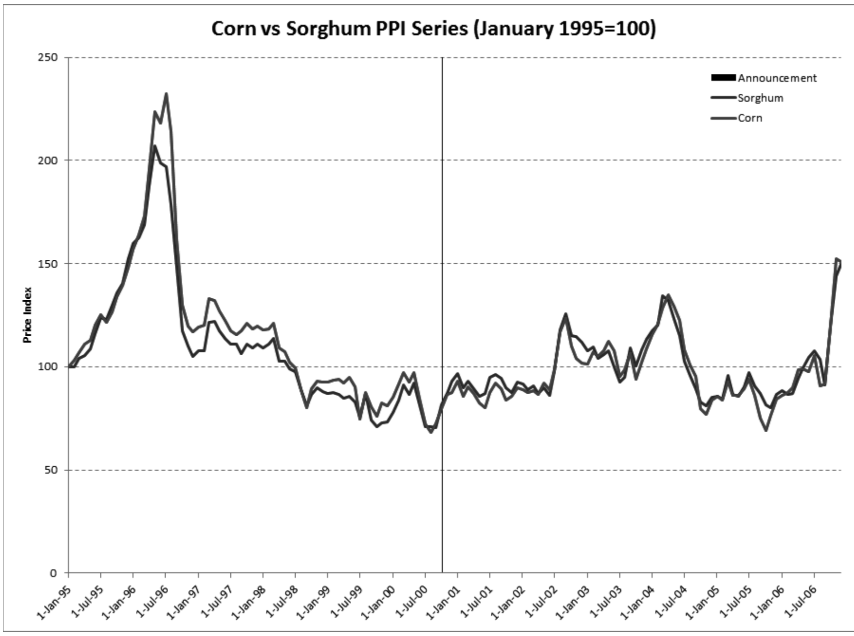
[138] *See Producer Price Index by Commodity for Farm Products: Corn (WPU012202)*, U.S. BUREAU OF LABOR STAT. (Sept. 15, 2016), https://www.fred.stlouis.org/series/WPU012202 [https://perma.cc/9REC-3PYN] (previewing the Producer Price Index ("PPI") series for corn).

[139] *See Corn Agronomy: Sorghum*, U. OF WIS. (Aug. 23, 2012), https://www.corn.agronomy.wisc.edu/Crops/Sorghum [https://perma.cc/WN42-S3C2] (highlighting that sorghum is a high dry matter and a short-day plant like corn).

[140] *See* HERBERT HOVENKAMP, FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE 605–07, 611 (West Publishing Co., 1994) (analyzing two different methods of measurement: "yardstick" and "before-and-after").

[141] *See Producer Price Index by Commodity for Farm Products: Corn (WPU012202)*, *supra* note 138 (reflecting the price of corn from January 1995 to July 2006); *see also Producer Price Index by Commodity for Farm Products: Sorghum, (WPU012205)*, U.S. BUREAU OF LAB. STAT., https://fred.stlouis.fed.org/series/WPU012205 [https://perma.cc/2CDQ-73MM] (reflecting the price of sorghum from January 1995 to July 2006).

[142] *See Producer Price Index by Commodity for Farm Products: Sorghum*, *(WPU012205)*, *supra* note 141 (showing the correlation coefficient between corn and sorghum).



Source: U.S. Bureau of Labor Statistics Producer Price Index by Commodity for Farm Products: WPU012202 for Corn, WPU012205 for Sorghum

The first step in an event study is to check whether the corn PPI and sorghum PPI series are non-stationary by conducting the ADF test.[143] The ADF test statistic for the corn PPI to be -1.711 and for the sorghum PPI series to be -1.524, each of which is greater than the 5 percent critical ADF value of -2.887, indicating that the null hypothesis of non-stationarity for either of these price series cannot be rejected.[144] That is, the series are non-stationary, meaning that any disturbance will not revert back to the mean relationship over time, but rather persist in the series.[145] Thus, in thinking about damages measures for growers injured by a GE contamination event in this market, the injury persists for a long time period, thus

---

143 *See* Yin-Wong Cheung & Kon S. Lai, *Lag Order and Critical Value of a Modified Dickey-Fuller Test*, 57 OXFORD BULL. OF ECON. & STAT. 411, 411 (1995) (defining the ADF test as a test that examines the null hypothesis of a unit root against stationary alternatives). "[T]he null hypothesis maintained is a nonstationary process, empirical failures to find stationary may reflect the power of the test." *Id.*

144 *See What's the Augmented Dickey Fuller Test?*, *supra* note 13 ("[T]he [augmented] Dickey-Fuller test is used to determine whether a unit root, a feature that can cause issues in statistical inference, is present in an autoregressive model.").

145 *See* Parker, *supra* note 132, at 65 (asserting that the tendency to revert back to the mean is central to the Dickey-Fuller test).

necessitating the consideration and calculation of these "price overhang" damages.[146] The ADF test was also conducted to determine whether one-month differences for the corn PPI and one-month differences for the sorghum PPI are non-stationary.[147] The ADF test statistic for one month differences for the corn PPI was -9.063 and for one-month difference for the sorghum PPI was -9.525, each of which is less than the 5 percent critical ADF value of -2.887, indicating that the null hypothesis of non-stationarity for one-month differences for both corn PPI and sorghum PPI series should be rejected.[148] That is, these series are stationary, so that they revert back to their mean levels following a shock.[149] This phenomenon, in which the *level* of the series is non-stationary, but the first-difference (i.e., the change from month to month) is stationary, is a common pattern for economic time series, and such series are referred to as first-difference stationary.[150]

To test whether the corn and sorghum PPI series are cointegrated, the Johansen's Maximum Likelihood test was conducted.[151] The results of this test suggest that the null hypothesis of no cointegrating vector should be rejected at the 5 percent level of significance, since the trace statistic of 30.574 is greater than the 5 percent critical value of 15.41.[152] This means

---

146 *See Overhang*, INVESTOPEDIA, https://www.investopedia.com/terms/o/overhang.asp [https://perma.cc/453U-V6T3] (defining overhang as "a measure of the potential dilution to which a common stock's existing shareholders are exposed due to the potential that stock-based compensation will be awarded to executives, directors[,] or key employees of the company").

147 *See* Parker, *supra* note 132, at 65 (explaining that the basis of the ADF test is that the tendency of stationary variables is to revert back to the mean).

148 *See id.* (claiming that if the calculated test statistic is less than the negative critical value, the null hypothesis is rejected).

149 *See id.* ("This tendency to revert back to the mean is the intuitive basis for the oldest and most basic test for stationarity: the *Dickey-Fuller test*.").

150 *See The Only Hope for Business/Economic Forecasting: Stationary Stochastic Processes*, QUANTITATIVE & APPLIED ECON. (Jan. 1, 2011), http://www.espin086.wordpress.com/tag/stationary-process/ [https://perma.cc/7QRM-E8LB] ("If the first difference of a stationary time series is stationary the[n] it is said to be integrated of order 1 or I(1)."). For example, taking the first difference of a non-stationary series that increases by a constant amount over time yields a stationary series with a constant mean that is equal to the amount the non-stationary series increases.

151 *See* Gerald P. Dwyer, *The Johansen Tests for Cointegration* 1 (Apr. 2015), https://www.jerrydwyer.com/pdf/Clemson/Cointegration.pdf [https://perma.cc/F9RF-SYUS] (explaining that "[t]he Johansen test and estimation strategy—maximum likelihood—makes it possible to estimate all cointegrating vectors when there are more than two variables").

152 *See id.* at 4 (providing that the first test is the test of the null hypothesis of no cointegration against that of the alternative of cointegration).

that the two series have a significant statistical relationship, so movements in one series are likely to predict movements in the other series.[153]

After verifying that the corn PPI and sorghum PPI series are non-stationary and cointegrated, and the one-month differences for both of these series are stationary, the following log-log regression model was run to measure the amount by which corn prices were *permanently* lower as a result of the contamination event in question, and the resulting drop in market demand:

$$Log(Corn_{Diff}) = \beta_0 + \beta_1 Log(Sorghum_{Diff}) + \delta_1 D_{announcement}.$$

The variables $Corn_{Diff}$ and $Sorghum_{Diff}$ indicate one-month differences of corn PPI and sorghum PPI series, respectively.[154] The parameter β_1 measures the relationship between one-month differences in corn PPI and one-month differences in sorghum PPI series. The variable $D_{announcement}$ takes the value of one in October 2000, the month immediately following the announcement of StarLink contamination; otherwise, this indicator variable takes the value of zero. The parameter of interest in this event study is δ_1, which measures the effect of the contamination announcement on the one-month differences in corn PPI series.

The results of the regression estimating the effect of the contamination announcement on the one-month differences in corn PPI series are reported in the table below.[155]

Corn Regression Results 1

Parameters[1]	Coefficient	Std. Error	t-Value
One month differences in Sorghum PPI Series	1.000	0.042	23.720
Announcement indicator			
October 2000	-0.071	0.037	-1.930
R^2			0.80
F-Statistic			283.84
Number of Observations			144
Date Range			Jan 1995 through Dec 2006

Notes:
[1] The coefficient estimate for the intercept is not shown in the table.

---

153 *See* Hjalmarsson & Osterholm, *supra* note 126, at 5–6 (describing the Johansen's Maximum Likelihood test).

154 *See* Guse, *supra* note 134 (providing the log-log regression model used). The authors are inputting $Corn_{Diff}$ in for the y value in the formula and $Sorghum_{Diff}$ in the x1 variable in the formula.

155 Corn Regression Results 1 (table).

The results suggest that there is a positive and statistically significant relationship between the one-month differences in corn PPI series and the one-month differences in sorghum PPI series. The coefficient on the announcement indicator variable, the empirical analog to the theoretical coefficient referred to as δ_1 above, which measures the effect of the announcement on one-month differences in corn PPI series, is one important result from this regression. This coefficient is statistically significant and negative, at -0.071, indicating that one-month differences in corn PPI series were seven percent lower due to the StarLink contamination announcement.[156] Therefore, the corn PPI series went down by seven percent in one month after the contamination announcement. Since the corn PPI series is non-stationary, this seven percent decrease in the series will not be recovered in the long run until another shock results in a statistically significant disturbance in the series. This highlights the need to account for price-overhang damages arising from GE contamination when calculating damages to market participants.

As explained above, the sorghum PPI series is used as a yardstick PPI series for corn.[157] In addition to the event study methodology, both corn and sorghum PPI series can be used in a regression model to estimate the but-for corn PPI values—the corn PPI values in the absence of any contamination announcement.[158] The difference between the but-for corn PPI and the observed corn PPI values is the effect of the contamination announcement on corn PPI values. This methodology is called a yardstick analysis.[159]

Because sorghum and corn are close substitutes in both production and consumption, both crops are influenced by the same supply and demand factors.[160] Therefore, in the regression model, the natural logarithm of the sorghum PPI series is the only explanatory variable.[161] To measure the effect of contamination announcement on corn PPI values, an

---

156 *See* Kaufman, *supra* note 136 (highlighting when the StarLink contamination announcement was made). Similar to the rice regression, this interpretation is subject to a slight adjustment due to the logarithmic form of the regression model. Authors' Table, *supra*, note 135.

157 *See* HOVENKAMP, *supra* note 140, at 605–06 (explaining the "yardstick" method of measurement).

158 *See* Guse, *supra* note 134 (giving the log-log regression model).

159 *See* HOVENKAMP, *supra* note 140, at 605–06 (furthering the discussion of yardstick measurement).

160 *See, e.g.*, *Five-Year Global Supply and Demand Projections*, INT'L GRAINS COUNCIL 19 (Dec. 2014), https://www.igc.int/en/downloads/grainsupdate/igc_5yrprojections2014.pdf [https://perma.cc/796T-G979] (providing an example of the higher demand in China for sorghum).

161 *See* Guse, *supra* note 134 (giving the log-log regression model used). The authors used the sorghum PPI series as the explanatory variable.

indicator variable that covers the period from the announcement day through the end of the analysis period is used. By using these variables, the following regression model is estimated:

$$Log(Corn) = \beta_0 + \beta_1 Log(Sorghum) + \delta_1 D_{announcement\ period}.$$ [162]

The variables *Corn* and *Sorghum* indicate the corn PPI and sorghum PPI series, respectively. The parameter β_1 measures the relationship between the corn PPI and the sorghum PPI series. The variable $D_{announcement\ period}$ takes the value of one from October 2000—the month immediately following the announcement of StarLink contamination—through December 2006; otherwise, this indicator variable takes the value of zero. The primary parameter of interest in this yardstick analysis is δ_1, which measures the effect of the contamination announcement on the corn PPI series. In the but-for world—when there is no GE contamination event and thus the indicator variable $D_{announcement\ period}$ is zero—corn PPI values are estimated by adding the estimate of β_0 to the value obtained by multiplying the estimate of β_1 by the natural logarithm of sorghum PPI values.

The results of the regression estimating the effect of the contamination announcements on the corn PPI series are reported in the table below.[163]

Corn Regression Results 2

Parameters[1]	Coefficient	Std. Error	t-Value
Sorghum PPI Series	1.025	0.018	56.630
Announcement period indicator			
October 2000 through December 2006	-0.073	0.008	-9.400
R^2			0.96
F-Statistic			1,798.96
Number of Observations			144
Date Range			Jan 1995 through Dec 2006

Notes:
[1] The coefficient estimate for the intercept is not shown in the table.

The results suggest that there is a positive and statistically significant relationship between the corn PPI series and the sorghum PPI series, as

[162] *See* Guse, *supra* note 134 (giving the generic log-log regression model used throughout the study). In this specific regression model, the authors put Corn for the y-value, Sorghum for the x-value, and the announcement day through the end of the analysis period for D. The following subsequent unfootnoted sentences represent an explanation of the formula found from this source.

[163] Corn Regression Results 2 (table). The following subsequent unfootnoted material represents the authors' interpretation of the table.

the two series are cointegrated. The coefficient on the announcement period indicator variable measuring the effect of the announcement on the corn PPI series is one important result from this regression. This coefficient is statistically significant and negative, at -0.073, indicating that the corn PPI series were 7.1 percent below what it would have been in the but-for world as a result of the contamination announcement for StarLink.[164] This estimate is nearly the same as the seven percent estimate of the event study methodology, confirming the validity of these two approaches in estimating the price overhang effect of the contamination announcement in corn PPI series.

V. CONCLUSION

In agricultural commodity markets, shifts in demand and supply are propagated across the entire market because of the commodity nature of the product. Shifts in demand can result in large price changes owing to the rigidity, that is, the inelasticity, of supply. In the case of supply chain contamination caused by the presence of GE plant material, the resulting drop in demand has been shown to be persistent in the marketplace, as buyers, especially importers of U.S. commodities, are hesitant to reopen markets after a GE contamination event. This Article demonstrates that sound econometric analysis confirms that, for two major GE contamination events, the price overhang effect is significant, both economically and statistically. Thus, accounting for damages attributable to the price-overhang effect is critical in restoring market participants to the same level of well-being that would have prevailed in a world absent the GE contamination and is, moreover, crucial to consider in any damages modeling or related analyses in litigation arising out of these types of market-shifting contamination events.

---

[164] Similar to the previous regression models, this interpretation is subject to a slight adjustment due to the logarithmic form of the regression model.