Quest

Volume 3 Article 4

2019

Genetically Modified Organisms in the United States Crop Market

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Economic Analysis

Research in progress for ECON 2302: Principles of Microeconomics

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The following paper represents research begun by students in Honors Principles of Microeconomics. The honors course introduced students to numerous economic models and methods of analysis. Students were asked to identify an economic issue or controversy related to topics studied in class and to provide a literature review relevant to their topic. Students were also asked to provide an economic analysis, discuss opposing viewpoints, present an economic evaluation of various policy options, and make a recommendation regarding the preferred policy response.

In the following economic analysis, Toluwani Ogunbayode examines the effects of Genetically Modified Organisms (GMOs) on the United States crop market. Toluwani uses multiple economic concepts in analyzing GMOs, including consumer choice, market impacts, and market failures and externalities. The paper also provides a social perspective to provide insight into the full costs and benefits of GMOs in agriculture production. This paper will further his understanding of the complexities of agricultural markets and economic methods for policy analysis in agricultural economics.

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Introduction

Food production methods have evolved: from the practice of subsistence agriculture, to mechanized agriculture, and, presently, to biotechnical agriculture. These three methods were developed with an aim to advance agricultural production. Biotechnical agriculture is the use of genetic technology to predetermine the traits and characteristics of a crop by adding and removing undesirable or desirable genes in the crop's genetic structure (Goldbas, 2014, p. 20). The biotechnical method of food production led to the use of Genetically Modified Organisms (GMOs) in agriculture. GMOs are organisms whose genetic structures have been altered by mutating, adding, or removing some genes through biotechnology (Goldbas, 2014, p. 20). Economically, GMOs have affected the crop market positively and negatively, sometimes resulting in medical issues from the misuse of herbicides. The effect of GMOs has also resulted in social issues caused by unintended crop contamination, which has led to several lawsuits. This paper examines the impact of GMOs in the U.S. crop market from a perspective of supply and demand, market failure, both social and medical externalities, market segregation, consumer choices, and market competition.

Supply and Demand

The use of GMOs as a means of food production is proven to have economic benefits because these plants produce a high crop yield and increase the supply of

produce. Farming with GMOs became a legal method of food production in the 1990s and was first tested with tomatoes (Fraiture et al., 2015, p. 1). In less than three decades, researchers reported exponential growth in GMO farming to 18.5 million hectares of plants in 28 nations around the world (Fraiture et al., 2015, p. 1). The increase in the use of GM crops can be closely linked to high crop yield because GM crops can yield significantly more than non-GM crops. The genetic mutation of seeds modifies and improves their ability to yield more produce and has enhanced the seed's ability to grow out of season (Goldbas, 2014, p. 21). GM crops have an improved adaptability to harsh climate conditions and can grow in regions with usually unfavorable weather conditions. With these types of crops in place, farmers can plant and harvest their produce all year, which does not limit the crop to the short traditional growing season. These increase the supply of crop produce to the market and eventually increase the availability of crops in locations where the climate conditions do not naturally support sufficient plant growth to feed a growing population.

Market Effects

Positive Externalities

GM crops have also been identified as resistant to some pests and diseases. Given the availability of crops with these characteristics, farmers save money traditionally spent on pesticides, making these crops less expensive to grow. GM crops can lead to an increase in the supply of food to the market and can create an easier food production method for farmers due to their cost-efficient production and high crop yield. Since GM crops can be produced more easily than non-GM crops, the supply of

GM crops to the market has increased. This has resulted in a lower price for GM crops, since the increase in the supply of produce has the ability to reduce the price. Goldbas (2014), a professor at Walden University who specializes in genetic engineering, writes in the *International Journal of Childbirth Education*, "To many, especially those charged with preventing starvation and malnutrition in developing countries, GMOs are considered major biotechnical advancements in agriculture" (p. 21). If GM crops are continuously cultivated, this could ultimately solve the problem of starvation and food scarcity in many rural areas. In addition, there could be increased crop yield in places afflicted with food inadequacy and unfavorable farming conditions. Many rural and poverty-stricken areas would be able to afford a reasonable quantity of food at a fair price.

Recent studies indicate that GM crops have a high potential for medical benefits. Several medical treatments, like the Hepatitis B vaccine, are created using GMOs; many of these medications have improved the human immune system to prevent diseases (Goldbas, 2014, p. 20). Furthermore, new findings from GMO research show improvement with the processes of childbirth, increasing the safety measures for the mother-to-be and the unborn child. Goldbas (2014) claims, "The drug ATryn is from transgenic goat's milk; it is an anticoagulant used to reduce blood clots in childbirth and surgery" (p. 20). GMO advancements led to the development of new crops that have an increased level of vitamin and mineral content. Specifically, genetic modification has been used to make protein insulin that is prescribed to treat diabetes (Goldbas, 2014, p. 21). With the availability of crops possessing these healthful characteristics, many

malnutrition problems can be solved by crops with a higher nutritional value supplied to the market.

Negative Externalities

GMOs have, however, been known to cause some negative effects with their changed biology such as an increase in the use of herbicides. Herbicides are chemical substances used to prevent the growth of weeds and other undesirable crops on farmland. GMO crops are commonly known to be resistant to herbicides. Some of the genes in GMO crops have been modified with the ability to withstand the effect of herbicides; as a result, GMO farmers tend to apply these chemical substances with less restraint. These herbicides contain certain chemicals that can affect the growth of desired crops in the process of preventing unwanted plants. Many of these herbicides are harmful to the soil, essential soil bacteria, and the environment. Consequently, non-GMO farmers tend to apply these substances in limited quantities and with caution. Landrigan and Benbrook specialize in GMO herbicides and are members of the Department of Preventive Medicine in New York and the Department of Crops and Soil Sciences in Washington State University. Landrigan and Benbrook (2015) make the following point in *The New England Journal of Medicine*: “First, there have been sharp increases in the amounts and numbers of chemical herbicides applied to GM crops, and still further increases—the largest in a generation—are scheduled to occur in the next few years” (p. 694). Since GM crops are resistant to herbicides, GMO farmers tend to use less constraint in the application of these chemicals. The reason for this misuse of herbicides is because GMO farmers are assured that the effects of the herbicides will

not impact their crops. However, they forget that the application of concentrated chemicals such as herbicides may cause indirect effects on the crops as they directly affect the soil and environment. In addition, the effects of GMOs have raised concerns about their impact on the environment. There has been a traceable relation between the impact of GMOs on the environment and some ecological concerns, like the possible negative impact of GMOs on Monarch Butterflies.

GMOs may be less expensive; however, scholars have illustrated that the consumption of GM crops can pose a threat to human health. The modification of genes in many of these crops has the potential to create health problems. Since many of the genes are experimented on in order to develop desirable traits, there may be unknown effects in the modification processes. The International Agency for Research on Cancer has classified glyphosate, which is the most commonly used herbicide on GM crops, as a “probable human carcinogen” (Landrigan & Benbrook, 2015, p. 694). The chemicals in the herbicides used on GM crops contain several carcinogenic substances that have negative effects on human health. Specifically, glyphosate and 2,4-dichlorophenoxyacetic, which are some of the most commonly used chemicals in the herbicides applied on GM crops, pose hazardous health effects. In fact, 2,4-dichlorophenoxyacetic is a component of the Agent Orange defoliant used in the Vietnam War (Landrigan & Benbrook, 2015, p. 695).

Social Problems

As prevalent as the medical effects may seem, GMOs have also caused some major social ramifications legally. There have been several legal issues resulting from

the transition of GMOs to the crop market. The most prevalent of these issues is the problem of unintended crop contamination that has resulted from the unpredictable spread of pollen grains. Pollen grains of different crops can be spread by several natural occurrences like the flow of wind or water and the movement of animals or insects. The wind or animals could accidentally transport GMO pollen from GMO farmland into non-GMO farmland. These pollen grains can fertilize the flowers of the non-GMO crop, leading to a contamination of the crop's purity. As a result of this accidental transfer of pollen grains, GMO crops are found growing on non-GMO farmland. This occurrence has led to several contaminations of non-GMO crops and farmland, leaving the crops of the non-GMO farmer GMO positive. In contrast, the cause of unintended crop contamination does not occur in a reverse situation, when a non-GMO crop is transferred into a GMO farmland.

There have been several court cases filed against both the non-GMO and GMO farmers; in most cases the non-GMO farmer is on the losing end. Research conducted on GM-crop field trials in 2008 by Christophe Bonneuil, Pierre-Benoit Joly, and Claire Marris, published in the *Science, Technology, & Human Values Journal*, explains the effects of unintended crop contamination. The authors state, "Between 1986 and 1996 thousands of field trials of genetically modified crops took place in France. The country ranked second only to the United States in terms of the number of field tests carried out and these experiments triggered no protests, whereas they did so in the United States" (p. 201). The unintended crop contamination has created several complications for non-GMO farmers; many of these farmers have faced severe economic loss from the

tarnishing of their reputation. On the opposing side, GMO farmers have several organizations and agencies in their support because of the constrained sale of GMO seed. As a result, when non-GMO farmer's crops are tested to be GMO positive, there is a high chance of lawsuits being filed against these farmers for the possession of GMO crops under a non-GMO brand.

Market Segregation

Although GMOs increase crop yield, they also impede sales in the crop market. Before the transition of GMOs, crop production was categorized in one catalog, simply called crop market, but since this transition, crops are now classified on a GMO or non-GMO basis. Although not every country has Mandated Uniform Labelling Laws, including the United States, many European countries like Italy, France, and Germany have mandatory labeling of nearly all GM crops, with a labeling threshold of 0.9% – 1% GMO content (Macahilo, n.d.). This has caused a split in the crop market, leading to a price premium for non-GM crops. Marion Desquilbet, a researcher at the Toulouse School of Economics in France, and David Bullock, a professor in the Department of Agriculture and Consumer Economics at the University of Illinois, both specialize in the effects of dual crop market. Desquilbet and Bullock (2009) write in the *American Journal of Agricultural Economics*, "Dual markets for several agricultural grains and oilseeds have emerged as a result, with some suppliers paying to segregate and preserve the identity of their non-GM products and in turn receiving a price premium" (p. 656). As a result of this transition to GMOs, non-GMO farmers were forced to increase the prices of their products due to the increase in cost to make a profit, which has caused a

domino effect on price increase in the wider market. As a result, non-GM agricultural products have experienced an increase in production cost.

Consumer Choice

Most consumers are restricted by budget constraints, meaning that the amount of income they earn can greatly affect their choices about what they purchase. The geographical location of consumers can also affect their consumption decisions, but more often, the amount of income determines their choices. Consumer decisions on crop purchasing can greatly depend on the availability of non-GM or GM crops within their geographic region. In some rural areas like Lubbock, Texas, consumers may be less exposed to GM crops compared to urban regions like the Dallas-Fort Worth metroplex. This geographical diversity can adversely affect consumer purchasing choices. Consumer income also affects decisions because low income earners have a lower purchasing power than high income earners. The combination of these two criteria, income and location, creates a complex and even more diverse choice because low-income earners in rural areas may not necessarily desire the same type of crop as low-income earners in urban areas due to the availability of GM crops in both locations. This same principle applies to high-income earners as a result of the diversity within different regions. Therefore, the purchasing decision and pattern is heavily influenced by the availability of GM crops.

Market Competition

The shift of GMOs to the crop market has created a competitive market in the field of monopolistic competition and oligopoly. Monopolistic competitive markets

feature a large number of competing firms, but the products that they sell may not be exactly the same while oligopolistic markets are those populated by a small number of firms that produce identical, similar, or different products (OpenStax College, 2017). Since GM and non-GM crops are similar, the decrease in the price of GM crops can reduce the demand for non-GM crops. There has been an increase in the price of non-GM crops as a result of the transition of GMOs to the crop market, which has affected the wider crop market. The effects caused by price increases in the crop market has affected the price of many other non-GM crop-based products. The cost of non-GM crops has increased. Thus, manufacturers of agricultural products that contain non-GM crop components have been forced to raise their prices to accommodate for this additional expense towards the cost of production or may bear the burden themselves, depending on the elasticity of their consumers.

Comparative Analysis

The effects of GM crop production may be seen as beneficial, but detailed comparison of the negative and positive effects derived from the transition of GMOs to the crop market show that these negative effects surpass the benefits. Some of the positive effects of GMOs are an increased supply of crops to the market and an improved nutritional value of certain crops supplied to the market. These are significant benefits; however, the negative medical effects of GMOs, the resulting market competition, the social implications, and the fact that GM crops increase the use of herbicides are substantial reasons to reconsider the question of whether GMOs truly benefit the crop market. These negative consequences contradict the positive; the result

of the negative medical problem counters the nutritional value derived from GMOs. Market competition opposes the increase in supply because as the supply of GM crops increases; it intensifies the competition in the crop market. These comparisons reveal that the negative effects of GMOs in the crop market surpass the benefits. This still leaves some aspect of the negative effects unresolved: market segregation and social implications. As long as GM crops remain in the crop market, the segregation between GM and non-GM crops will remain an evident trait in the crop market and an effect of the transition of GMOs to the crop market. This comparative analysis shows that the negative effects derived from the transition of GMOs to the crop market outweigh the benefits.

Conclusion

This explanatory analysis demonstrates some of the advantages and disadvantages of GM crops to the U.S. crop market and shows how these effects have led to externalities such as increased crop supply and prices on the wider market. Although GM crops have beneficial effects on the market and contribute to some positive externalities, the negative effects derived from the shift of GM crops to the market are significantly more than the benefits. GMOs may have the potential to significantly increase crop yield, but the influx of GM crops impedes the market for non-GM crops. GM crops have led to a competitive market, resulting in adverse effects on consumers' choices and causing a domino effect on the price increase of agricultural crop-based goods in the wider market.

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