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Economic and Political Implications of Agricultural Subsidies and US Farm Policy

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ECONOMIC AND POLITICAL IMPLICATIONS OF AGRICULTURAL SUBSIDIES AND US FARM POLICY

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ABSTRACT

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This thesis pertains to agricultural subsidies, their economic and political implications and what would happen to both price and production levels of different crops should those subsidies be removed. The 3 main crops examined are corn, wool and soybeans. Technological advancements made after 1900 had a profound effect on productivity and efficiency, leading to a number of important economic effects. Market integration, economies of scale, market structure, vertical integration and subsidization, all led to government intervention in the form of regulation and subsidy.

Farm policy, starting in early 1900s, focused on price stabilization policies and food programs through the different federal acts and agencies created over this time period, starting with the USDA and New Deal in the early 1900s to the post WWII farm bills, culminating with the recent farm bills in Congress now. The empirical analysis is based on data obtained through the USDA regarding production, import, export, price and subsidy data. The analytic focus of the econometric model is on the potential effects of eliminating subsidies, hypothesizing that production would be lower, prices higher and the level of disparity between farm and non-farm incomes, higher. I found the conclusion mixed, with the hypothesis being supported for some, but not all cases.

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Chapter 1
Mechanical and Scientific Advancements and Their Effects

Beginning in the early 1900s, there have been several technological advancements that have impacted the farming process, both for producers and for consumers. There are four distinct areas of advancement that instituted dynamic change in not only costs but also efficiency and output levels. These three areas include technological advancements, biotechnological advancements and expansion of information and marketing. Between them, the result was the mechanization and industrialization of the farming industry, with effects including an increase in farm size, an increase in output, a decrease in price and a decrease in labor. There are both positive and negative externalities related to these effects that shaped the agricultural sector into what it is today.

Technological Advancements

There have been a multitude of technological advancements since the turn of the century that have had a great impact on efficiency and cost. Arguably the most important of them was the change from horsepower to the gasoline tractor. This change not only influenced the amount produced, but also which crops were grown to begin with. In addition to the switch to the tractor, the electrification of rural areas and the development of interstate travel were two more major advancements that expanded on these increases.

Horsepower was the backbone of farm power since the beginning of American agriculture. By 1915 it had reached its peak with over 21 million horses in use. (Gardner, pp. 10-11) At the same time however, the gasoline tractor was being developed and improved. By the 1930s the tractor had reached a new level of versatility, reliability and

affordability and began to replace the traditional form of power.[2] The economic result was a dramatic increase in output per hour.[3]

Pertaining to the production aspect of farming, the usage of horses contained a major drawback, namely that the horses needed to be fed. The main food source for horses was oats, meaning that farmers needed to set aside a certain amount of their farmable land to grow the feed. The economic implications are essentially that the area set aside is a deadweight loss, meaning that it is lost revenue. With the switch to the tractor, there was no more need to grow the oats for feed, leading to a major shift in which crops were grown in the United States. The initial figures indicate that over 93 million acres were used to grow oats, and by the 1960s this dropped to only 4 million acres.[4] By switching to the gasoline tractor, farmers had essentially freed up over 25% of America's farmable land area.

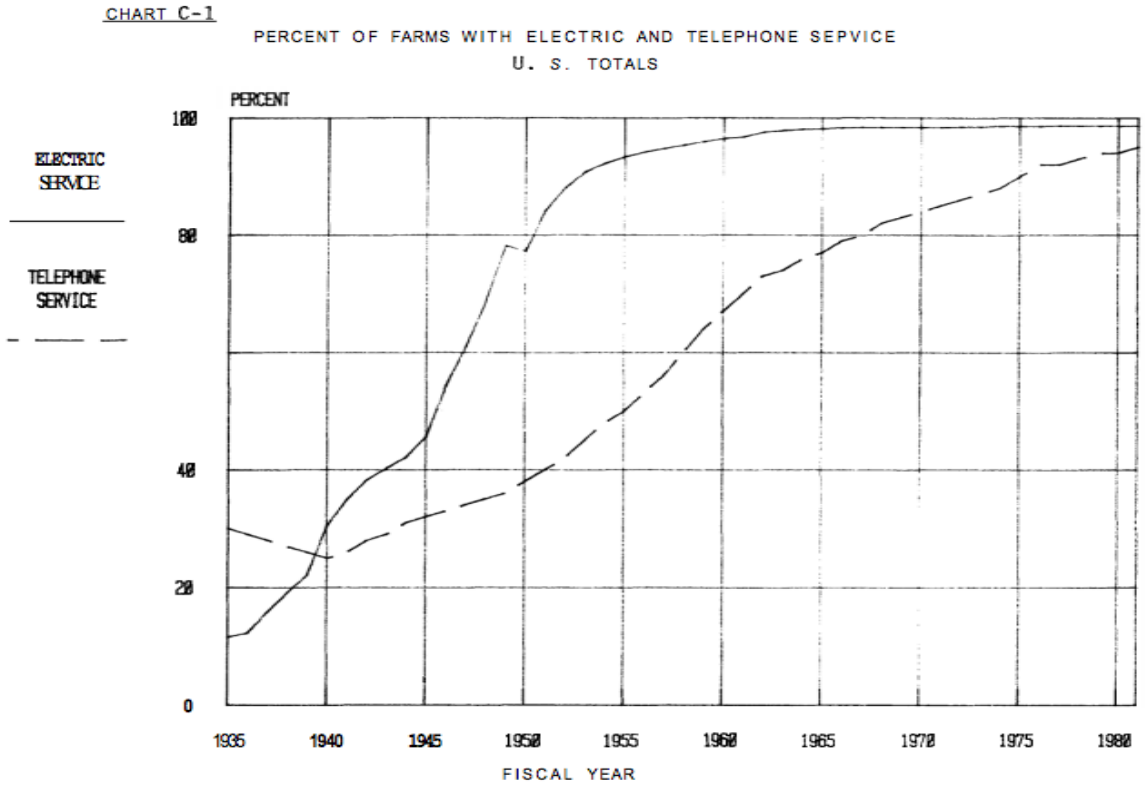
In addition to the adoption of the tractor, there have been a myriad of other technological innovations in the period between 1900 and 1940. These include the introduction of completely new types of machinery as well as durability improvements of existing inputs. Table 2.1 below lists some of the notable technical innovations during the time period.[5] The effects of these amazing changes were a sharp increase in output given the current inputs and both qualitative and quantitative changes in both crops and livestock.

[2] Ibid.
[3] American Agriculture pages 14-15
[4] American Agriculture page 12
[5] American Agriculture page 9

Table 2.1 Notable technical innovations, 1900–1940

Machinery	
All-purpose tractor	Fertilizer spreader
Pneumatic tires	Power sprayer
Diesel tractor	Automatic drainage pump
Corn picker	Spray irrigation equipment
Power mower	Electric fence
Silage and hay chopper	Electric poultry equipment
Pickup baler	Hay dryer
Beet lifter and topper	Crusher-mower
Cane harvester	Duck-foot cultivator
Multirow planter	Seed placement plates

The second major area of dynamic change was the electrification of rural areas, which led to not only the advancement of rural areas with respect to urban areas but also to a new level of mechanization of smaller farms. The major electrification effort began with the New Deal under President Roosevelt. Under it, the Rural Electrification Administration was established in 1935 and tasked with wiring rural areas, notably major farm areas, with electricity. In 1982 a report was submitted to the House Appropriations Committee regarding the accomplishments of the REA program. The resulting report highlighted the success of the program, with the graph below showing that "By 1953 more than 90 percent of all farms in the U.S. had electricity; for telephone service, the 90 percent mark was passed in 1976". With this electrification, communication in the form of telephone lines also increased, generating a much greater flow of information in and out of rural areas.



The third and final major area of technological advancement came later on in the 1950s with the development of the Interstate highway system. Prior to the inception of the highway system, train delivery was the standard. The process was expensive, slow and given the time sensitive nature of crops almost wholly unfeasible, in effect leaving farming much more localized. However, after President Eisenhower signed the Interstate Highways Act into law in 1956, cross-country travel was much easier, linking the different regions within the country. As Andrew Armbruster wrote in his paper *The Interstate Highway System*, "Movement of freight via trucks using the interstate highway system is markedly less expensive than movement by rail." (Armbruster, 2005) The graph below shows that highway freight costs are ¼ as much as railway costs, which holds true for the agricultural sector as well.

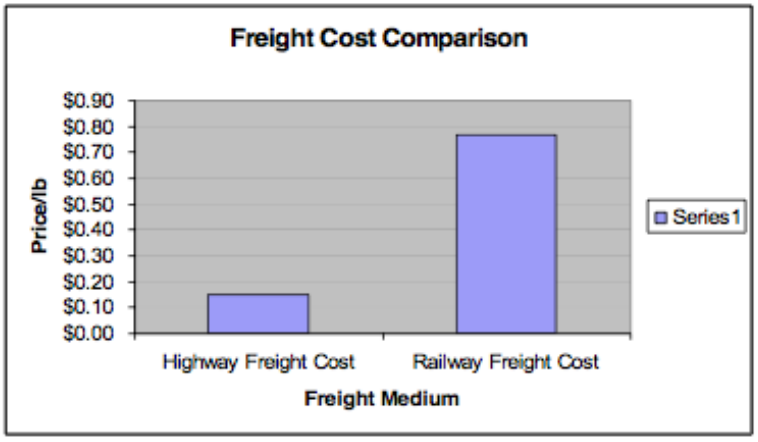


***Figure D**. Data compiled by Andrew Armbruster from the Policy Options for Intermodal Freight Transportation; Transportation Research Board Special Report 252*, Transportation Research Board, National Academy Press, 1998.

The effects of these technological advancements can be described as the "mechanization of the farm". With the introduction of new machinery, much of the more painstaking labor was alleviated, and both the cost and amount of labor provided went down during the 1930-1960 period. Figure 2.3a shows the amount of labor hours needed for several major crops over the 1900-1990 period, and it confirms the downward trend.[8]

[8] American Agriculture page 16

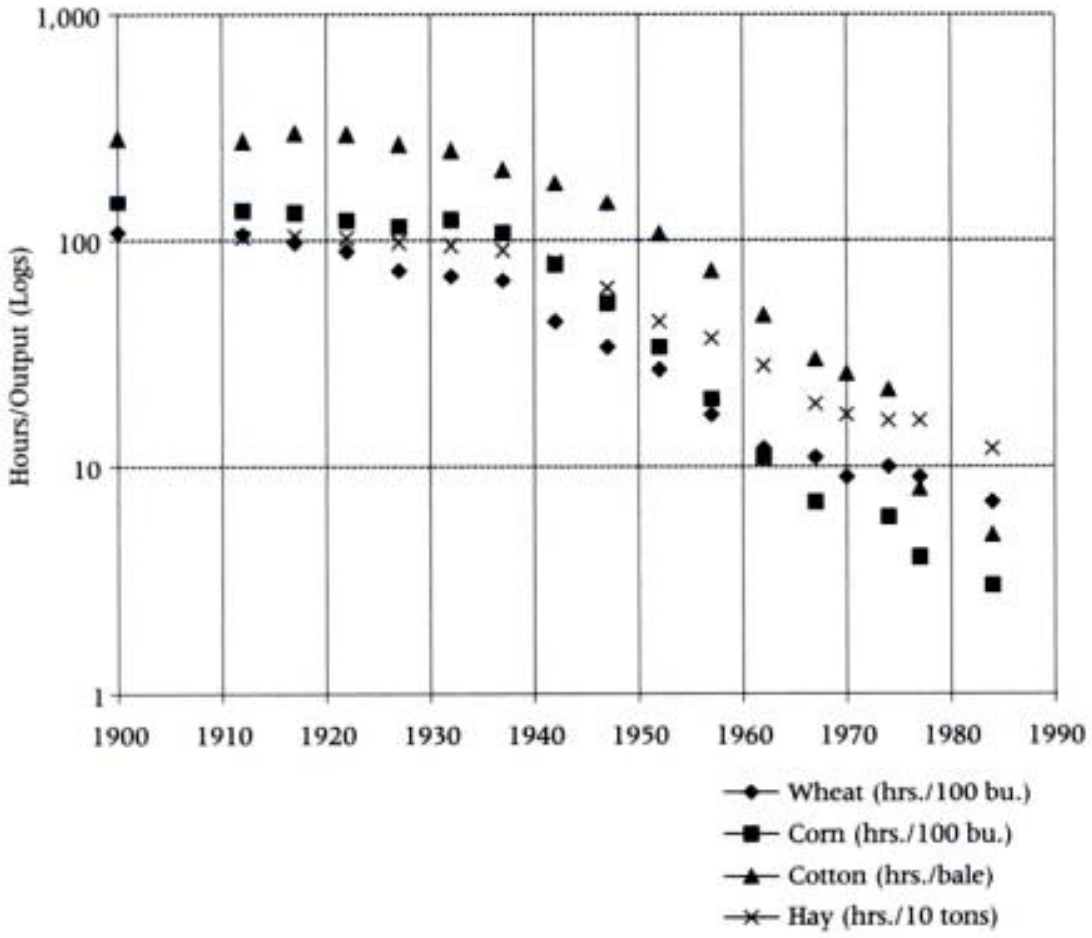


Figure 2.3a Labor hours per unit output of crops. Data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics,* various years.

Following WWII, which in itself drew a lot of labor away from the farming sector, labor was pushed out further with more technological substitutes. In terms of production, the adoption of the tractor over the horse led to major efficiency and output level related gains, and also changed land allocation protocols.[9] Later on with biotechnological changes, these gains would see further increases. Finally, with the electrification of rural America, the development of new machinery and their subsequent availability in rural areas led to the steep divide between rural and urban areas mellowing.

[9] American Agriculture pages 18-19

Chemical and Biotechnological Advancements

The second major area of farming advancement was in the biotech field. The advent of pesticides, fertilizers and genetic engineering rivals the importance of the tractor in the evolution of American agriculture. Later on the in the 1960s biotech would make another great leap forward with the introduction of animal antibiotics and hormones. Through these character improvements output and land availability grew even further.

The first improvements came in the form of pesticides and fertilization. During the post WWII period, commercial fertilization took off, particularly the use of nitrogen based fertilizer.[10] Figures 2.6a and 2.6b show the growth trend in the use of fertilizer over time, with a major uptick starting in 1940, right around the end of WWII.[11]

[10] American Agriculture pages 22-26
[11] American Agriculture page 23

Figure 2.6a Commercial fertilizer used on farms. Data from USDA (1997d).

Figure 2.6b Inorganic nitrogen fertilizer use and real nitrogen price. Data from USDA (1997d).

Nitrogen is extremely important to the growth of plants and coupled with seed advancements that allowed for the uptake of more nutrients, the growth rate of crops increased.

The second major group of chemicals used in farming is pesticides. Figure 2.7 shows a similar trend to that of fertilizers, with usage following WWII massively increasing.[12]

Figure 2.7 Indicators of pesticide use. Data from USDA (1997d).

The economic gains from pesticides are very real, around $3 to $5 dollars for every $1 of pesticides used.[13] Not every outcome is positive however, and pesticide use has garnered heavy media attention surrounding the pesticide chemicals and their potential harm to both the environment and to the population who consume the crops. Over time the more

[12] American Agriculture page 24
[13] Ibid.

harmful chemicals such as DDT and others that have long-term environmental effects have been phased out.[14]

Genetic engineering of crops for pest control and desirable traits has been one of the most significant achievements for not only the farming sector in the United States but also the world. While selective breeding has been around for hundreds if not thousands of years, the scientific achievement of targeted genetic engineering has made it possible to grow stronger, more resilient crops. And while there are arguments against genetically modified organisms (GMOs), the overall consensus is one of major success.

The advent of GMOs has been a boon for both supply and output of major crops. The breeding of traits for resiliency to pests and varying weather conditions have allowed for much less crop loss to weeds, destructive insects and extreme weather.[15] Another great economic and environmental benefit is that the cost of genetically modified seeds is "…more than offset by the savings from the reduction in the use of pesticides".[16] According to the American Institute of Biological Sciences paper *Benefits and Risks of Genetic Engineering in Agricultur*e, "Engineering crop resistance to insect and plant pathogen pests offers opportunities to reduce the use of insecticides and fungicides in crop production. This approach can be expected to reduce problems from pesticides and improve the economics of pest control."[17] The result is that over half of soybean acreage and one fourth of corn acreage contained genetically modified seeds by the year 2000.

The final major advancement in farming due to biotech and other scientific advancements is the introduction of antibiotics and hormones to livestock. Antibiotics

[14] American Agriculture page 25
[15] American Agriculture page 26
[16] Ibid.
[17] D. Pimentel, 1989

have been routinely given to cattle and other animals since 1960, but it really took off in the 1980s when scientists could mass-produce synthetic hormones and specifically engineer antibiotics.[18] These hormones allow for animals to grow at a much faster rate and to also grow to a much bigger size.

The pushback against GMOs and animal hormones has been focused primarily on scientific ambiguity. One example is the argument that there is no way to be sure of the long-term health effects of GMOs or the hormones in animals. This argument has been mostly discarded; as we are now well into the future since the adoption of modified seeds and the introduction of hormones. The major argument against is now focused primarily on biodiversity and more importantly the lack thereof. The Biological Sciences paper states, "The Traditional plant breeding techniques have dramatically reduced genetic diversity in most crops. Unfortunately, this genetic uniformity has increased crop vulnerability to insect pests, diseases, and climatic fluctuations (NAS 1972)".[19]

Previously, crop fields contained many different species of the same crop in the effort to diversify in case of pests or weather anomalies. With selective breeding essentially discontinuing many species of seeds in favor of a handful that are genetically superior, the threat then is whether or not a "superbug" can effectively kill off the entire crop. This question is also poised with respect to antibiotics in livestock and whether or not we are breeding an antibiotic resistant superbug that will be detrimental to humans. These questions must be addressed moving forward in order to ensure the safety of both the food supply and of consumers.

[18] American Agriculture page 26
[19] D. Pimentel et all *Benefits and Risks of Genetic Engineering in Agriculture*

The effects of the biotech and other scientific advancements are very similar to the technological ones. With better, faster growing livestock and crops, costs decrease and the supply of these products increase, which at the same time lowers prices. Genetic advantages also allow for increased land usage into areas that before might have been impossible. In the benefits section of their genetic engineering paper, Pimental and the other authors argue the same points in saying, "Genetic engineering could significantly improve yields and enhance the efficiency of crop and livestock production in the coming decades (NAS 1987b). These goals can be accomplished by increasing the proportion of a crop that can be harvested and by enhancing a crop's tolerance to various stresses".[20]

On the more critical side, the introduction of genetic engineering begs the question of product rights and ethics. The US is currently seeing this with Monsanto and the question of whether or not one can "patent life". Pimental and his co-authors address these issue of ethics and economic incentives, "The financial rewards for successful research in genetic engineering are enormous. However, these incentives are unlikely to encourage innovation aimed at providing the greatest humanitarian good (Buttel et al. 1985)".[21] Their conclusion given these ethical concerns is to have a clearly defined government role in regulating the process while at the same time promoting research.

Information and Marketing

The improvement of communications technology during the 20th century had a profound effect on the dissemination of information in real time, something more than advantageous for farmers. Through the radio, telephone, television, and later on through

[20] Ibid.
[21] Ibid.

the Internet, farmers had access to new information that ultimately led to better crop yields and to better marketing and selling of their products.

Through the electrification of rural areas, farmers gained access to means of communication that dwarfed their current system. The radio and television were the first of these advancements, and brought not only economic but also social and cultural improvement as well.[22] With the introduction of the radio and television to rural communities and to farmers, real time information of weather and markets gave a huge leg up to rural farmers. In the cultural and social aspect, the radio also brought educational programming and entertainment, which helped to close even further the gap between urban and rural populations.[23] The second major advancement during the first half of the 20th century was the telephone. In addition to the advantages gained above in real time transfer of information, the telephone went further in that it also allowed for farmers to conduct business transactions at an unprecedented speed.[24]

The last major communications improvement came much later around the 1980s with the invention of the Internet. With the Internet and related technologies information gathering went from fast to instantaneous, and meteorological science became significantly more accurate, giving farmers much more reliable a picture of what was going to happen. Combined with GPS satellites, planting and harvesting became much more accurate and to a point automated as tractors with GPS systems could essentially plow the fields without the need for a driver. With respect to marketing, the Internet gave

[22] American Agriculture page 27
[23] Ibid.
[24] Ibid.

farmers and other businesses a much bigger customer base, as well as a much more precise measure of different markets not only locally but also nationwide.

There were significant gains made through the use and spread of communications technology into rural America. From 1925 to 1954 radio use increased from 4% to almost universal use, and television use was at almost 35%. With an addendum to the Rural Electrification Act in 1949 to include a subsidization program for telephone installation, telephone ownership rose to 76% by 1964. [25]

Overall Effects

Looking at the different technological and scientific advancements together, an overall picture of progress can be seen between the turn of the 20th century until the present. The economic impacts can be seen in three major areas: production, costs and price. All three show positive change, with production levels up and costs and prices down. On a related note, farm labor has also been affected, and there are both pros and cons to the resulting figures.

The large majority of advancements have been focused on the supply side of the farming equation. Scientific achievements have allowed for great growth in land productivity, namely the total amount of land available and how much can be extracted from it. Coupled with efficiency increases in related technologies including the tractor and processing equipment, the amount of crops harvested and the speed in which they are processed has increased steadily, leading to a tremendous increase in supply. Additionally, scientific advancements allowed for a much stronger crop, leading to an expansion in land area used, further boosting production levels.

[25] Ibid.

With these advancements came not only production increases, but also cost decreases. With the genetic engineering of crops, more generic growth aids such as fertilizer and pesticides became less and less necessary. The outdating of these chemicals, as well as the efficiency gains in the production process led to major decreases in production costs. The end result was a sharp decline in both food prices and the amount of money households had to spend on food. From the beginning to the end of the 1900s, food prices went down 35% and the percentage of disposable income spent on food also declined 29%.[26] While a decline in food prices is beneficial to consumers, the impact of such a decline much harsher for farmers. A decrease in price leads to a direct decrease in farm income.

One of the biggest effects of these advancements is the expansion of big farms. For big farms, the technological improvements were as much if not more important than for small farms. Tractor tech. and other commercial machinery allowed for the minimizing of costs. Secondly, communications tech. is more beneficial for large companies as the cost benefit ratio is better than with small companies, if small companies can even afford to advertise. The gains can be seen as the average acreage per farm increased from 55 acres in 1929 to 220 acres in 1997.[27] This highlights the increasing amount of land concentration. Large farms also benefit from economies of scale. What this means is that as farms grow, their cost per unit actually decreases, leading to much higher profits.

A second motivation in the shift to big farming is vertical integration. Vertical integration is the linking of different levels of the supply chain through a common owner.

[26] American Agriculture page 141
[27] American Agriculture pages 66-67

For agriculture, this is seen through company involvement with the production, transport and sale of crops and livestock. Through this integration, the cost of doing business is consolidated, benefiting consumers as prices can go down in response to lower input costs. However, this is not always the case as vertically integrated companies often have tremendous market power, leading to the monopolization of markets.

In conclusion there have been several technological advancements that have impacted the farming process, both for producers and for consumers. The technological advancements, biotechnological advancements and expansion of information and marketing have led to the mechanization and industrialization of the farming industry, effectively increasing farm size, increasing output, decreasing price and decreasing labor. There are both positive and negative externalities related to these effects that shaped both political and economic policy related to the agricultural sector.

Chapter 2
Economic Theory and Political History

There are four major areas of economic theory that affect the agricultural market: vertical integration, economies of scale, elasticity of markets and subsidization. These theories affect the agricultural sector in a myriad of ways, some positive and some negative. Through the processes of integration and expansion of scale and combined with the elasticity and variability of the market, government subsidization in the form of price controls and income supports has been the answer.

From the post WWII period onward, legislation has evolved and the way in which the government tackles the question of subsidies has also evolved. From the New Deal in the 1930s to the Farm Bills in the 60s and 70s to the FAIR Act and ARPA in the 90s the method by which the government has supported the farmer has changed. Along with it, the involvement of interest groups has shifted and consolidated power. The landscape today has shown there to be a tight relationship between government and business, leading to precarious positions for those in government who do not wish to jeopardize their futures in the private sector. These economic and political factors have all led up to the landscape of the agricultural sector today, and understanding the past evolutions is the key to moving forward with solutions.

Economic Theory

The first area of economic theory is vertical integration otherwise known as supply chain integration. In theory, vertical integration is the consolidation of different levels in the supply chain by one company. For example, a company owning both the production of a product and the methods of shipping can be said to own two levels within

the supply chain. In the late 1800s, this vertical integration took the form of companies owning the major mode of transportation, railroads. Because of the manipulation of prices and abuses by these companies, the first form of anti-trust legislation came in to protect the consumers.

In practice, there are two major forms of this integration in the agricultural sector: contract integration and ownership integration. Contract integration is basically the commitment of farmers to sell to one company and ownership integration is similar to the theory above, a company owning two or more levels within the system.[28] The most important aspect of vertical integration within the agricultural sector is that there is an exemption from existing antitrust law, leading to monopoly abuses including food price increases.[29]

The economic impacts of vertical integration within the agricultural sector are similar to many other areas in which there are abuses. Through the consolidation of the supply chain, farms have become bigger and more powerful and it has resulted in more control over both crop prices as well as intermediate input prices. In the area of intermediary inputs, much of the mechanical equipment is manufactured through a handful of companies, leading to increases in the prices of their machines as well. These costs are passed along to the consumer, who suffers the most.

The second area of economic theory is what is known as economies of scale. An economy of scale is the theory that as a company gets bigger their costs decrease, giving them an advantage within the market. This directly relates to the incidence of abuses and

[28] Ronald D. Knutson, 1990 pages 243-44
[29] Ronald D. Knutson, 1990 page 285

vertical integration above, as a sector with tremendous economies of scale will have a much easier time integrating and growing.

There are two main forms of the economics of farm size, technical economics and pecuniary economics. The first implies that the increase in size causes a reduction in the average cost of production, coming with it huge market power. Pecuniary economics cites the advantage being that as a company grows their cost of inputs goes down.[30] Figure 8.2 below showcases the effects of technical economics, with the short run average cost curves (SAC) decreasing as farm size increases, eventually reaching a minimum efficient size. Looking to the long-term effects we see again the cost per unit of output decreasing toward the point C_3.

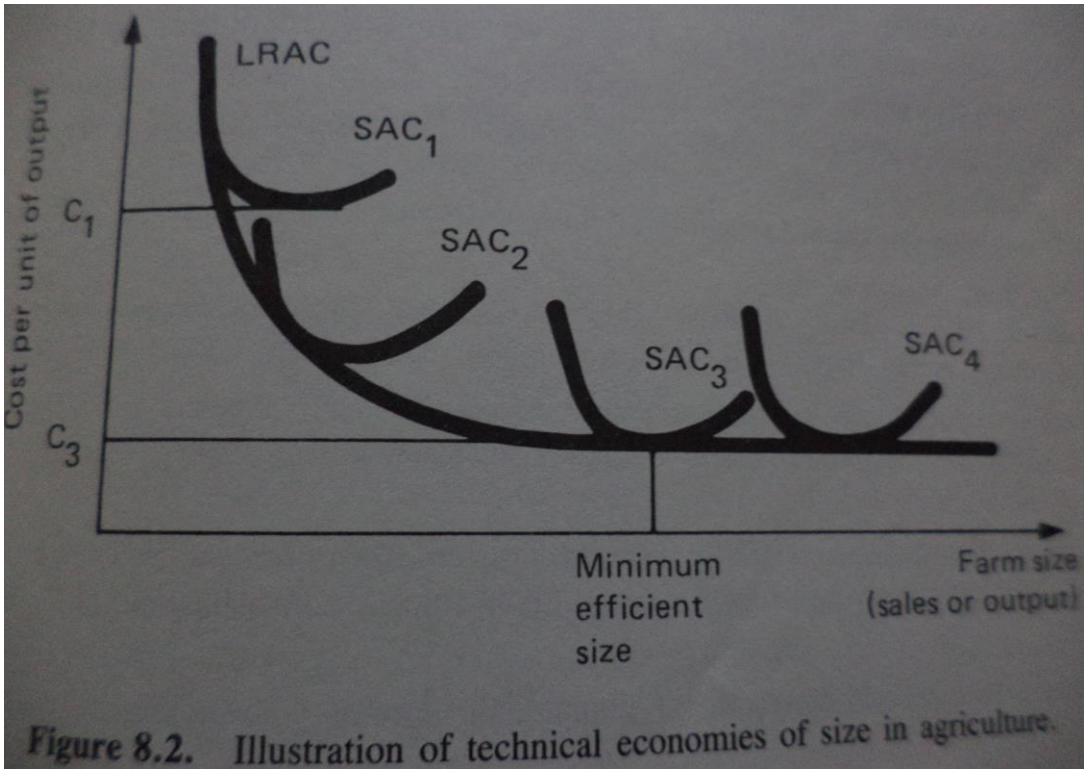
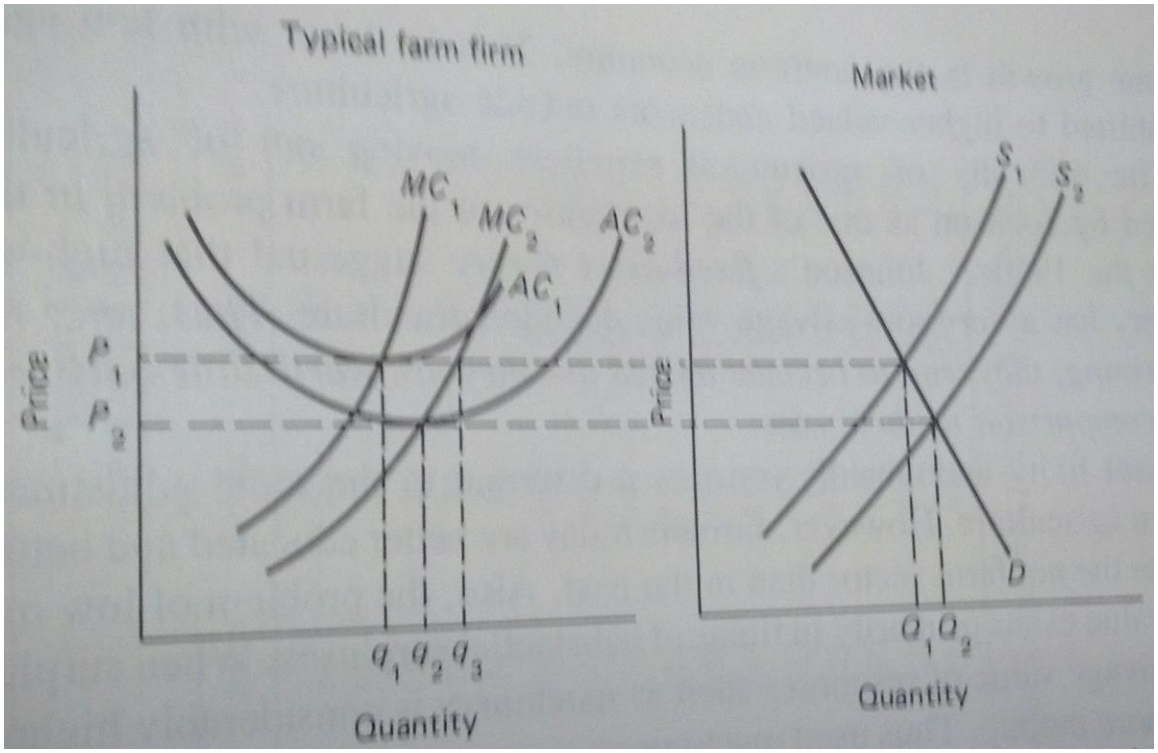


Figure 8.2. Illustration of technical economies of size in agriculture.

While these economies of scale are terrific for producers, considerations need to be taken with respect to consumer implications and impacts. Given the reductions in costs and

[30] Ronald D. Knutson, 1990 pages 177-180

increase in technological progress, the consumers seem to benefit in both the short and long run through the reduction of prices. The graph below shows the economic theory behind the supply curve shift, indicating that through the marginal and average cost shifts downward prices will indeed drop.[31] However, there is also the implication that the producers wont pass these savings along to the consumer in a less than competitive market, but rather reap more profits for themselves. In practice, this seems to be more the case in the real world.



Within the agricultural sector there are two main reasons for the scalability of farms: technological changes, marketing and market equilibrium. Technological changes, which were covered in chapter one, equal major cost minimization. Much of the machinery used in farming is expensive, and bigger companies have a much easier time affording and implementing these tools. Secondly, marketing costs are also much

[31] Ronald D. Knutson, 1990 Figure 8.4 page 181

lighter as the company gets bigger. The costs for marketing in a certain area are the same for both big and small companies, which means that the bigger companies have less real cost in comparison.[32]

The elasticity of demand for crops within the agricultural market plays an important role in the determination of whether or not the government should grant subsidies and directly intervene in the market. In economics, elasticity indicates how much of one good will be sold when another variable is changed. This can be on the supply side or demand side. For the supply side the question would be how much more will I produce and the demand side would be how much more will be demanded. Within these parameters, price elasticity of demand is almost always negative, meaning as the price of the good goes up; the demand for it will go down.

Within the agricultural sector, this negative price elasticity can be seen. The elasticity of demand for crops according to Gardner in *American Agriculture in the 20th Century* is -.2, meaning that for every unit of price increase the demand for the good will go down by .2 units.[33] Within the market itself, the price of these crops is also very sensitive. Given the volatile nature of farming, with weather anomalies and crop failures, prices shift dramatically. These price swings, coupled with the inelastic nature of the market leads to demand inconsistencies.

The picture painted by these three economic effects is not economically or politically ideal. The market is unpredictable, big corporate farms are pushing out the small farmers, consumers are being subjected to artificially higher prices and there is no private sector insurance for farmers in case of crop disaster. These negative externalities

[32] Gardner *American Agriculture* page 73
[33] Gardner *American Agriculture* page 141

beg for resolution, and the answers dating all the way back to the New Deal era and used still today is subsidies.

History and Evolution of Subsidies and Legislation

Subsidization as an economic theory is the support of a sector within the economy with the goal of promoting certain outcomes. In the case of the agricultural sector these outcomes are to support and stabilize crop prices and to ensure farmers a basic level of income. In conjunction with these two main goals there are also secondary goals in the form of food programs aimed at helping impoverished citizens. Over the course of the 20th century there have been a myriad of ways to go about solving these two dilemmas, but many have been phased out or evolved into the main forms we see today.

The Agricultural Adjustment Act of 1933 signaled the first step in the government's involvement within the agricultural sector, mainly through a quota system that limited production. The main goal of this act was to in effect create what is known as "parity" prices. Limiting production artificially moved the crop prices towards a standard value. For example if in 1920 a bushel of wheat could purchase 2 dollars worth of goods then in 1933 that same bushel should be worth the same amount. In economic effect, it creates a price floor, a direct response to the plummeting prices during the Great Depression.[34] Following in the New Deal was a set of 7 different subsidization policies, many which are still alive in some form today. These 7 are:

1. Price supports
2. Subsidized distribution
3. Export subsidies

[34] Pasour, 2005 page 87

4. Farm credits
5. Land conservation
6. Crop insurance
7. Expansion in research[35]

This increased involvement dwindled with the start of WWII and did not truly come back into effect until the 1950s with the reintroduction of the post WWII Farm Bills. These farm bills were reauthorized every 5 or so years, and come into form with many different titles. Between 1965 and 2008 there were 10 farm bills, with the 2014 bill marking the eleventh.[36] The ten bills are:

1. Food and Agricultural Act of 1965
2. Agricultural Act of 1970
3. Agricultural and Consumer Protection Act of 1973
4. Food and Agriculture Act of 1977
5. Agriculture and Food Act of 1981
6. Food Security Act of 1985
7. Food, Agriculture, Conservation, and Trade Act of 1990
8. Federal Agriculture Improvement and Reform Act of 1996
9. Farm Security and Rural Investment Act of 2002
10. Food, Conservation, and Energy Act of 2008

Each of these bills contain its own prominent feature, with some bills amending pre-existing legislation and others passing more progressive legislation. Coupled with other

[35] Pasour Jr. and Rucker *Plowshares and Pork Barrels* page 90
[36] CRS Report for Congress: Agriculture: A Glossary of Terms, Programs, and Laws, 2005 Edition

agriculture related policy in the 1940s and 50s, the shift from more supply oriented policies to producer and consumer oriented policies can be seen. The first farm bill, the Food and Agricultural Act of 1965 is important in that it repealed one of the more cost inefficient policies known as the Soil Bank.[37] Though the model was used again in a subsequent conservation program in the 1980s, the retirement of acreage was seen as a more obsolete and wasteful use of arable land.

The Agricultural Act of 1970 furthered this progressive legislative trend by easing restrictions including quotas, allotments and planting restrictions. In addition to this shift in commodity support policy, a new maximum payment amount was set at $55,000 dollars per crop.[38] Moving to the Act of 1973, the 4-year bill marked the first incidence of target pricing and deficiency payments, two of the major policies still in use today. It did reduce payments from the 1970 bill down to $20,000 dollars, but compensated by enacting disaster payments as well as disaster reserves, and also amended the Food Stamp Act.[39] The last farm bill of the 1970s came later in 1977, and increased price and income supports for grain crops, simplified further the eligibility requirements for the Food Stamp Program, and made the USDA the leading agency for agricultural research.[40]

The last 3 farm bills before the major FAIR Act reforms in 1996 were the Agriculture and Food Act of 1981, Food Security Act of 1985, and the Food, Agriculture, Conservation, and Trade Act of 1990. In 1981 the commodity programs were continued through 1985, and target prices were set grains, cotton, rice and wheat, but were subsequently frozen in 1984. In 1990 several new agencies and programs were created

[37] CRS Report for Congress http://www.cnie.org/NLE/CRSreports/05jun/97-905.pdf
[38] Ibid.
[39] Ibid.
[40] Ibid.

related to forest land stewardship and community forestry. Additionally, safety standards in the handling of eggs and other products were increased in an effort to combat food-borne illness.[41]

The 1996 Federal Agriculture Improvement and Reform Act marked the most significant change in governmental policy with the shift from direct government involvement to much more market oriented policies. Over time, several methods were phased out in favor of more cost effective, targeted programs. Major governmental supply controls were halted, including the idling of acreage, reduction of supply and grain storage in favor of more direct payments.[42] Figure 7.1 below shows the change in governmental acreage idling over time up until 1994, around the time of the passage of the FAIR Act, which marked the major shift towards market oriented policies. As the graph shows, between 1934-1954 there was no idling due to World War 2. It picked up again following the war and continued into the 1970s. The major decline during the 1970s was due to the Soviet scare and subsequent grain shortages. After that recovery it rose, but immediately began to decline over the 1984-1994 period, confirming the shift

[41] Ibid.
[42] Gardner *American Agriculture* page 216

away from this costly, inefficient policy.

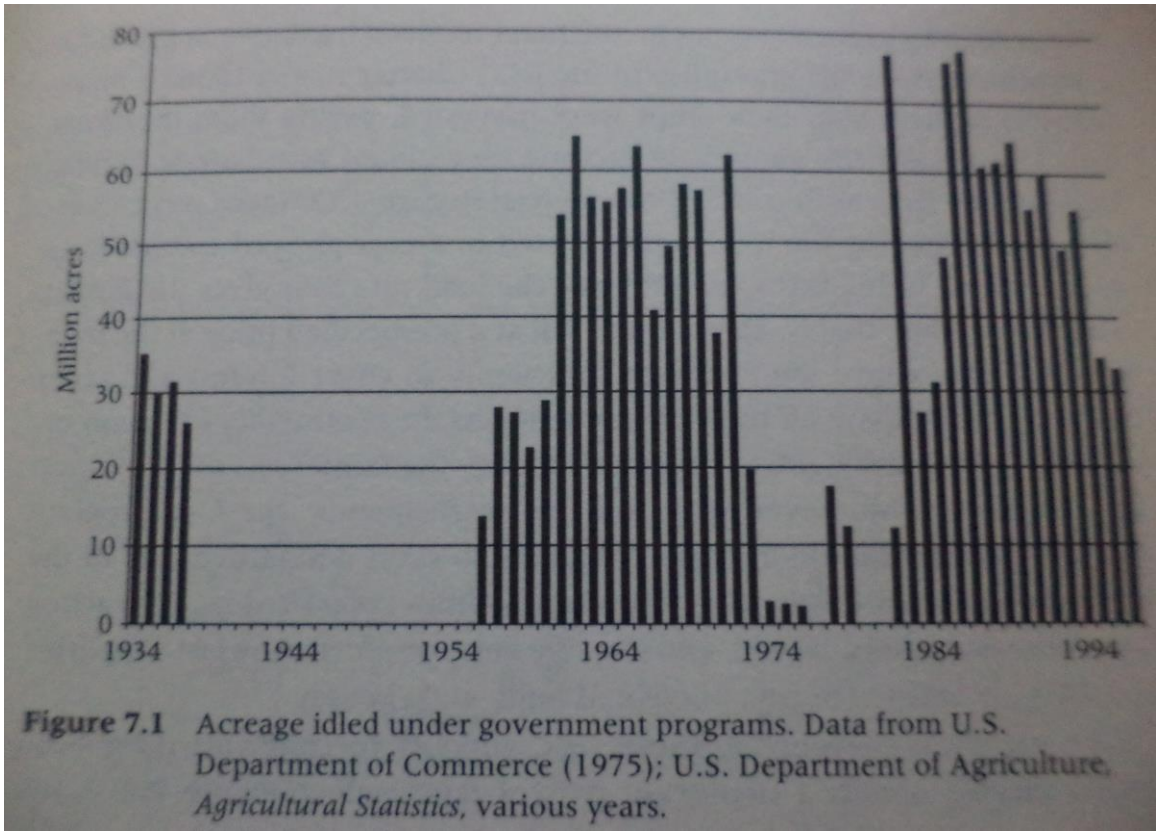
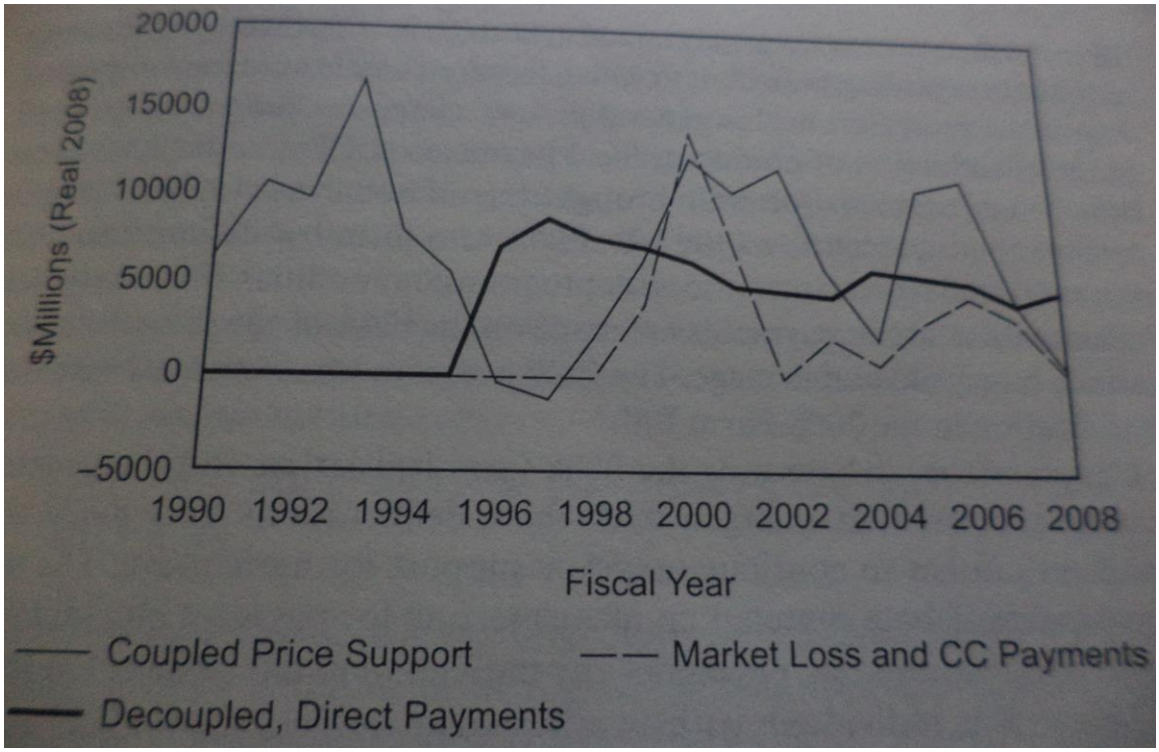


Figure 7.1 Acreage idled under government programs. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years.

The three major channels through which the subsidies now flowed were price supports tied to production, income supports not tied and disaster payments.[43] The mechanisms in which the funds were transferred were through direct payments, market loss assistance and loan deficiency payments. Figure 1.2 below shows the trend of the three major payment types from 1990 through 2008. As expected, direct payments and market loss payments did not begin until the FAIR Act took effect, and while price supports were used, their usage declined in the years prior to the FAIR Act, but increased

[43] S. Graff Zivin Joshua, 2012 pages 21-22

with the other two around the same time.



A second major recent policy shift came in 2000 with the Agriculture Risk Protection Act. This piece of legislation focused on the third facet, disaster payments, in the form of crop insurance. In addition to the price stabilization and income protection policies set forth by the government, crop insurance is the third major area of government intervention. Private insurance is often not available within the agricultural sector due what is known as uninsurable risk, meaning that it is often not profitable for insurance companies to insure farmland and crops. In response to this, the government became to provider of most of the insurance policies.[44]

With the restructuring of the governmental crop insurance program in 2000, higher insurance coverage became much more affordable to farmers, with approximately

[44] Zivin and Perloff *Intended and Unintended Effects* Section: Babcock *Policies and Economics of Crop Insurance Programs* page 88

$7 billion dollars outlayed by the CBO for the foreseeable future. Additionally, the program has shown itself to be very successful, with 80% of the eligible acres covered under the program.[45] Figure 3.1 below shows an interesting piece of information related to the crop insurance dilemma. Prior to the easing of restrictions and costs to farmers, the coverage levels seen below were not attainable affordably. With the passage of ARPA, coverage levels increased and farmers were able to take advantage of higher levels of protection. Interestingly, the 70% coverage levels has the most acres covered under it, signifying that farmers are more than content with 70% coverage, and aren't necessarily holding out for complete coverage.

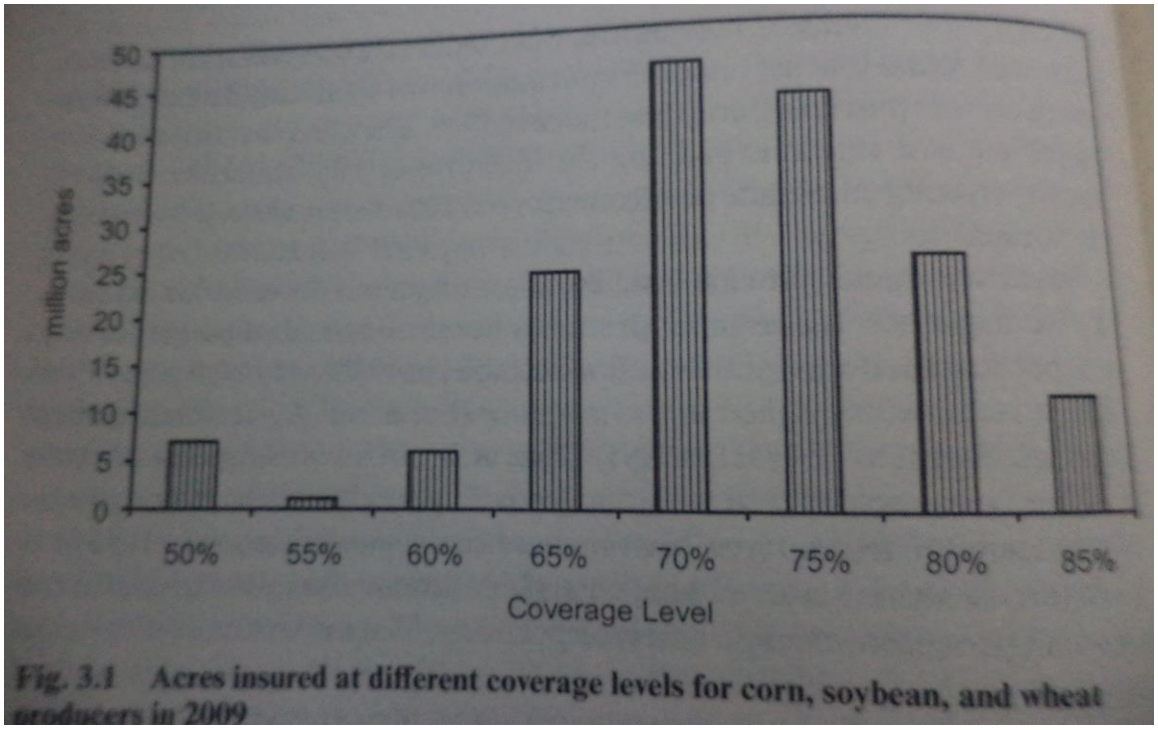


Fig. 3.1 **Acres insured at different coverage levels for corn, soybean, and wheat producers in 2009**

[45] Ibid page 85

The crop insurance program grew dramatically over the 2000-2010 period, but it has not been all good news. The taxpayer costs grew along with the size of the program, and by 2010 the costs were large enough to merit steps to rein them in.[46]

Interest Groups and Agribusinesses

The last major area of influence in both the economic and political aspect of agricultural subsidies is the private sector and more narrowly business involvement. Interest groups lobby Congress for bills that will directly impact them and shape the economic argument in their favor, and businesses comingle with the government in ways that can and do cause negative externalities.

There are two main branches of interest groups, first the producer lobby and second agribusinesses. Under these large umbrellas are different sub groups with a wide range of numbers and issues. Within the bulk of these groups there are both conservative and liberal organizations that sometimes butt heads on legislation. In the area of agricultural policy it is often the case that when one group benefits from a bill another loses out in some capacity. Over time specific groups have amassed a large amount of political clout and the landscape today highlights the winners.

The first interest group sector is the producer lobby. The strength of the lobby lies in the amount of farmers represented and their relative importance in the state they are in. Consequently, as their numbers decline their power and influence also declines. Within the producer lobby there are three main groups, the general farm organizations,

[46] Ibid page 110

commodity groups and cooperatives. Each specific group focuses on a different aspect of the production side of the farm equation.[47]

The first group, the general farm organization is the widest ranging of the three groups, encompassing farmers in many different areas, not limited to food or commodity crops. In this area there are two main organizations, the American Farm Bureau Federation and the National Farmers Union. On the conservative side is the American Farm Bureau, which in this case advocate for more of a free market, minimal government approach. The National Farmers Union on the other hand is more liberal, and its members are staunch supporters of price and income supports as well as major governmental involvement in price setting and crop insurance.[48]

Moving to the second group, the commodity group, the focus is much narrower. These commodity groups focus on a specific product or crop, and include not only the farmers and their crops but also the input producers, including the machinery makers and transportation companies. Consequently, the relative strength of certain commodity lobbies rise and fall with their relative importance in the American agricultural sector. As it stands now, two of the most important organizations are the National Association of Wheat Growers and Corn growers, as they occupy a large portion of the land used.[49]

The final sector within the producer lobby is the cooperative. These cooperatives harken back to the original cooperatives of farmers joining together to enhance their ability to market and sell their goods. With respect to the lobbying aspect, these cooperatives function in much the same way, collectivizing in order to fight for shared

[47] Ag and Food Policy pages 65-73
[48] Ibid.
[49] Ibid.

goals. These cooperatives can have both narrow and wide aims, and are a major source of PAC contributions.

The second umbrella of interest groups is agribusinesses. Unlike producer lobbies, these businesses share a close working relationship with the government, and are not just donating money to political figures in exchange for support. Their revolving door relationship has been a big focus point for the problems currently facing America, not only in the agricultural sector but also in other sectors as well. Similarly to the producer lobbies, agribusinesses are also split into three main groups, general organizations, commodity organizations and Washington Representatives. These three share many characteristics in common with their counterparts above, but the breakdown of groups within the three larger sectors is slightly different.

The first group is the general organization, which encompasses groups such as the Chamber of Commerce, Frozen Foods and Grocery stores. In this area the groups can be thought of as certain key areas of food sales.[50] Moving to the second group, the commodity organization, the focus is similarly as narrow as the commodity producer lobby above. These commodity groups focus on specific products as well, including the cotton, meat, milk, and grain commodities. The final sector within the agribusiness area is the Washington Representative. These representatives represent specific firms, and directly lobby Congressmen and donate to their campaigns.[51]

There is what is known as a revolving door relationship between business and government, and there are both positive and negative externalities stemming from this reciprocating relationship. Many now argue that the problems currently facing America,

[50] Ag and Food Policy pages 74-78
[51] Ibid.

not only in the agricultural sector but also in other sectors as well, stems from this unchecked relationship. The positives of this are that the candidates are very knowledgeable in the area, allowing them to perform their jobs extremely well. However, there are some skeptics that short change this theory and argue that there is no incentive to perform their jobs well if it would potentially harm future job opportunities.

Conclusion

In conclusion, the four major areas of economic theory that affect the agricultural market--vertical integration, economies of scale, elasticity of markets and subsidization--affect the agricultural sector in a myriad of ways, some positive and some negative. Through the processes of integration and expansion of scale and combined with the elasticity and variability within the market, government subsidization policies in the form of price controls and income supports has been the answer.

From the post WWII period onward, the legislation has evolved from the New Deal, heavy government intervention policies in the 1930s to the Farm Bills in the 60s and 70s to the much more market oriented policies in the FAIR Act and ARPA in the 90s and 2000s. The methods in which the government has supported the farmer has changed from more government and farmer centric policies to more hands off, market oriented policies. Alongside this shift, the involvement and composition of the interest groups has also changed, growing considerably larger and consolidating power.

The landscape today has shown there to be a tight relationship between government and business, leading to precarious positions for those in government who do not wish to jeopardize their futures in the private sector. These economic and political

factors have all led up to the landscape of the agricultural sector today, and understanding the relationship is the key to moving forward in a progressive and positive way.

Chapter 3
Data Set and Regression Analyses

Introduction

This chapter will contain multiple regressions analyses designed to determine the real correlation between subsidization and price and production. The main question is what will happen to the agricultural sector if price supports and all other subsidies stop? Using the regressions in order to determine the independent variable coefficients, this chapter will conclude with an equation I developed which can then be used to calculate the effects. My hypothesis is that production would be lower than it is today and the level of disparity between farm and non-farm incomes would be much higher. Also, the price and market structure would be much different; prices would be higher and there would be even higher a level of monopolization within the agricultural sector.

The structure of this fourth chapter will be first an exposition on the data set, namely where the data was obtained, the nature and definitions of the variables and their importance to the model. Second will be the bulk of the chapter containing the multiple regression analyses for the chosen crops, corn, cotton and soybeans. I will also detail the methodology of my research as well discuss why I have chosen the crops I did. The third and final section will be the empirical model containing the variable coefficients as well as the formula used to ascertain the effects of subsidies and more importantly what would happen should they cease to continue.

The model as it is so far will have 4 separate regressions for each of the 3 crops (corn, wool, soybeans), one with price as the dependent variable and the others with production levels, subsidy amounts and gross revenue (price x production) as the other

dependent variables. The independent variables included in the analyses are subsidy levels, import levels, export levels, net farm income, and either price/production depending on the regression. There are also several nuances in the structure of the variables as well as their relationships to one another that I will expound on when beginning the analysis.

Data Set and Descriptive Statistics

Within this paper, my economic analysis will focus on three distinct crops, corn, cotton and soybeans. There are several specific reasons as to why these were the crops chosen, none more important than their overall importance in the agricultural sector of the economy. Corn and cotton are the biggest food and non-food crops respectively. Their importance both historically as well as presently make them ideal candidates for an empirical analysis, and the data for both is very well catalogued and researched. The soybean was the third crop chosen because much more recently it has become somewhat of a competitor to corn. With the expanding biofuel market, both corn and soybean products can be used as fuel, and as direct competitors in that respect makes for an interesting comparison.

The data for the regression analyses comes from USDA agricultural crop databases for all three crops. The subsidy figures come from the Environmental Working Group subsidy database. The data will be in a time series format, spanning the 1995 to the 2012/2013 periods. For soybeans, the data begins in 2000 and concludes in 2011, due to its more recent nature and with the 2012 and onward figures still under evaluation. As stated above, the variables included for all three crops include price, production, import, export, and subsidy amounts, as well as a gross price*production figure. Additionally,

the inclusion of the American Net Farm Income variable helps identify other mediating factors which trend along with price and production. In analyzing the price and production variables together, I have decided to include a 1-year lag for price and production figures, as production one year might correspond to a shift in prices in the following year rather than the same year.

The tables below outline the data for all three crops

Table 1. Corn Data

Year	Production (Million Bushels)	Exports (Million Bushels)	Imports (Million Bushels)	Subsidy Amount (million dollars)	Weighted-average farm price (dollars per bushel)	NFI (Real 2009 Dollars)	Price x Production
1995	7400.051	56.589	16.487	2934.905	2.26	72250417	16724.11526
1996	9232.557	45.655	13.261	2119.059	3.24	79362708	29913.48468
1997	9206.832	38.214	8.81	2906.3	2.71	78033315	24950.51472
1998	9758.685	50.401	18.806	5064.623	2.43	73141540	23713.60455
1999	9430.612	49.191	14.744	7567.377	1.94	72353587	18295.38728
2000	9915.051	49.313	6.824	8058.49	1.82	70051721	18045.39282
2001	9502.58	48.383	10.14	5982.553	1.85	74080388	17579.773
2002	8966.787	40.334	14.446	2498.438	1.97	59778179	17664.57039
2003	10087.292	48.258	14.076	3439.944	2.32	83159504	23402.51744
2004	11805.581	46.181	10.83	5308.631	2.42	93871157	28569.50602
2005	11112.187	54.201	8.806	10138.944	2.06	94199225	22891.10522
2006	10531.123	53.987	11.983	5796.967	2	72183779	21062.246
2007	13037.875	61.913	20.021	3805.91	3.04	79505716	39635.14
2008	12091.648	46.965	13.53	4194.188	4.2	88755793	50784.9216
2009	13091.862	50.295	8.343	3778.97	4.06	73874299	53152.95972
2010	12446.865	46.59	27.669	3495.34	3.55	96543061	44186.37075
2011	12359.612	39.184	29.368	4663.99	5.18	122829596	64022.79016
2012	10780.296	17.781	162.394	2702.462	6.22	127947766	67053.44112

Table 2. Cotton Data

Year	Production (Million Bushels)	Exports (Million Bushels)	Imports (Million Bushels)	Subsidy Amount (million dollars)	Weighted-average farm price (dollars per bushel)	NFI (Real 2009 Dollars)	Price x Production
1995	17900	7675	408	211.64	72	72250417	1288800
1996	18942	6865	403	807.49	76.5	79362708	1449063
1997	18793	7500	13	744.71	70.5	78033315	1324906.5

1998	13918	4298	439	1317.97	66.2	73141540	921371.6
1999	16968	6750	97	1944.9	61.7	72353587	1046925.6
2000	17188	6740	16	2067.6	46.8	70051721	804398.4
2001	20303	11000	21	3332.6	51.6	74080388	1047634.8
2002	17209	11900	67	1950.393	32	59778179	550688
2003	18255	13758	45	2550.96	45.7	83159504	834253.5
2004	23251	14436	29	2229.214	63	93871157	1464813
2005	23890	17673	28	3696.295	44.7	94199225	1067883
2006	21588	12959	19	2979.752	49.7	72183779	1072923.6
2007	19207	13634	12	2541.484	48.4	79505716	929618.8
2008	12815	13261	0	1582.403	61.3	88755793	785559.5
2009	12188	12037	0	2213.782	49.1	73874299	598430.8
2010	18104	14376	9	828.339	62.8	96543061	1136931.2
2011	15573	11714	19	1311.672	84.2	122829596	1311246.6
2012	17315	13026	10	560.924	91.4	127947766	1582591
2013	13105	10400	10		74.8	122110381	980254

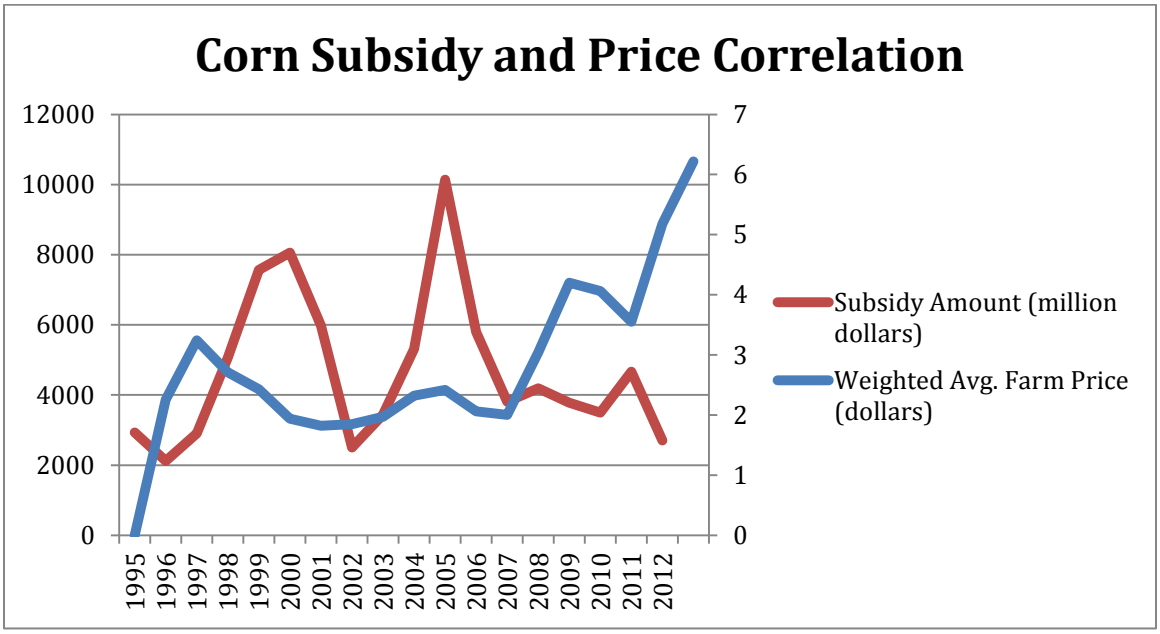
Table 3. Soybean Data

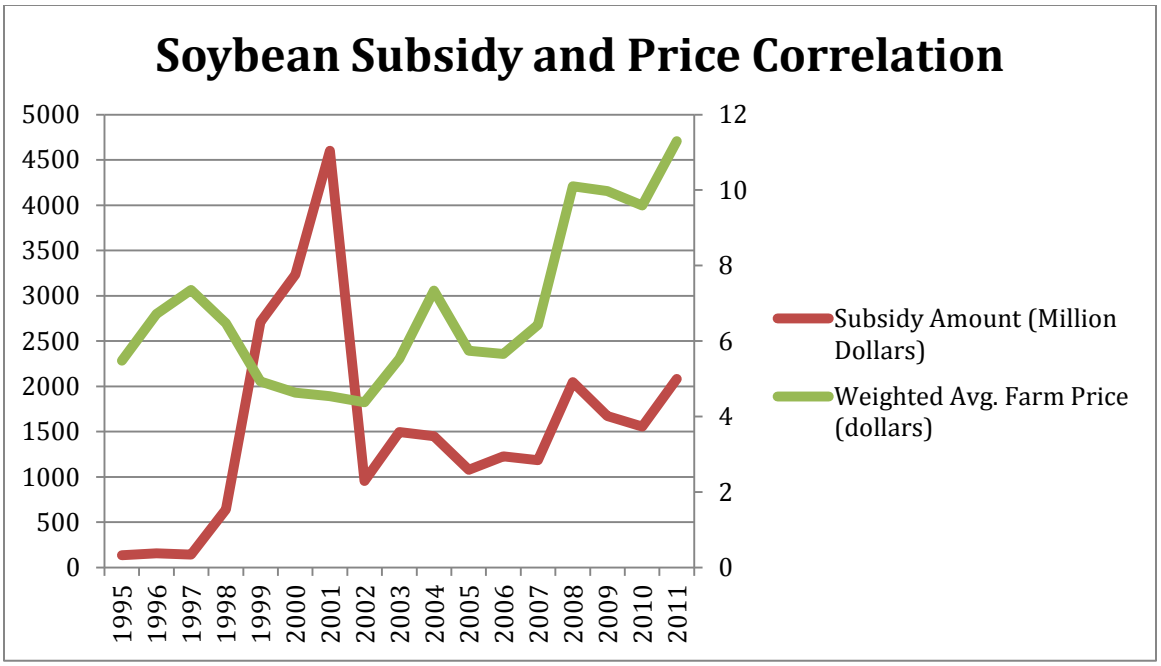
Year	Production (Million Bushels)	Exports (Million Bushels)	Imports (Million Bushels)	Subsidy Amount (million dollars)	Weighted-average farm price (dollars per bushel)	NFI (Real 2009 Dollars)	Price x Production
2000	2758	995.871	3.568	3234.051	4.63	70051721	12769.54
2001	2891	1063.65	2.32	4602.195	4.54	74080388	13125.14
2002	2756	1044.37	4.661	954.541	4.38	59778179	12071.28
2003	2454	886.551	5.562	1493.547	5.53	83159504	13570.62
2004	3124	1097.15	5.576	1449.036	7.34	93871157	22930.16
2005	3068	939.878	3.372	1079.888	5.74	94199225	17610.32
2006	3197	1116.49	9.034	1228.029	5.66	72183779	18095.02
2007	2677	1158.82	9.871	1183.622	6.43	79505716	17213.11
2008	2967	1279.29	1.3263	2048.182	10.1	88755793	29966.7
2009	3359	1499.04	1.4598	1672.746	9.97	73874299	33489.23
2010	3329	1501.30	1.4449	1554.841	9.59	96543061	31925.11
2011	3056	1275	1.6136	2082.443	11.3	122829596	34532.8

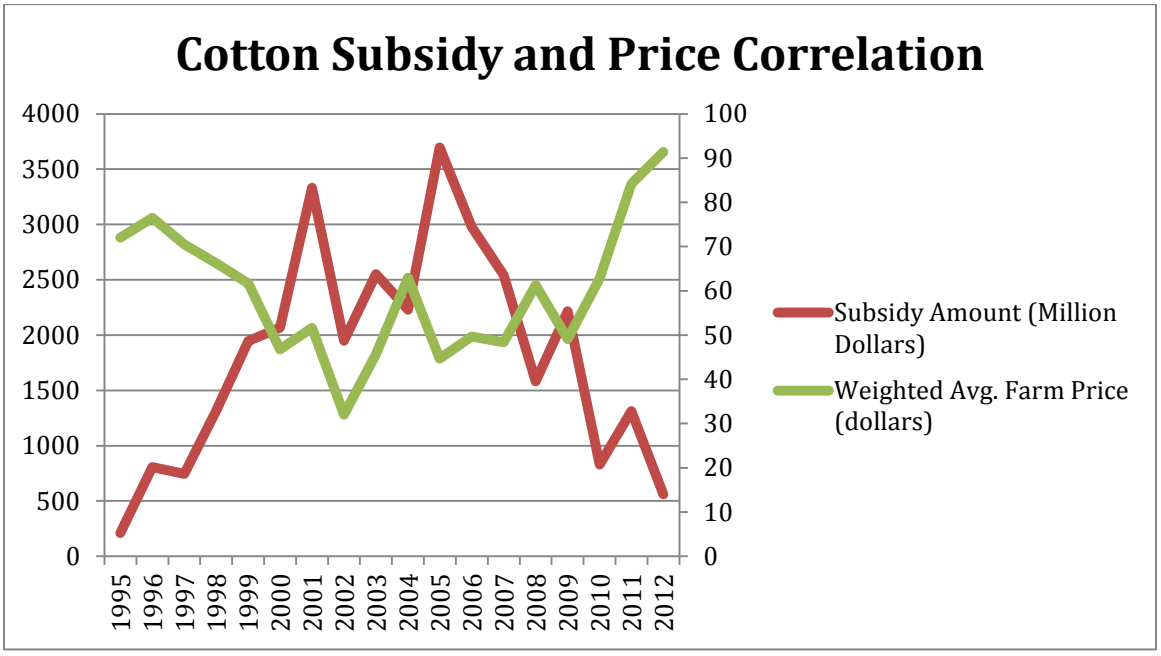
Regression analysis

Each table below, 4 each for corn, cotton and soybeans, will contain individual explanations of the results. After all 12 regression analyses, a cross-sectional analysis will be done, basically an analysis comparing one to each other to determine the true

relationship between subsidization and price and production. I have chosen to do multiple regressions for each crop in order to mete out correlation bias, namely a question as to which variable might cause the other. This is especially pertinent concerning the relationship between subsidization and price. One the one hand, subsidization may and most likely does cause changes in prices. However, in a world with price prediction, economic forecasts of future prices may also impact the political negotiations that allocate subsidy money. So which of the two is to be believed, or are both at play? In order to determine these parallel scenarios, I have analyzed the data together, and have made graphs charting the relationship between the two. In these cases, there is no clear relationship for corn, a somewhat positive relationship for soybeans, and an oppositional (negative) relationship for cotton. I have also run regressions with both price and subsidy amount as independent variables, which should, when analyzed together, come to form a complete picture.







The regression analysis done in this chapter uses the Gretl statistical software and runs regressions using ordinary least squares estimations. There are several key figures to note within the regression tables, and they are the variable coefficients, the p-values, the R-squared statistic as well as the adjusted R-squared statistic. First are the variables

and their coefficients. There are 7 total variables for each of the three crops, with 4 different regressions run. Several of the variables are self explanatory, with production, export, import and subsidy variables denoting the amount in each category. Weighted-average farm price can be better thought of as average price of the crop throughout each year. The price of each crop should be noted as nominal in price, not indexed to inflation or set to a base year. The final two variables are net farm income (NFI) and gross revenue. Gross revenue is simply price*production, which yields the total amount of money generated for each crop. NFI is the total farmer income for all farmers for each year. Unlike price, net farm income (NFI) is set to real 2009 dollars, indicating its real vs. nominal nature and its 2009 base year.

Moving to the variable coefficients column, the values tell us that for a 1% increase in the independent variable, the total increase or decrease of the dependent variable would change by that coefficient value on average, holding the other variables constant. It must be said however that this only holds for variables with statistical significance, as those without significance cannot be said to have that relationship. For the p-values specifically, it is important to note that asterisk denotations indicate statistical significance for the .1, .05 and .01 levels.

Table 4. Corn Gross Crop Value as Dependent Variable

Dependent variable: Price_x_Production

	coefficient	std. error	t-ratio	p-value	
const	1032.54	3963.68	0.2605	0.7986	
Exports_Million_~	78.0151	61.0186	1.279	0.2234	
Imports__Million~	-7.57032	17.1169	-0.4423	0.6656	
Subsidy_Amount__~	-0.0606996	0.175326	-0.3462	0.7347	
NFI__Real_2009_D~	7.58365e-05	2.75223e-05	2.755	0.0164	**

Mean dependent var	10600.60	S.D. dependent var	1597.819
Sum squared resid	26316515	S.E. of regression	1422.796
R-squared	0.393649	Adjusted R-squared	0.207079
F(4, 13)	2.109930	P-value(F)	0.137721
Log-likelihood	-153.2989	Akaike criterion	316.5978
Schwarz criterion	321.0497	Hannan-Quinn	317.2117
rho	0.371463	Durbin-Watson	0.862740

Excluding the constant, p-value was highest for variable 4 (Subsidy_Amount__million_dollars)

The first regression uses the gross price*production figure as the dependent variable, with exports, imports, subsidy amount and NFI as the independent variables. Interestingly, there was only one statistically significant variable, NFI. Its coefficient of $7.5*10^{-5}$ seems small, but it is important to note that the scale of these variables is in the millions, so a small change in the independent variable can still yield larger results when put into context. In this case, the coefficient indicates that a 1 unit increase in NFI would lead to an increase of $7.5*10^{-5}$ for the gross price*production figure. Another notable figure to look at is the R-squared statistic. The R-squared statistic measures the amount of variation that can be accounted for within this analysis. In this case, at .39, only 39% of the variation within the gross price*production figure can be said to come from these independent variables. Looking critically, this means that there are potentially other variables not included that might hold more of a correlation than the ones listed here. On the other hand, it is not uncommon for R-squared percentages to be around this 30-50%

range, as there are certain outliers and inconsistencies that can sometimes diminish the explained variation.

Table 5. Corn Price as Dependent variable

Dependent variable: Weighted_average_farm_price__do

	coefficient	std. error	t-ratio	p-value	
const	-0.587969	1.50026	-0.3919	0.7020	
Exports_Million_~	-0.0184798	0.0244417	-0.7561	0.4642	
Imports__Million~	0.00770675	0.00651048	1.184	0.2594	
Subsidy_Amount__~	-0.000183056	6.64914e-05	-2.753	0.0175	**
NFI__Real_2009_D~	2.79819e-08	1.30751e-08	2.140	0.0536	*
Production__Mill~	0.000259124	0.000104732	2.474	0.0293	**

Mean dependent var	2.959444	S.D. dependent var	1.249821
Sum squared resid	3.462116	S.E. of regression	0.537131
R-squared	0.869624	Adjusted R-squared	0.815301
F(5, 12)	16.00832	P-value(F)	0.000060
Log-likelihood	-10.70447	Akaike criterion	33.40894
Schwarz criterion	38.75117	Hannan-Quinn	34.14556
rho	0.241869	Durbin-Watson	1.477845

Excluding the constant, p-value was highest for variable 2 (Exports_Million_Bushels_)

The next regression uses the corn price as the dependent variable, with exports, imports, subsidy amount, NFI and production amount as the independent variables. Unlike the first regression, there are 3 statistically significant results in this run. For all three-subsidy amount, NFI and production there is a statistically significant correlation with price. It is important to note however, that this correlation does not necessarily imply causality. In this case, there might even be reciprocal relationships between the independent and dependent variables that hinder any real analyses.

The coefficients for these three variables indicate a negative relationship between subsidization and price, which is to be expected. As subsidization goes up, the price will go down as the increased subsidization will lead to higher production, which in turn increases supply, thereby decreasing price. For the other two variables, the correlation is

positive; meaning as they go up price goes up as well. However, I do believe there to be some reciprocity in these relationships, meaning that it may be the case that price is impacting NFI and Production, not the other way around. In this way price increases would lead to more production and a higher NFI as the higher price would entice more production to occur. In any case, one must be careful to not take the data at face value alone, but must think critically in order to ascertain the real meaning behind it. Notably, the R-squared statistic in this case is very high, at .869, meaning that almost 87% of the variation in price can be accounted for by these independent variables. Looking critically, this means that this set of variables do well to explain the changes in price on a year-to-year basis.

Table 6. Corn Production as Dependent Variable

Dependent variable: Production__Million_Bushels_

	coefficient	std. error	t-ratio	p-value	
const	1450.45	3360.54	0.4316	0.6737	
Exports_Million_~	75.7510	51.6764	1.466	0.1684	
Imports__Million~	-15.0636	14.8066	-1.017	0.3291	
Subsidy_Amount__~	0.198575	0.181673	1.093	0.2958	
Weighted_average~	1303.64	526.899	2.474	0.0293	**
NFI__Real_2009_D~	1.37088e-05	3.42445e-05	0.4003	0.6960	

Mean dependent var	10597.64	S.D. dependent var	1597.189
Sum squared resid	17417672	S.E. of regression	1204.771
R-squared	0.598368	Adjusted R-squared	0.431021
F(5, 12)	3.575612	P-value(F)	0.032751
Log-likelihood	-149.5845	Akaike criterion	311.1690
Schwarz criterion	316.5113	Hannan-Quinn	311.9056
rho	0.218689	Durbin-Watson	1.172027

Excluding the constant, p-value was highest for variable 6 (NFI__Real_2009_Dollars_)

The third regression takes production amount of corn as the dependent variable. Unlike with price, production does not see as much in the way of statistically significant relationships. The only significance comes from the price independent variable, but I

believe that to be from price's heavy impact on future production. As indicated with the data tables above, there is a one year lag in order to see price's effect on production the year after, and it is unsurprising that it is significant, and so high as well. In this regression a 1-dollar increase in crop price per bushel leads to 1303.64 increases in production, which is in millions of bushels. In this way one can see the tremendous impact even a small change in price can do. Going from say 4 to 5 dollars a bushel leads to over a billion more bushels being produced in order to try and get some of the profits.

Table 7. Corn Subsidy Amount as Dependent Variable

Dependent variable: Subsidy_Amount__million_dollars

	coefficient	std. error	t-ratio	p-value	
const	-2524.41	5079.73	-0.4970	0.6282	
Exports_Million_~	23.3809	84.7616	0.2758	0.7874	
Imports__Million~	9.22162	23.2326	0.3969	0.6984	
NFI__Real_2009_D~	8.73459e-05	4.57491e-05	1.909	0.0804	*
Weighted_average~	-2114.72	768.130	-2.753	0.0175	**
Production__Mill~	0.455979	0.417167	1.093	0.2958	

Mean dependent var	4692.061	S.D. dependent var	2158.553
Sum squared resid	39995466	S.E. of regression	1825.638
R-squared	0.495064	Adjusted R-squared	0.284674
F(5, 12)	2.353075	P-value(F)	0.104274
Log-likelihood	-157.0660	Akaike criterion	326.1321
Schwarz criterion	331.4743	Hannan-Quinn	326.8687
rho	0.183904	Durbin-Watson	1.608722

Excluding the constant, p-value was highest for variable 2 (Exports_Million_Bushels_)

The final corn regression takes subsidy amount as the dependent variable. As Table 7 shows, both NFI and crop price are statistically significant, with price having a negative relationship and NFI a positive one. Intuition would say that this is to be expected, as when price goes down subsidization goes up due to the price support policies in place by the government. On the other hand it must be noted that this could also be a reciprocal relationship in that increased subsidization makes the price go down, similar to Table 5's regression with price as the dependent variable.

Looking at all four of the corn regressions together, the picture painted is one of very close relationships between price, production and subsidization. Price as an independent variable was significant in all instances, and NFI was also a great predictor. While exports and imports were never significant, it is interesting to think about why. As a crop, corn is the biggest food crop in the US, used in a variety of different industries. Intrinsically, import figures are going to be very low as such a major crop would not need to be imported. As well the relationship between import amounts and the other variables would not be that important.

Moving to cotton, I hypothesized that these regressions would behave in a similar manner to corn. Being the biggest non-food crop, the close ties between price, production and subsidization should be present. Additionally, as cotton is a majorly exported crop, with the US exporting almost 50% of the world's cotton, I also expect export numbers to also play a statistically significant role in the regression analyses.

Table 8. Cotton Gross Crop value as Dependent Variable

Dependent variable: Price_x_Production

	coefficient	std. error	t-ratio	p-value	
const	10516.9	5481.84	1.918	0.0773	*
Exports_Million_~	0.321352	0.332685	0.9659	0.3517	
Imports__Million~	6.27038	6.68653	0.9378	0.3655	
Subsidy_Amount__~	1.29918	1.08752	1.195	0.2536	
NFI__Real_2009_D~	1.19579e-05	5.69203e-05	0.2101	0.8369	

Mean dependent var	18026.92	S.D. dependent var	3155.158
Sum squared resid	1.22e+08	S.E. of regression	3066.335
R-squared	0.277744	Adjusted R-squared	0.055511
F(4, 13)	1.249789	P-value(F)	0.338437
Log-likelihood	-167.1204	Akaike criterion	344.2408
Schwarz criterion	348.6926	Hannan-Quinn	344.8546
rho	0.203001	Durbin-Watson	1.579642

Excluding the constant, p-value was highest for variable 6 (NFI__Real_2009_Dollars_)

The first regression again used the gross price*production figure as the dependent variable, with exports, imports, subsidy amount and NFI as the independent variables. Interestingly and similarly to corn, there was only one statistically significant variable, in this case the constant. Unlike corn, NFI was not significant. The R-squared statistic in this case is notable as at .27, only 27% of the variation within the gross price*production figure can be said to come from these independent variables. Looking critically, this means that there is probably other variables not included that might hold more of a correlation than the ones listed here. Moving forward, it will be important to see whether this remains the case or if the issue just lies with this regression's structure and not with the variables.

Table 9. Cotton Price as Dependent Variable

Dependent variable: Weighted_average_farm_price__do

	coefficient	std. error	t-ratio	p-value	
const	19.1920	10.9531	1.752	0.1052	
Exports_Million_~	-0.00191421	0.000608010	-3.148	0.0084	***
Imports__Million~	0.0120263	0.0121903	0.9866	0.3433	
Subsidy_Amount__~	-0.00484810	0.00202241	-2.397	0.0337	**
NFI__Real_2009_D~	6.97065e-07	1.00594e-07	6.929	1.58e-05	***
Production__Mill~	0.000618482	0.000489723	1.263	0.2306	

Mean dependent var	59.86667	S.D. dependent var	15.30951
Sum squared resid	351.3384	S.E. of regression	5.410933
R-squared	0.911823	Adjusted R-squared	0.875083
F(5, 12)	24.81807	P-value(F)	6.13e-06
Log-likelihood	-52.28330	Akaike criterion	116.5666
Schwarz criterion	121.9088	Hannan-Quinn	117.3032
rho	-0.294559	Durbin-Watson	2.575422

Excluding the constant, p-value was highest for variable 3
(Imports__Million_Bushels_)

Moving to the price regression for cotton, there are three significant independent variables. NFI and subsidy amount remain positive and negatively respectively similar to the corn price regression, which makes sense given the nature of the subsidization policy

within the US. What is unique about this regression is the negative relationship between price and export amount. In this case as export amounts increase, price goes down. Notably, the R-squared statistic in this case is very high, at .91, meaning that 91% of the variation in cotton's price can be accounted for by these independent variables. This means that this set of variables do well to explain the changes in price on a year-to-year basis.

Table 10. Cotton Production as Dependent Variable

Dependent variable: Production__Million_Bushels_

	coefficient	std. error	t-ratio	p-value
const	5619.78	6601.37	0.8513	0.4113
Exports_Million_~	0.648274	0.414744	1.563	0.1440
Imports__Million~	3.23941	6.95698	0.4656	0.6498
Subsidy_Amount__~	2.06997	1.22399	1.691	0.1166
Weighted_average~	189.692	150.201	1.263	0.2306
NFI__Real_2009_D~	-0.000122294	0.000119483	-1.024	0.3263

Mean dependent var	17967.06	S.D. dependent var	3157.791
Sum squared resid	1.08e+08	S.E. of regression	2996.628
R-squared	0.364331	Adjusted R-squared	0.099468
F(5, 12)	1.375547	P-value(F)	0.300278
Log-likelihood	-165.9861	Akaike criterion	343.9722
Schwarz criterion	349.3144	Hannan-Quinn	344.7088
rho	0.251712	Durbin-Watson	1.491106

Excluding the constant, p-value was highest for variable 3 (Imports__Million_Bushels_)

The third cotton regression shows no significant relationships between the independent and dependent variables. This is similar in a way to corn, but even so price was not significant as it was for corn. The closest variable to being statistically relevant was subsidy amount, with a p-value of .11, higher than the .10 thresholds. Again, the R-squared was not reasonably low, but at only .36 there can be other variables that predict the variation in production amounts.

Table 11. Cotton Subsidy Amount as Dependent Variable

```
Dependent variable: Subsidy_Amount__million_dollars

                      coefficient      std. error    t-ratio  p-value
  ------------------------------------------------------------------------
  const                2490.62         1248.50         1.995   0.0693  *
  Exports_Million_~      -0.0521419       0.0952530    -0.5474  0.5941
  Imports__Million~      -0.518692        1.48017      -0.3504  0.7321
  NFI__Real_2009_D~       2.72503e-05     2.52066e-05   1.081   0.3009
  Production__Mill~       0.0929804       0.0549797     1.691   0.1166
  Weighted_average~     -66.7912         27.8623       -2.397   0.0337  **

Mean dependent var   1826.229   S.D. dependent var   986.0149
Sum squared resid     4840314   S.E. of regression   635.1059
R-squared            0.707142   Adjusted R-squared   0.585117
F(5, 12)             5.795088   P-value(F)           0.006001
Log-likelihood      -138.0600   Akaike criterion     288.1199
Schwarz criterion    293.4621   Hannan-Quinn         288.8565
rho                 -0.430221   Durbin-Watson        2.788935

Excluding the constant, p-value was highest for variable 3
(Imports__Million_Bushels_)
```

The final cotton regression takes subsidy amount as the dependent variable. In this case only the constant and cotton price were significant, with price having a negative relationship. As stated above with corn, intuition would say that this is to be expected, as when price goes down subsidization goes up due to the price support policies in place by the government. On the other hand it must be noted that this could also be a reciprocal relationship in that increased subsidization makes the price go down.

Table 12. Soybeans Gross Crop Value as Dependent Variable

```
Dependent variable: Price_x_Production

                      coefficient     std. error    t-ratio  p-value
  ------------------------------------------------------------------------
  const                1931.43        760.571         2.539   0.0387  **
  Exports_Million_~       0.896930      0.410515      2.185   0.0652  *
  Imports__Million~      -9.75430      32.2624       -0.3023  0.7712
  Subsidy_Amount__~      -0.0270192     0.0784516    -0.3444  0.7407
  NFI__Real_2009_D~       1.20031e-06   4.68277e-06   0.2563  0.8051

Mean dependent var   2976.767   S.D. dependent var   274.7091
Sum squared resid    379512.2   S.E. of regression   232.8433
R-squared            0.542820   Adjusted R-squared   0.281575
F(4, 7)              2.077817   P-value(F)           0.187362
Log-likelihood      -79.19767   Akaike criterion     168.3953
Schwarz criterion    170.8199   Hannan-Quinn         167.4977
rho                  0.108838   Durbin-Watson        1.766566

Excluding the constant, p-value was highest for variable 6
(NFI__Real_2009_Dollars_)
```

Table 13. Soybeans Price as Dependent Variable

Dependent variable: Weighted_average_farm_price__do

	coefficient	std. error	t-ratio	p-value	
const	-3.90008	4.23578	-0.9207	0.3927	
Exports_Million_~	0.00893609	0.00212845	4.198	0.0057	***
Imports__Million~	-0.124429	0.130323	-0.9548	0.3766	
Subsidy_Amount__~	-0.000342013	0.000317496	-1.077	0.3228	
NFI__Real_2009_D~	7.22132e-08	1.88744e-08	3.826	0.0087	***
Production__Mill~	-0.00142413	0.00151500	-0.9400	0.3835	

Mean dependent var	7.100833	S.D. dependent var	2.486774
Sum squared resid	5.241270	S.E. of regression	0.934636
R-squared	0.922950	Adjusted R-squared	0.858742
F(5, 6)	14.37435	P-value(F)	0.002746
Log-likelihood	-12.05721	Akaike criterion	36.11441
Schwarz criterion	39.02385	Hannan-Quinn	35.03723
rho	-0.215234	Durbin-Watson	2.418878

Excluding the constant, p-value was highest for variable 1 (Production__Million_Bushels_)

Tables 12 and 13 show some promising statistical significances, mostly concerning exports. For both regressions export amount was relevant, highlighting the major role exports have in both cotton production and price. Strengthening this argument, the R-squared statistic for the price regression was .92 meaning that almost all of the variation in price can be accounted for. Given that only exports and NFI were statistically significant, it is easy to conclude that they play a major role in determining price levels. In the price regression NFI was also significant, but I hesitate to conclude that it is really NFI that raises price or if it is the other way around. As prices increase it is only logical that farm income would increase as well, as farmers would receive higher compensation for their crops. In this way it can be said for all three crops to be the case

Table 14. Soybeans Production as Dependent Variable

Dependent variable: Production__Million_Bushels_

	coefficient	std. error	t-ratio	p-value
const	1337.76	998.887	1.339	0.2290
Exports_Million_~	1.58058	0.844231	1.872	0.1103
Imports__Million~	-19.6213	34.2656	-0.5726	0.5877
Subsidy_Amount__~	-0.0541140	0.0844159	-0.6410	0.5452
Weighted_average~	-90.1370	95.8890	-0.9400	0.3835
NFI__Real_2009_D~	7.49378e-06	8.25819e-06	0.9074	0.3992

Mean dependent var	2969.667	S.D. dependent var	273.2865
Sum squared resid	331735.2	S.E. of regression	235.1365
R-squared	0.596204	Adjusted R-squared	0.259707
F(5, 6)	1.771795	P-value(F)	0.252676
Log-likelihood	-78.39038	Akaike criterion	168.7808
Schwarz criterion	171.6902	Hannan-Quinn	167.7036
rho	-0.023442	Durbin-Watson	2.036675

Excluding the constant, p-value was highest for variable 3
(Imports__Million_Bushels_)

Table 15. Soybeans Subsidy Amount as Dependent Variable

Dependent variable: Subsidy_Amount__million_dollars

	coefficient	std. error	t-ratio	p-value
const	3777.79	5098.12	0.7410	0.4867
Exports_Million_~	3.49879	4.76181	0.7348	0.4902
Imports__Million~	-239.905	132.337	-1.813	0.1198
NFI__Real_2009_D~	2.30976e-05	4.01092e-05	0.5759	0.5856
Production__Mill~	-1.18451	1.84780	-0.6410	0.5452
Weighted_average~	-473.837	439.870	-1.077	0.3228

Mean dependent var	1881.927	S.D. dependent var	1053.282
Sum squared resid	7261430	S.E. of regression	1100.108
R-squared	0.404969	Adjusted R-squared	-0.090890
F(5, 6)	0.816701	P-value(F)	0.578721
Log-likelihood	-96.90635	Akaike criterion	205.8127
Schwarz criterion	208.7221	Hannan-Quinn	204.7355
rho	-0.209350	Durbin-Watson	2.330311

Excluding the constant, p-value was highest for variable 6
(NFI__Real_2009_Dollars_)

The last two regressions concerning production and subsidy amount as dependent variables both found no statistically significant results. This was interesting, and I can venture several reasons as to why this is the case. While corn and cotton go as far back

as 1995 in the data, yielding 17 observations, soybeans only contain data from 2000-2011. In this way it is even more surprising to find statistical relevance at all given the small number of observations. Additionally, soybeans are relatively new to the stage compared to corn, signifying that there may be less subsidization in that area, leading to a much looser relationship between subsidization and price and production.

Looking across all three crops, there are several similarities that lead to some general conclusions. For both corn and cotton price and production were very closely related, as was NFI for all three crops. This indicates that the agricultural sector as a larger entity is not as starkly diversified in its relationships as one might think, and even across food and non-food crops the relationship between subsidization and output can be seen.

Chapter 4
Pros and Cons of Price Supports

Introduction

This chapter will outline the pros and cons of price and income supports. The main point of this chapter will be to show that there are both positive and negative attributes with these two means of subsidy support. I have outlined below 4 distinct pros and cons of price and income support subsidies.

Pros

1. Creates price stability
2. Helps support farmer's incomes
3. Increases political involvement
4. Elastic vs. Inelastic nature of the market spurs an economic power struggle

Cons

1. Price supports lead to higher commodity prices, which is bad for consumers.
2. Price support programs cost money.
3. The government may not accurately support the different crops.
4. Overproduction can lead to expansion in capacity when there might not need to be expansion.

In the narrative of agricultural subsidization, the two major political factions come down as either in favor of a more highly involved government or in favor of a much freer market. By looking at both the positives and negatives of the current policies in place, the cost benefit analysis can be determined and the overall discussion of where to go from here can be discussed. Overall, I believe that while there are certainly some

drawbacks, they can be mediated and moving forward there can be a comprehensive policy platform that can both achieve the economic goals of the government while at the same time not impinging on the free market or personal/ collective rights.

Pros and Cons of Price and Income Supports

Price Stability vs. Higher Prices

The first positive achievement of the current free market oriented price and income supports is the stabilization of crop markets. As the agricultural market expanded throughout the 20th century through increased in demand and production capacity, the larger market also increased in unpredictability.[52] Food markets in particular fall victim to certain trends of unpredictability and much higher booms and busts. As Gardner wrote in his book *American Agriculture*, food is much more cyclically sensitive, meaning that supply and demand are much more responsive to market forces.[53] This leads to much bigger market booms and busts. While promoters of the free market might hail the large upswings, the downturns have devastating effects. As was seen in times of economic hardship such as the Great Depression, low demand can lead to rotting crops and farmers being unable to sell their product. This in turn puts farmers out of business.

In response to this unpredictability, the government had an incentive to stabilize prices, both by setting a price floor and indexing prices to a set base level. This goal of supporting prices and farm incomes began in the 1930s with several new deal policies, and became explicitly more important in the 1970s.[54] Over that 40-year 1930-1970 period, the policies implemented were impactful, but not necessarily economically

[52] Gardner *American Agriculture* page 128
[53] Ibid page 133
[54] Knutson, Penn and Boehm *Agriculture and Food Policy* page 202

efficient. Certain production control programs that were designed to bolster falling prices, such as acreage retirements and government purchasing of grain were seen as unnecessarily inefficient, and the transition moved toward more market oriented policies in the 1990s, as I discussed in the previous chapter.[55]

While the bolstering of prices is definitely a positive boost for farmer's production and incomes, the drawback comes in the form of higher food prices, which is bad for consumers. The impact of these market-oriented policies designed to set base levels for crops is that in certain instances the price is higher than the market equilibrium price. The flaw in this case is that when prices are set to parity levels, it is often the wrong level. As Knutson, Penn and Boehm write in *Agriculture and Food Policy*, the parity price level is set to equal purchasing power of 1910-1914.[56] This means that the cost per unit of the crop will be able to buy the same amount of goods it was able to buy in 1910-1914. While this may sound good on the surface, there are more hidden effects. By setting prices to a level so far in the past, the economic and productive gains since then are not reflected in the price. This means that while it now costs less per unit to produce a certain crop thanks to increasingly effective fertilizer and genetic modifications, the costs to consumers do not necessarily go down accordingly. The producers realize the entirety of the savings, while the consumer sees none.

Painting the picture of the stark contrast between price stability vs. higher prices for consumers is somewhat disingenuous. While it is enticing to say that the consumers have not realized any cost savings, it is not the case when looking at the data. There are several key economic figures that paint a much more positive picture for consumers,

[55] Ibid page 217
[56] Ibid page 208-210

indicating that there is not just a reaping of profits by producers alone, but that consumers also have benefited over time. Firstly, the percentage of disposable income spent on food has gone way down from 41% to 12% over time.[57] And secondly, food prices have actually gone down overall (35%) throughout the past several decades. Now, is it plausible to say that these downtrends have been due to the policy decisions put in place by the government or is it in spite of them? Overall, I believe that the benefits in this case do outweigh the risks. The increased stability has certainly positively benefitted both the industry and the market as a whole, and even though setting prices to a level so far in the past might diminish cost savings towards consumers, there have still been realized effects in the form of lower prices and lower amounts of income spent on food.

Income Support vs. Costs

In addition to price stability policies, income support to farmers has been the second major policy goal of the US government. Throughout history farm incomes have been lower than non-farm incomes, and in response the government has sought to redistribute income in a sense towards these low-income farmers.[58] Falling prices also have a tremendous impact on farmer income, which in a very real way ties together both price supports and income payments. With the Great Depression came a plummeting prices, down 55% between 1929-1933.[59] The New Deal in this respect painted farmers as a very weak group, with little to no bargaining power.[60] From then onward, the government has aggressively supported farmers growing major crops, as well as

[57] Gardner *American Agriculture* page 141
[58] Pasour Jr. and Rucker *Plowshares and Porkbarrels* page 20-21
[59] Ibid page 86-87
[60] Ibid page 73

increased and stabilized earnings over time through the passage of Farm Bills throughout the 1950s-1990s.[61]

While this depiction of farmers as a weak group both economically and politically has been true historically, there is much more doubt today as to whether or not it is still true. Knutson, Penn and Boehm highlight this in their work by noting the major arguments against this government involvement in favor of a much freer market. The argument presented is that both price and income supports are no longer necessary, as farmers' incomes are fine now.[62] Additionally, with the increasing average size of farms, along with the increase in automation, the necessity of the same amount of support has been challenged.[63] Thirdly, many of the concerns that farmers are not represented politically have gone away with the introduction of lobbyists and interest groups in Washington.

This is one area of current policy where I struggle to see current merit in the structure of income supports. I accept more the premise that farmers are in less need of generous income supports, given the successful nature of price supports along with other factors. With the rise of industrial farms, coupled with the heavy automation today, there is less and less labor required to farm a given area. This leads me to believe more that smaller farms and farmers are being pushed out of the marker and that big business is reaping the subsidies, which in my mind is unnecessary. There is certain room to adapt this policy to help the small farmer, which I do agree is a noble cause, but to increasingly

[61] Zivin and Perloff *Intended and Unintended Effects* page 2, 20
[62] Knutson, Penn and Boehm *Agriculture and Food Policy* page 228-235
[63] Zivin and Perloff *Intended and Unintended Effects* page 45

increase income supports through direct payments to parties that are generating massive profits is unnecessary and not a wise decision.

Beginning all the way back with the New Deal programs, government involvement and by extension government expenditures have increased dramatically. From 1929-1935 alone the USDA expenditures went up from $200 million dollars to $1.2 billion dollars.[64] This continued well into the 1970s and 80s, with additional programs such as acreage allotments and grain conservation costing even more through lost revenue and opportunity costs. The table below shows overall subsidy amounts from the 1995 through 2011 period, with each year growing more and more.[65] Just over the last 15 years the total amount spent on crop subsidies was $277,672,554,138 dollars, over a quarter trillion dollars.

Year	Overall Subsidy Amount	Subsidy Amount as a percentage of GDP
1995	8,131,563,163	0.07%
1996	8,255,869,060	0.07%
1997	8,357,895,525	0.07%
1998	13,303,944,390	0.11%
1999	22,964,171,712	0.18%
2000	24,740,234,687	0.19%
2001	24,247,372,508	0.19%
2002	14,068,373,158	0.10%

[64] Pasour Jr. and Rucker *Plowshares and Porkbarrels* page 90-91
[65] Farm.ewg.org

2003	18,116,222,690	0.13%
2004	15,341,958,208	0.10%
2005	24,309,014,460	0.16%
2006	17,035,215,324	0.11%
2007	14,430,758,109	0.09%
2008	17,032,492,997	0.11%
2009	16,321,523,606	0.11%
2010	15,364,353,500	0.10%
2011	15,651,591,041	0.10%

When discussing subsidization of agriculture, the staggering amount of money spent to ensure stable prices and high farmer income does come at a cost. In this case it is exactly that, the costs of the programs. Billions of dollars spent per year have to come from somewhere, and that normally winds up coming from the taxpayers. In this structure, it is not always going to be feasible or wise to spend this money on subsidies over other programs, and in times of economic hardship when the American people need the money the most it becomes a moral argument as to why they should pay out. In recent years there have been attempts to rein in skyrocketing costs, but not in a fashion that would cut subsidizations in any meaningful ways. Looking to the future, the cost benefit analysis must be done in order to see whether it is sound policy to continue such costly programs.

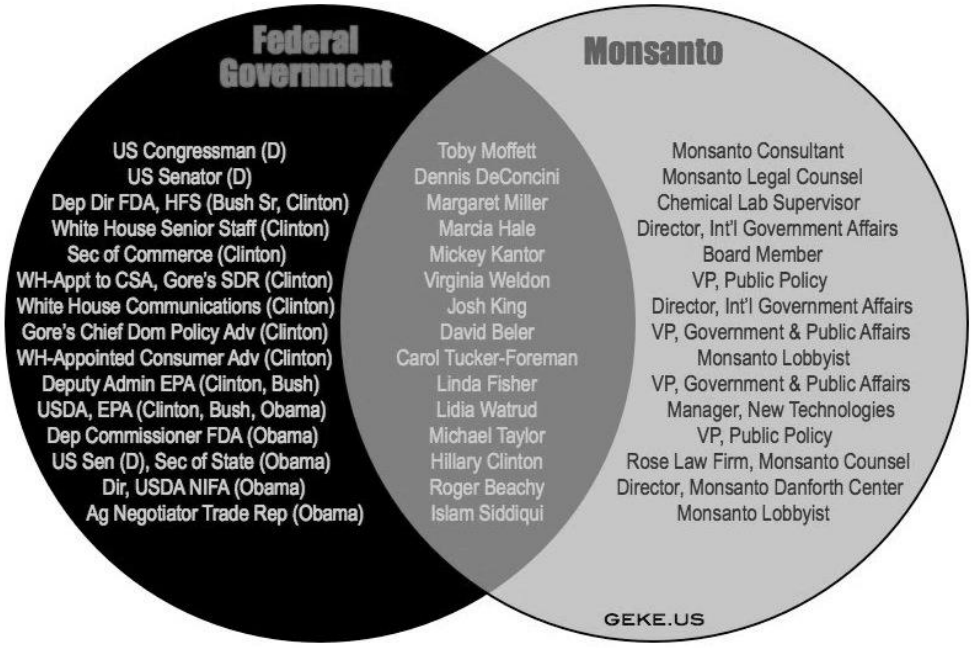
Political Activism vs. Moneyed Interests

Political activism from farmers and farm groups has been a great benefit with respect to political activism. Interest groups lobby Congress for bills that will directly impact them and shape the economic argument in their favor, and representation in Washington is something all major groups in Washington should strive for. However, when businesses comingle with the government in ways that cross the boundaries between the just and unjust, moneyed interests can and do cause negative externalities.

The two main branches of interest groups, the producer lobbies and agribusinesses have amassed a large amount of political clout and the landscape today highlights the winners. The strength of the producer lobby lies in the amount of farmers represented and their relative importance in the state they are in. Consequently, as their numbers decline their power and influence also declines. This begs the question of why aid has gone up even though the number of farmers has gone down. One of the two main farmers unions, The National Farmers Union is a staunch supporter of price and income supports as well as major governmental involvement in price setting and crop insurance.[66] This is a particularly strong reason as to why aid has continued. Through donations and the political games of Washington, the NFU can sway the outcomes on bills that will directly influence its members.

Moving to a second politically active group, commodity groups who focus on a specific product or crop, including input producers, machinery makers and transportation companies, their relative strength rises and falls with their relative importance in the American agricultural sector and the relative strength of the sector as a whole. Increasing

[66]Knutson, Penn and Boehm *Agriculture and Food Policy* page 65-73



and continued subsidization in this case will only strengthen their sales and increase their productive capacities, which spells out why many commodity groups, like farmers unions, are in favor of continuing the current policies in place.

Looking at the current political landscape from a more cynical perspective, there seems to be what is known as a revolving door relationship between business and government, which holds both positive and negative consequences. Many now argue that the problems currently facing America, not only in the agricultural sector but also in other sectors as well, stems from this unchecked relationship. Below is a picture depicting the relationship between the Federal Government and the Monsanto Corporation, a leader in genetically modified seeds and pesticides. As it shows, lobbyists on Monsanto's side move to representatives and consultants for the Federal Government, and Congressmen and staff members move into consultant positions within Monsanto.

The positives of this relationship are that the candidates are very knowledgeable in the area, allowing them to perform their jobs extremely well. However, there are some

skeptics that short change this theory and argue that there is no incentive to perform their jobs well if it would potentially harm future job opportunities. For example, why would someone working for the FDA push for stricter regulation if it would harm Monsanto, when they plan on potentially working for Monsanto in the future? The landscape today has shown there to be a tight relationship between government and business, leading to precarious positions for those in government who do not wish to jeopardize their futures in the private sector. These economic and political factors have are ever important in today's uncompromising political climate and understanding the relationship is the key to moving forward in a progressive and positive way.

Government Estimation and the Problem of Overproduction

While most of the issues discussed above have both positive and negative attributes, two specific cons of price supports are the problems of accurate support and over/underproduction. First, when the government institutes policies such as price and income supports, there are measurable effects on the specific crops the policies are purported to protect and promote. In this way, if the government inaccurately supports the crops by either setting prices too high or too low, the economy is negatively affected. This brings about case number two, overproduction. In the case of the government overshooting the market price, overproduction occurs, which brings along with it its own set of externalities.

Knutson, Penn and Boehm highlight the first of the two problems in their book *Agriculture and Food Policy*. They identify what they call the "price support dilemma", which states that price supports lead to increased production, which in turn leads to

perverse incentives that further perpetuates government involvement.[67] In this way, price supports contain an inherent flaw in that if they are not matched exactly what would be the true equilibrium price there will be over/underestimations of demand, leading to overproduction or shortages.

Elastic vs. Inelastic Markets and the Struggle for Economic Power

The elasticity of demand for crops within the agricultural market plays an important role in the determination of whether or not the government should grant subsidies and directly intervene in the market. As was stated in chapter 2, in economics, elasticity indicates how much of one good will be sold when another variable is changed. This can be on the supply side or demand side. For the supply side the question would be how much more will I produce and the demand side would be how much more will be demanded. Within these parameters, price elasticity of demand is almost always negative, meaning as the price of the good goes up; the demand for it will go down.

Within the agricultural sector, this negative price elasticity can be seen. The elasticity of demand for crops according to Gardner in *American Agriculture in the 20th Century* is -.2, meaning that for every unit of price increase the demand for the good will go down by .2 units.[68] Within the market itself, the price of these crops is also very sensitive. In this sense, the power in the dynamic is not in the hands of the consumers, as they are at the mercy of volatile price swings. These price swings, coupled with the inelastic nature of the market leads to demand inconsistencies, as well as the potential for consumers to wind up in positions where food prices could be so high as to not be affordable or too low, in which case there would be food shortages.

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[67] Knutson, Penn and Boehm *Agriculture and Food Policy* page 208-210
[68] Gardner *American Agriculture* page 141

The picture painted by these three economic effects is not economically or politically ideal. The market is unpredictable, big corporate farms are pushing out the small farmers, consumers are being forced to buy at artificially higher prices and there is no private sector insurance for farmers in case of crop disaster. These negative externalities beg for resolution, and the answers dating all the way back to the New Deal era and used still today is subsidies. This is arguable the biggest positive factor for both price stabilization and income support. The price stabilization methods put in place shift the power back to the consumer, who now does not have to worry about these massive swings. The markets have stabilized, which in turn stabilize demand. So in this case not only do the consumers benefit, but also companies. Their profit horizons are more easily predictable, spurring innovation, investment and expansion.

Conclusion

In conclusion, the narrative so far has been one of a rabid, unstable agricultural market, replete with negative externalities as well as disadvantaged consumers and farmers alike. These negative externalities have been dealt with for the past 80 years through price and income supports stemming from government intervention. Earlier in history, the benefits of these policy decisions were seen to far outweigh the risks. However, recently politics has split into two major factions, one side in favor of a more highly involved government and the other the opposite, in favor of a much freer market. Overall, the arguments presented regarding the current state of affairs do not mean that these price and income programs should be scrapped entirely; I think that that would be a huge detriment to the agricultural sector as well as the larger economy. However, I believe that while there are certainly some drawbacks, they can be mediated.

By adapting and slightly modifying the policies in place, costs can be brought back under control and rampant political influence can be marginalized in favor of a system that benefits both sides evenly as opposed to solely moneyed interests. Moving forward there can be a comprehensive policy platform that can both achieve the economic goals of the government while at the same time not subjecting consumers, small farmers and others to the growing agribusiness sector.

In the next chapter in this thesis, I will closely analyze the current state of affairs in both a political and economic light. This section will include the formulaic data obtained regarding production and exports, and as was said in chapter three project out into the future where we are headed now and where we could be headed without subsidies. Coupled with this, the most recent farm bills passed in 2008 and 2013 will be deconstructed to see what, if anything, has changed. Finally, I will move towards the concluding chapter in this thesis, namely what is next for American agriculture? I will prescribe both policy recommendations as well as give my thoughts on a broader take on agriculture and its place in American life and whether or not the system of conglomerate farming is necessarily the best policy moving into a more globalized, mechanized future.

Chapter 5
Where we are today, and where we're going

Introduction

After the previous chapter highlighted the relationships between price and production with other independent variables, it is key not only to look at the history of the factors, but to also project out to see what to expect in the coming years. In this way I will use the regression coefficients to structure a formula used to ascertain the effects of subsidies and more importantly what would happen should they cease to continue. For each of the three crops there will be both a speculation using current subsidy figures that will continue to grow at the rate they have been during the past decade as well as a speculation where subsidy amounts will be zero. The second part of the chapter will look into the most recent farm bill from 2008 as well as the two farm bills that failed to pass in 2013. This will also help give insight to the future of the agricultural sector and how Congress and different interest groups are moving forward.

Growth Rates

Using the same data from the regression for all three crops, I graphed the change in the variable values over time.[69] Using an exponential trend line function, I found the average growth rates for each of the variables, exports, imports, production, subsidy, and price. Below is a table outlining all of the growth rates for corn, cotton and soybeans.

Table 1 Growth rates

	Production	Exports	Imports	Subsidy	Price	NFI
Corn	2.50%	-2.10%	6.78%	0.36% -12.7% since 2005	5.35%	2.66%

[69] Graphs are in the appendix

Cotton	-1%	4.37%	-32.40%	3.28% -24% since 2005	0.58%
Soybeans	1.51%	3.68	-0.89%	-0.34%	8.71%

Two important figures are the subsidy growth rates in both corn and cotton. While the overall average growth rates are both positive, they have both gone down substantially since 2005, indicating a shift in policy around that time that curtailed subsidy support. Another interesting figure is Net Farm Income, which has grown 2.66% over the 1995-2013 period. This shows that farmers have been doing better, with incomes rising.

Using these growth rates, it is easy to roughly extrapolate out into the near future, keeping in mind that the speculative values would only hold given no major shifts in policy. Table 2 below shows the speculative values for all three crops.

Table 2. Speculations

	Year	Production (Million Bushels)	Exports (Million Bushels)	Imports (Million Bushels)	Subsidy Amount (million dollars)	Weighted-average farm price (dollars per bushel)	NFI (Real 2009 Dollars)
Corn	**2014**	14273.275	31.08	37.373	2799.75063	7.258615	125358517.1
	2015	14630.107	30.43	39.90688	2900.54165	7.646950903	128693053.7
	2016	14995.860	29.79	42.61257	3004.96115	8.056062776	132116288.9
	2017	15370.756	29.17	45.50170	3113.13975	8.487062134	135630582.2
	2018	15755.025	28.55	48.58672	3225.21278	8.941119958	139238355.7
	2019	16148.901	27.95	51.88090	3341.32044	9.419469876	142942096
	2020	16552.623	27.37	55.39843	3461.60798	9.923411515	146744355.7
	2021	16966.439	26.79	59.15444	3586.22587	10.45431403	150647755.6
	2022	17390.600	26.23	63.16511	3715.33000	11.01361983	154654985.9
	2023	17825.365	25.68	67.44771	3849.08188	11.60284849	158768808.5
Cotton	**2014**	12973.950	10854.48	6.76	579.322307	75.23384	
	2015	12844.210	11328.82	4.56976	598.324078	75.67019627	
	2016	12715.768	11823.89	3.089157	617.949108	76.10908341	
	2017	12588.610	12340.59	2.088270	638.217839	76.55051609	
	2018	12462.724	12879.88	1.411670	659.151384	76.99450909	
	2019	12338.097	13442.73	0.954289	659.085469	77.44107724	
	2020	12214.716	14030.18	0.645099	659.019560	77.89023549	
	2021	12092.569	14643.29	0.436087	658.953658	78.34199885	

	2022	11971.643	15283.21	0.294795	658.887763	78.79638245
	2023	11851.927	15951.08	0.199281	658.821874	79.25340147
Soy	**2012**	3102.146	1321.92	1.613438	2082.2347	12.28423
	2013	3148.988	1370.57	1.613277	2082.0265	13.35418643
	2014	3196.538	1421.00	1.613115	2081.81833	14.51733607
	2015	3244.805	1473.30	1.612954	2081.6101	15.78179604
	2016	3293.802	1527.51	1.612793	2081.4019	17.15639048
	2017	3343.538	1583.73	1.612632	2081.1938	18.65071209
	2018	3394.026	1642.01	1.612470	2080.9857	20.27518911
	2019	3445.276	1702.43	1.612309	2080.7776	22.04115808
	2020	3497.299	1765.08	1.612148	2080.5695	23.96094295

While the price and production variables have also been expanded into the short future, it is still important to use the variable coefficients on the independent variables to see what figures we get. For the corn price dependent regression, the coefficients were -.018, .0077, -.0001, $2.7*10^{-8}$, and .0002 for exports, imports, subsidy, NFI and production respectively. Looking at the year 2023, using these coefficients with their corresponding variable values the price comes out to 7.86. This is around $4 below the projected value that used the average growth rate. This can possibly be explained through other variables not included in the regression. The same types of differences are found in the other regression estimations.

Moving to the main focus, that being the estimated production and price figures when subsidy amounts were set to zero, the results are interesting.

	Price without subsidy	Price following projected growth	Production without subsidy	Production following projected growth
Corn	$7.48	11.6	19677.42	17825.37
Cotton	106.6	79.25	15112.1	11851.93
Soybeans	17.23	23.96	3035.16	3497.3

The results of the cancellation of the subsidization programs are interesting, and not at all surprising. With one of the main goals of current agricultural policy being price supports, it is not surprising to see the prices of both corn and soybeans go down. Interestingly, the price of cotton went up, indicating an opposite trend. I believe this to be due to the major role of exporting in the cotton industry. With subsidization helping control input and other prices, a lack of those subsidies would force the price up in response to the higher production costs.

Moving to production figures, all three crops shows similar, smaller changes. For corn and cotton, the production figures increased while for soybeans it decreased. I believe the increase in cotton stems from the higher projected price of the crop, allowing for a higher production amount yielding much greater profits. Similarly for corn, the reduction in price coupled with the slight increase in production leads to a very similar gross revenue, showing that the industry would not collapse from an elimination of subsidization.

Political Landscape Today

The 2008 farm bill is the second most recent farm bill to become a law. Both the House of Representative and Senate's 2013 bills were shot down in the House, and the most recent bill was passed only 3 short months ago in February of 2014. Below is a table outlining the expenditures in the several major areas, including commodities (price and income support programs), conservation (land retirement, etc.) and crop insurance. Those three areas, which have been the major ones I have focused on as they pertain to direct subsidization over food aid programs and others alone total 194.1 billion dollars. Additionally, Nutrition as a sector tops the list with 432.2 billion dollars outlaid into

things like the Food Stamp and SNAP programs among others. This shows that over the past decade the flow of government money into the agricultural sector has not slowed down.

Estimated cost of farm bill mandatory programs-Congressional Budget Office (CBO) baseline assumptions 1/		
Programs	**(A) Estimated cost under March 2008 baseline**	**(B) Estimated cost for baseline plus 2008 farm bill cost**
	Billion dollars	
Commodities	75.8	74.8
Conservation	52.5	57.7
Crop insurance	66.1	61.6
Agricultural trade programs, new horticulture and organic spending, and supplemental disaster assistance in the 2008 farm bill	3.2	7.1
Nutrition	432.2	441.8
Other spending/offsets	6.5	-3.0
Total	**636.2**	**640.0**
1/ Excludes funding for discretionary programs, which is provided through annual appropriations. 2/ Outlays over 10 years		
Source: CBO projections for outlays.		

Source: http://www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/program-provisions/cost-of-2008-farm-bill.aspx#.U2rZw-ZdXu8

Moving to the direct payment aspect, below are the rates for corn, cotton and soybeans. As the USDA notes, "Base acres and payment yields are unchanged from those specified in the 2002 Farm Act…DP rates are unchanged from the 2002 Farm Act. However, the

DP rate is reduced by 20 percent for producers electing to enroll in the ACRE program".[70]

Direct payment rates			
Commodity	**Unit**	**Direct payment rate**	**Direct payment rate if enrolled in ACRE**
Corn	Bushel	$0.28	$0.22
Upland cotton	Pound	$0.0667	$0.0534
Soybeans	Bushel	$0.44	$0.35

The second major economic program that has been continued is counter-cyclical payments. These, remember, are payments made to farmers only when prices fall below the threshold, as a way to stabilize farm income. As was the case for direct payments, not much has changed from the 2002 farm bill. Below again is the rates for the three main crops I have looked at in this thesis, corn, cotton and soybeans.[71]

Target prices				
Commodity	**Unit**	**CY 2008**	**CY 2009**	**CY 2010-12**
Corn	Bushel	$2.63	$2.63	$2.63
Upland cotton	Pound	$0.71	$0.71	$0.71
Soybeans	Bushel	$5.80	$5.80	$6.00

Agricultural Act of 2014

The 2014 Farm Bill is a major change from the previous legislation, with the Direct Payment, Countercyclical Payment, and the Average Crop Revenue Election (ACRE) program all being repealed. Instead, two new programs will take the place of

[70] http://www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/program-provisions/direct-payments.aspx#.U2raw-ZdXu8
[71] http://www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/program-provisions/counter-cyclical-payments.aspx#.U2rc8-ZdXu8

these commodity programs, the Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC) programs.[72]

The first program, the PLC program, acts much in the same way as counter cyclical payments, in that farmers receive payments when the crop price falls below the set threshold. An important note is that cotton is not a covered commodity in this program. Below is the reference table for both corn and soybeans.[73]

2014 Farm Act reference prices

Covered commodities	**Reference prices**
Corn	$3.70 per bushel
Soybeans	$8.40 per bushel

The second program is the Agriculture Risk Coverage (ARC) Program, which has both county-based and individual coverage. This means that for either of the two, payments are provided to producers for their commodities when crop revenue drops below 86 percent of either the county benchmark revenue or the farm's individual benchmark guarantee. For each commodity the payment amount is as the USDA calculates first for the country choice "the difference between the per-acre guarantee (as calculated above) and actual per-acre revenue (but no greater than 10 percent of the commodity's benchmark revenue), times 85 percent of base acres of the commodity". For individual coverage, "The payment amount is the individual farm payment rate (the difference between the individual farm guarantee and actual individual farm revenue, but no greater than 10 percent of the farm's benchmark revenue) times 65 percent of base

[72] http://www.ers.usda.gov/agricultural-act-of-2014-highlights-and-implications/crop-commodity-programs.aspx#.U2rgceZdXu8
[73] Ibid.

acres for all covered commodities for the individual farm."[74]One interesting facet of this ARC program is the installation of payment limitations. Payments are limited to $125,000 for each farmer, with an extension of an additional $125,000 for spouses.[75]

[74] Ibid.
[75] Ibid.

Chapter 6
Conclusions

This thesis on agricultural subsidies, their economic and political implications and what would happen to both price and production levels contained several key insights into both the political and economic spheres in this industry. Looking first at the technological and scientific advancements, the economic impacts can be seen in three major areas: production, costs and price. All three show positive change that has shown to be a big boon to the consumer, dropping prices dramatically over time. However, on a related note farm labor has also dropped, which has transformed America into a manufacturing and service economy. Overall the technological advancements, biotechnological advancements and expansion of information and marketing have led to the mechanization and industrialization of the farming industry, effectively increasing farm size, increasing output, decreasing price and decreasing labor. The externalities related to these effects helped shape both political and economic policy related to the agricultural sector.

Moving to what has been a (Gardner, 2002)ffected, namely the economic and political theory and action behind agricultural policy, the historical and economic analysis I have undertaken has led to interesting findings. I have focused on four major areas of economic theory that affect the agricultural market: vertical integration, economies of scale, elasticity of markets and subsidization. These economic linchpins often hold true to one main school of thought, for instance that subsidization is often a poor economic policy to undertake because if a company cannot survive on their own they should be allowed to fail and be replaced. However, in the real world it has not been

as simple. Through the processes of integration and expansion of scale within the farming business model and combined with the elasticity and variability within the commodities market, government subsidization policies in the form of price controls and income supports has been the answer to the two main questions, How can we stabilize the market and make sure farmers earn enough to support themselves?

Politically, the legislation has evolved from the New Deal to the post WWII Farm Bills in the 50s, 60s and 70s to the much more market oriented policies in the FAIR Act and ARPA in the 90s and 2000s. These economic and political factors have all led up to the landscape of the agricultural sector today, one with a tight relationship between government and business, leading to precarious positions for those in government who do not wish to jeopardize their futures in the private sector.

So we come to where we are today and where we are going. In the past 10 years, there has been some drawdown on the vast amount spent on commodities programs, with the most recent 2014 Agriculture Act essentially cutting and combining everything into two main support programs, alongside crop insurance. While this does certainly continue the downward trend on expenditures, it is still in line with the economic and political school of thought that there should continue to be subsidization at the federal level for specific crops. The real question that stems from this is what does this mean for the consumer, the producer, and the American economy? The chapter on the pros and cons of these price and income supports does well to illuminate the effects. The narrative historically has been one of an unstable agricultural market, replete with negative externalities as well as disadvantaged consumers and farmers alike. These negative

externalities have been dealt with for the past 80 years through price and income supports stemming from government intervention.

While the current program outline seems to be balancing both economic and political goals and at the same time reigning in the massive amount of money going out, there is still merit to the idea that subsidies, more specifically their end, would not completely dismantle the agricultural sector as some believe. While there are 10s if not 100s of other variables not accounted for in my model, I believe my model's merit lies within its exploratory nature and forward prediction. Looking across all three crops, there are several correlations between both the dependent and independent variables that lead to some interesting conclusions. For both corn and cotton price and production were very closely related, as was NFI for all three crops. This indicates that the agricultural sector as a larger entity is not as starkly diversified in its relationships as one might think, and even across food and non-food crops the relationship between subsidization and output can be seen. While most major economic data already supports such a conclusion, it is important to quantify the magnitude, as well as establish a base to build a forward-looking perspective on. My results are predictable in that price and production move in the predicted direction given a stoppage in support, but are interesting in that the swings are not at all as dramatic as I thought they were going to be.

	Price without subsidy	Price following projected growth	Production without subsidy	Production following projected growth
Corn	$7.48	11.6	19677.42	17825.37
Cotton	106.6	79.25	15112.1	11851.93
Soybeans	17.23	23.96	3035.16	3497.3

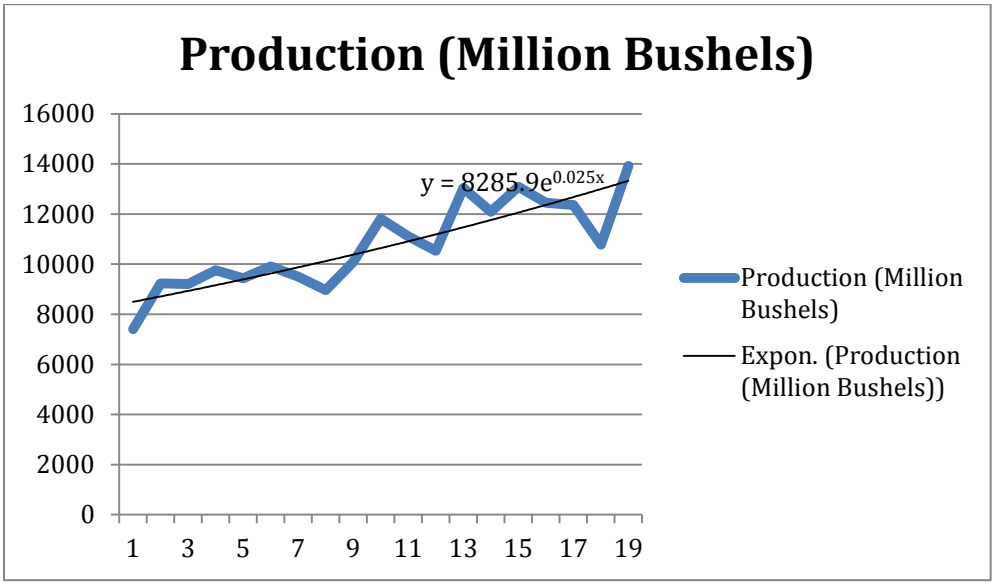
With one of the main goals of current agricultural policy being price supports, it is not surprising to see the prices of both corn and soybeans go down. However, while this decrease might spell the end to some farmers that lie right on the edge of profitability, it did not plummet to cents on the bushel. Similarly with production, it only increased around 10% for corn, with cotton increasing more along 30%. While this is nothing to scoff at given the amount produced, it is not too dramatic an increase to make impossible a return to the projected gross revenue seen today.

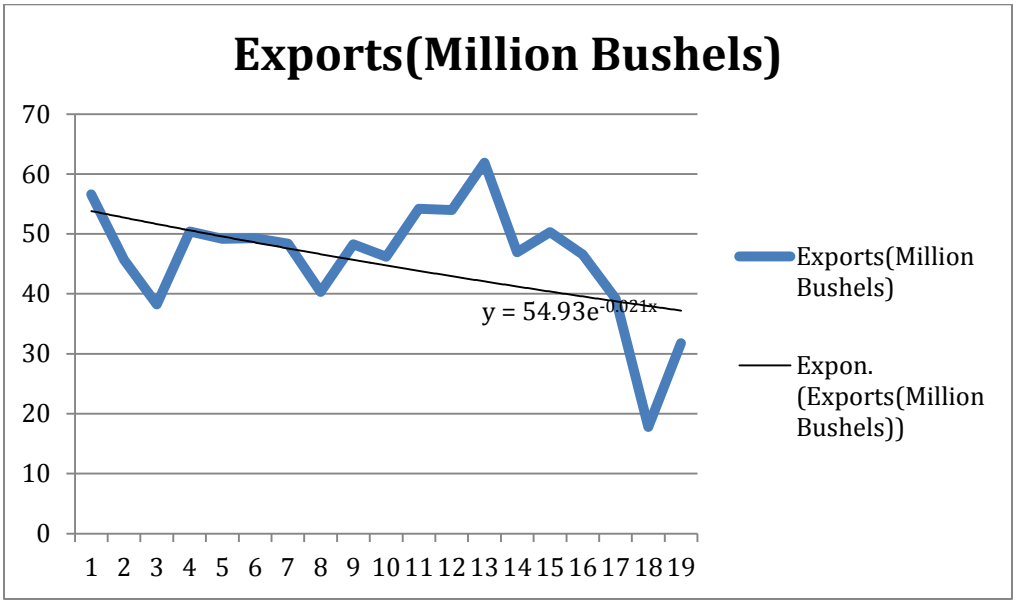
Overall, the arguments presented regarding the current state of affairs do not sway completely in either the direction of unwavering support or complete repulsion. To scrap these programs entirely and all at once would be a huge detriment to the agricultural sector as well as the larger economy. However, to continue to slightly draw down these supports as has been done might not necessarily be a bad thing from an economic viewpoint, but it would come at a cost. By adapting or slightly modifying the policies in place to accommodate a much smaller subsidy program, costs could easily be brought to much lower levels, but it would most likely come at the cost of many small farmers being put in a bad if not impossible situation due to the great scale advantages afforded big, mechanized farms. While this could be argued to be better for the American economy from an efficiency perspective, if indeed the government continues to believe it has a duty to ensure these small farmers a living, this will make it nigh impossible to achieve both ends. And with such a switch, the already rampant political influence could just get worse. Moving forward there can and must be a comprehensive policy platform that can maybe not fully achieve the both the economic and political goals, but can reach some

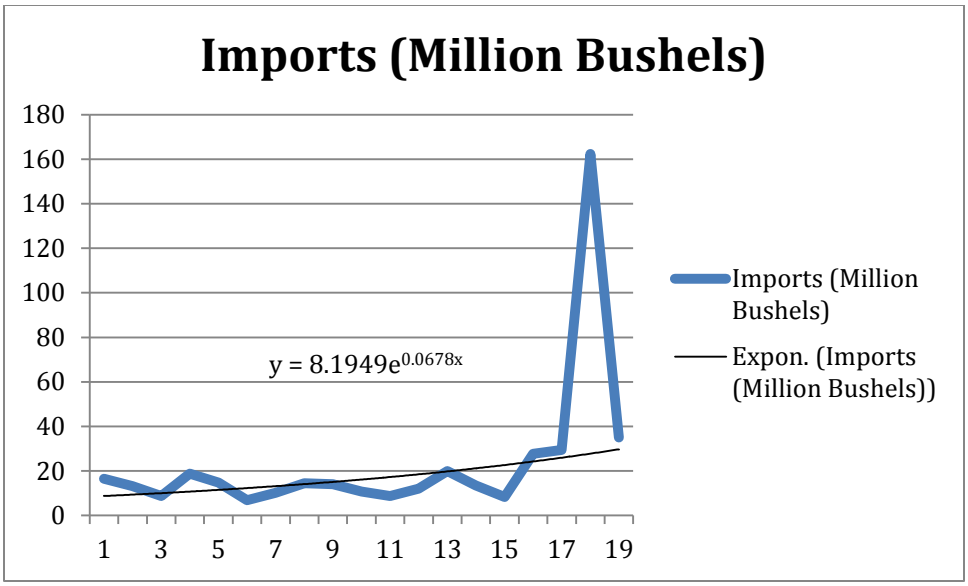
economic goals while at the same time not subjecting consumers, small farmers and others to the growing agribusiness sector.

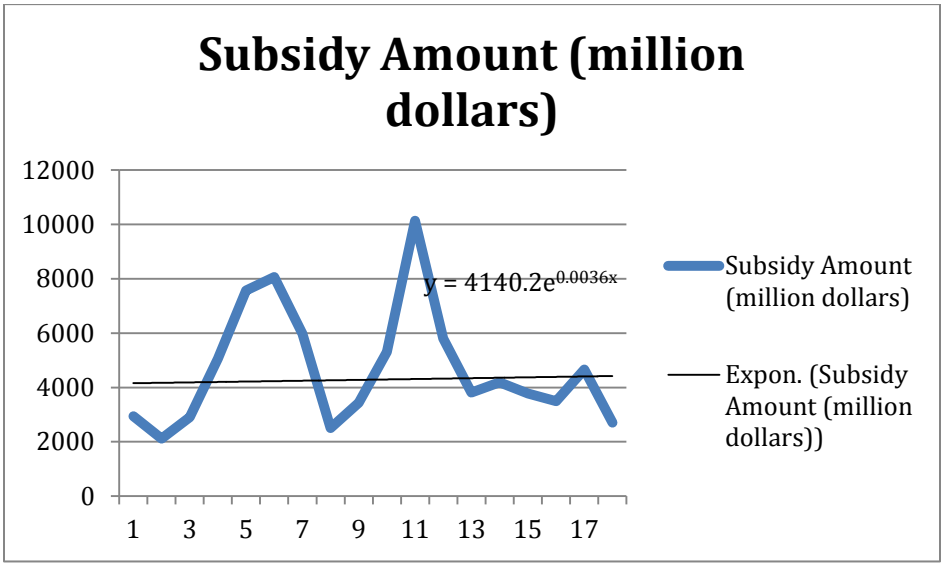
Appendix 1. Evolution Graphs

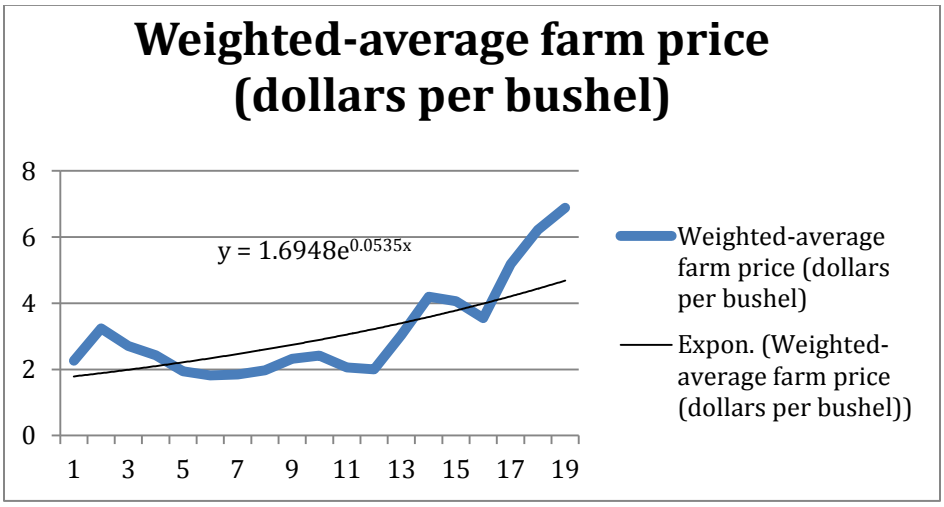
Corn



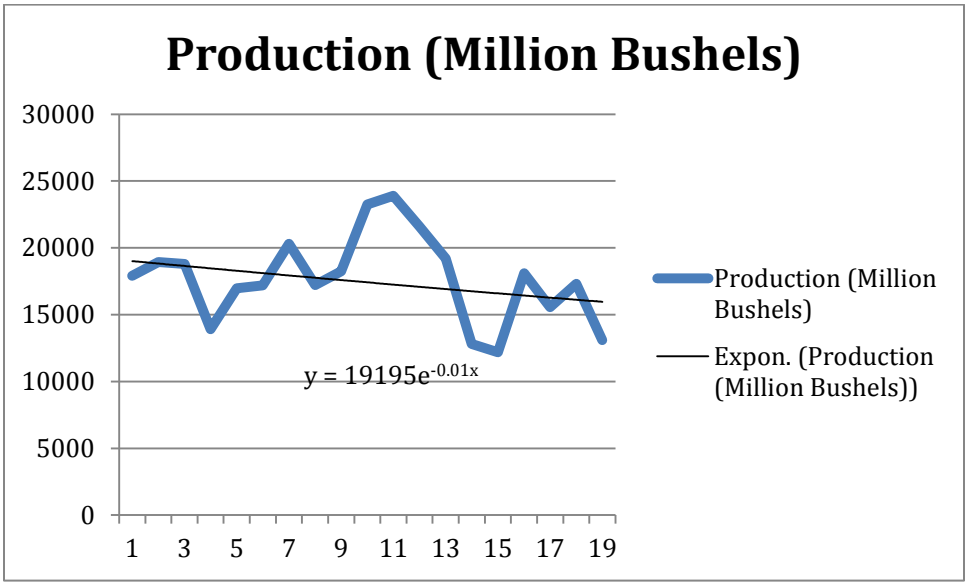


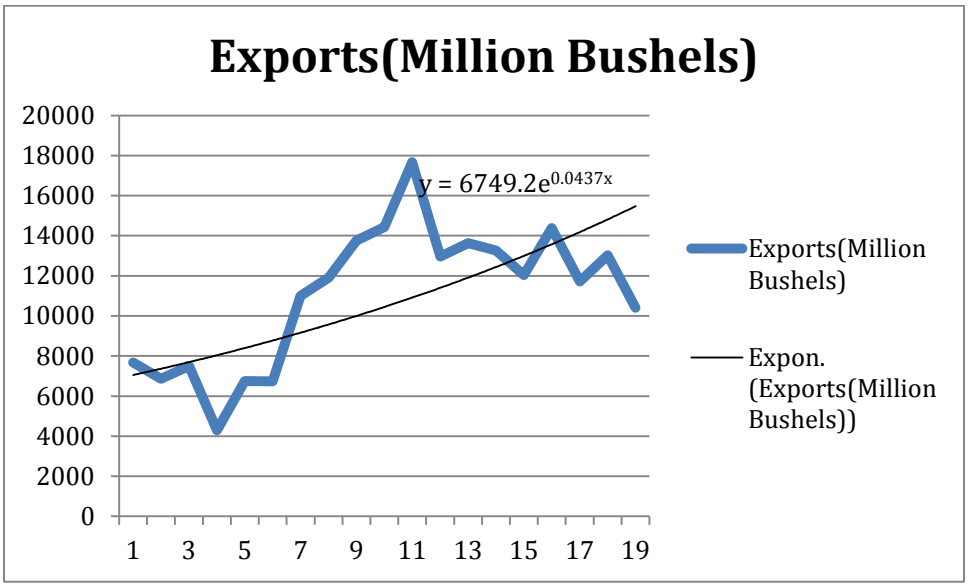

Imports (Million Bushels)
180
160
140
120
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19
y = 8.1949e0.0678x
Imports (Million Bushels)
Expon. (Imports (Million Bushels))

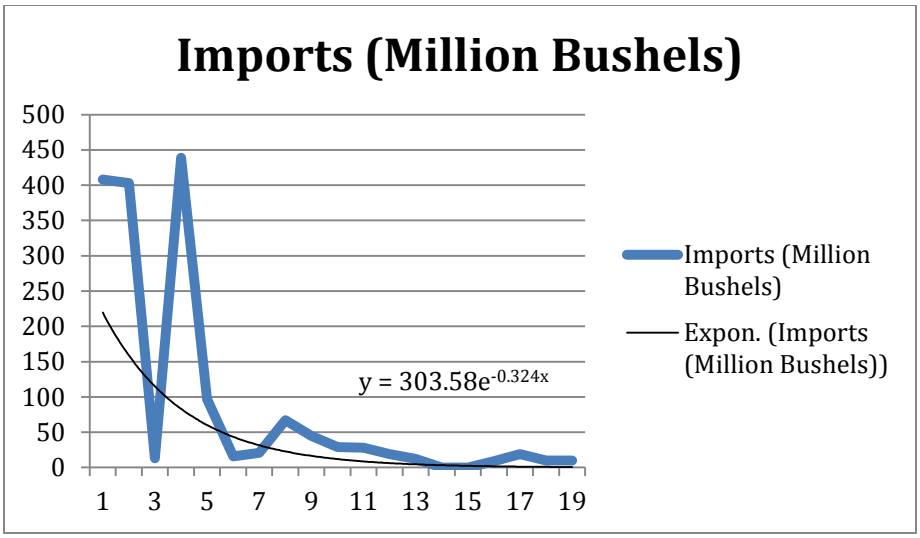

Subsidy Amount (million dollars)
12000
10000
8000
6000
4000
2000
0
1 3 5 7 9 11 13 15 17
y = 4140.2e0.0036x
Subsidy Amount (million dollars)
Expon. (Subsidy Amount (million dollars))

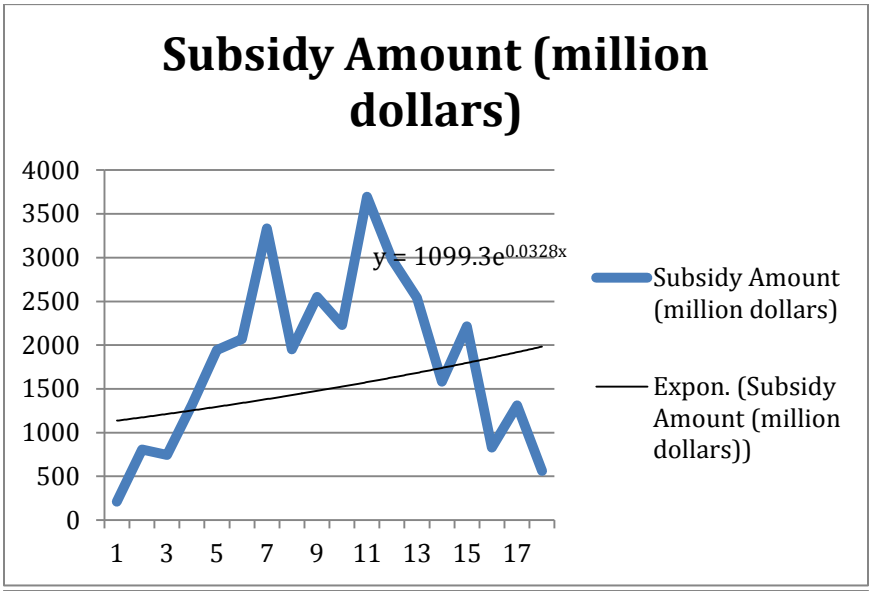

Weighted-average farm price (dollars per bushel)
8
6
4
2
0
1 3 5 7 9 11 13 15 17 19
y = 1.6948e0.0535x
Weighted-average farm price (dollars per bushel)
Expon. (Weighted-average farm price (dollars per bushel))

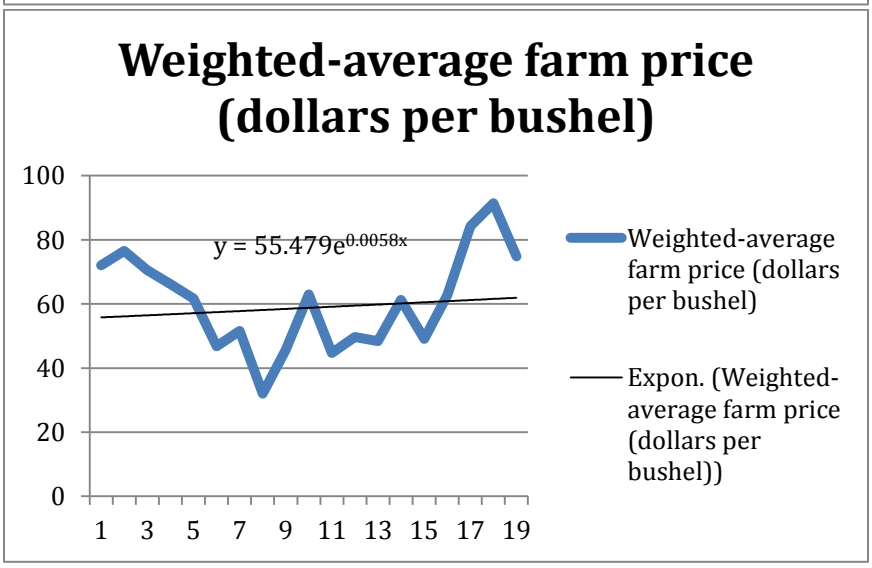
Cotton


Production (Million Bushels)
30000
25000
20000
15000
10000
5000
0
1 3 5 7 9 11 13 15 17 19
y = 19195e-0.01x
Production (Million Bushels)
Expon. (Production (Million Bushels))

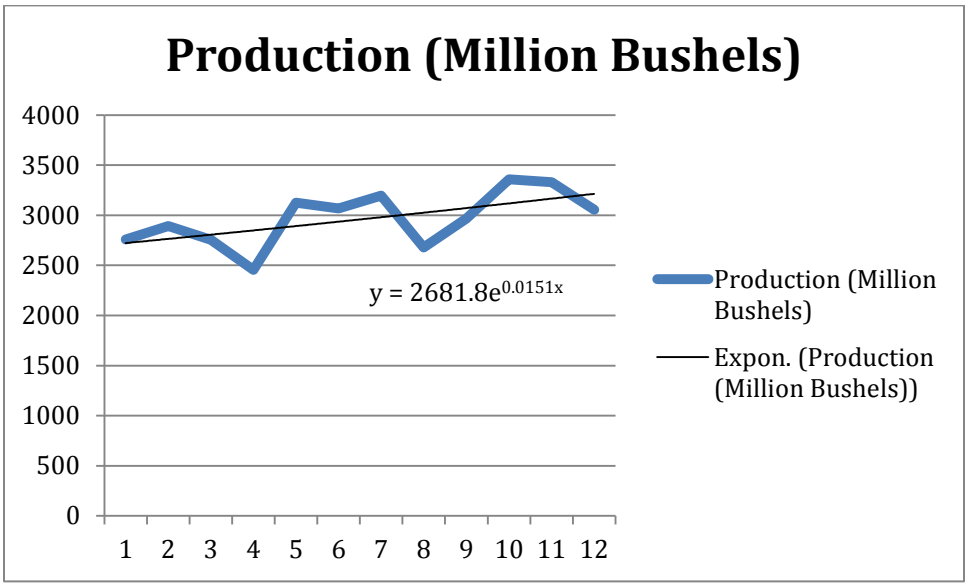

Exports(Million Bushels)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1 3 5 7 9 11 13 15 17 19
y = 6749.2e0.0437x
Exports(Million Bushels)
Expon. (Exports(Million Bushels))

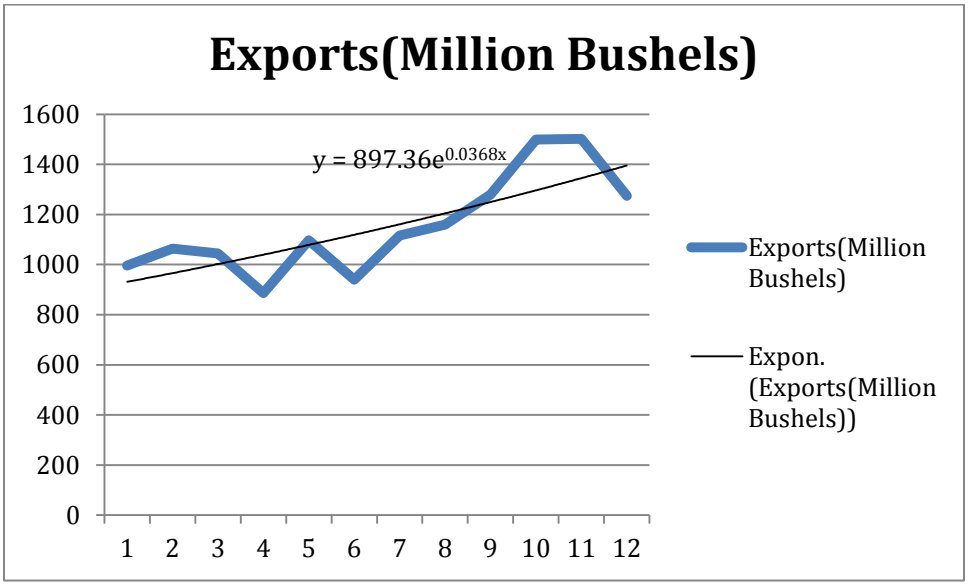

Imports (Million Bushels)
500
450
400
350
300
250
200
150
100
50
0
1 3 5 7 9 11 13 15 17 19
y = 303.58e-0.324x
Imports (Million Bushels)
Expon. (Imports (Million Bushels))

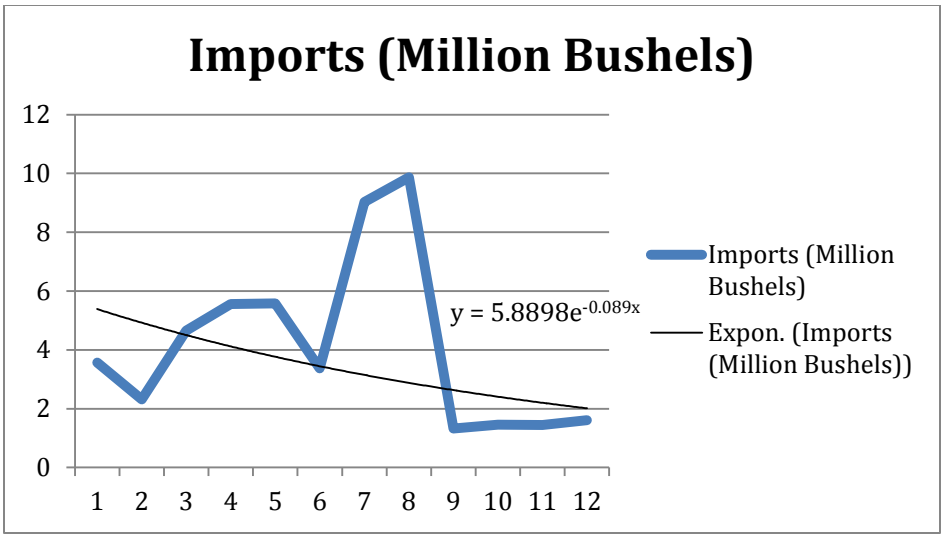

Subsidy Amount (million dollars)
4000
3500
3000
2500
2000
1500
1000
500
0
1 3 5 7 9 11 13 15 17
y = 1099.3e0.0328x
Subsidy Amount (million dollars)
Expon. (Subsidy Amount (million dollars))

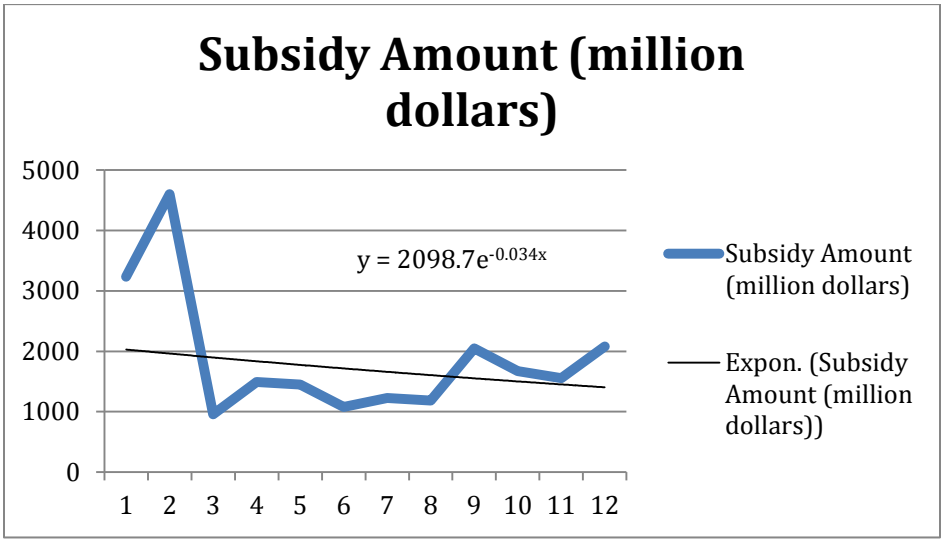

Weighted-average farm price (dollars per bushel)
100
80
60
40
20
0
1 3 5 7 9 11 13 15 17 19
y = 55.479e0.0058x
Weighted-average farm price (dollars per bushel)
Expon. (Weighted-average farm price (dollars per bushel))

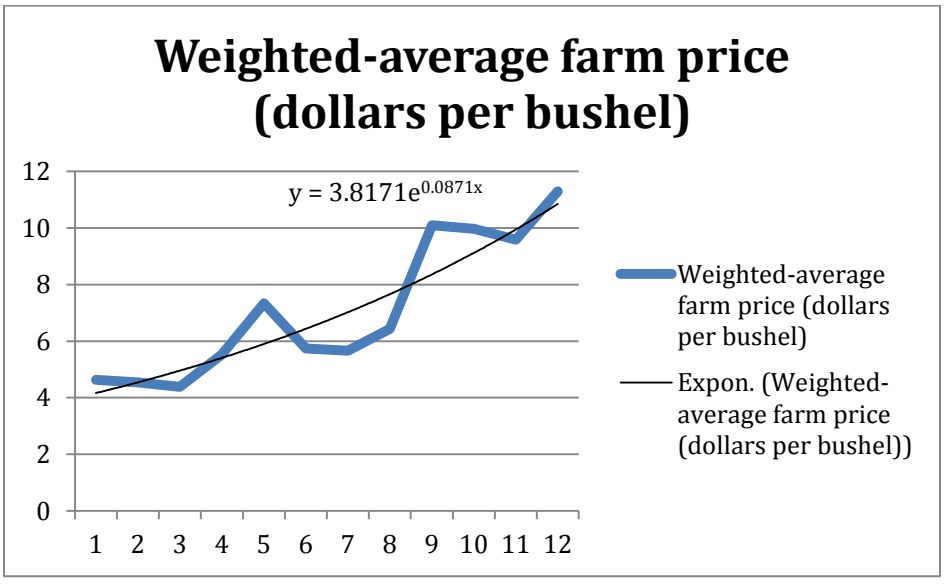
Soybeans


Production (Million Bushels)
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12
y = 2681.8e0.0151x
Production (Million Bushels)
Expon. (Production (Million Bushels))


Exports(Million Bushels)
1600
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12
y = 897.36e0.0368x
Exports(Million Bushels)
Expon. (Exports(Million Bushels))


Imports (Million Bushels)
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12
y = 5.8898e-0.089x
Imports (Million Bushels)
Expon. (Imports (Million Bushels))


Subsidy Amount (million dollars)
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12
y = 2098.7e-0.034x
Subsidy Amount (million dollars)
Expon. (Subsidy Amount (million dollars))


Weighted-average farm price (dollars per bushel)
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12
y = 3.8171e0.0871x
Weighted-average farm price (dollars per bushel)
Expon. (Weighted-average farm price (dollars per bushel))

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