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Measuring Inefficiencies of Federal Acreage Reduction Programs

Julie Brewer
Illinois Wesleyan University

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Julie Brewer
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Farm commodity programs have been a major component of U.S. agricultural policy for more than fifty years. The federal government first implemented these programs during the 1930's to help small farmers maintain their lifestyles. Supply control measures such as acreage reduction programs increased farm income by keeping commodity prices artificially high. In addition, other policies were designed to help reduce possible financial risks and losses involved in farming by guaranteeing a minimum support price. Although the emergency conditions of the Great Depression no longer exist, the federal government has continued to rely upon these orignial commodity programs to deal with agriculture's basic problem of overproduction.

In the short run, farm commodity programs have been successful in increasing farm income and prices but have failed to solve the underlying problem of overproduction. Ironically, these measures have operated in the opposit manner, not only stimulating production in the long run, but also causing production to be less efficient than what it would be in a free market setting. Due to resource combinations below the optimal level, commodities are produced at a higher cost to society and inefficiencies arise.

In addition to this problem of inefficient use of resources, agricultural commodity programs have caused some equity and distributional problems over the years. For example, due to price supports and land retirement programs which have increased the prices of American commodities relative to the world, the level of exports has been below that which would be found in a free market. Another problem resulting from these measures is that the programs have actually

benefited the large farm operator, rather than the small farmer as orignally intended by directly tying the amount of benefit to farm size and output. Furthermore, the problem of escalating land prices can be attributed to agricultural commodity programs since benefits from these programs have been capitalized into land values. Finally, these programs have been a growing burden on the federal budget as programs' costs and cash benefits to farmers have risen. Nevertheless, the federal government has continued to implement these measures despite these negative secondary effects.

The purpose of this paper is to measure the economic inefficiencies caused by federal acreage reduction programs. This measurement of inefficiency found by using an econometric model of the feed grain sector, will be used to help support the belief that farm commodity programs which the federal government has continually sponsored, do not serve as long term solutions to agriculture's historical problem of overproduction. Furthermore, it will support the view that alternative approaches such as returning agriculture to a more laissez faire, free market structure, would be more efficient and should replace present policies.

To develp this thesis, the paper will be divided into three secitons. Section I will give a description and background information on the major types of farm commodity programs which have been sponsored by the federal government. This will enable the reader to get a better understanding about farm commodity programs and their effects. Next, Section II will examine the most recent acreage reduction program, the 1983 Payment-in-Kind (PIK) program and its effects on farmers as well as other members of society. PIK was chosen not only to exemplify the

impact of supply control measures on the economy, but also to emphasize that this "new" farm commodity programs was actually not new, but merely another acreage reduction program, like those originally implemented in the 1930's. Finally, Section III will attempt to measure the inefficiencies resulting from the federal government's acreage reduction programs using an econometric model applied to the feed grain sector. This estimate will be used to show that supply control programs are not efficient measures, nor do they solve the farm sector's overproduction problem.

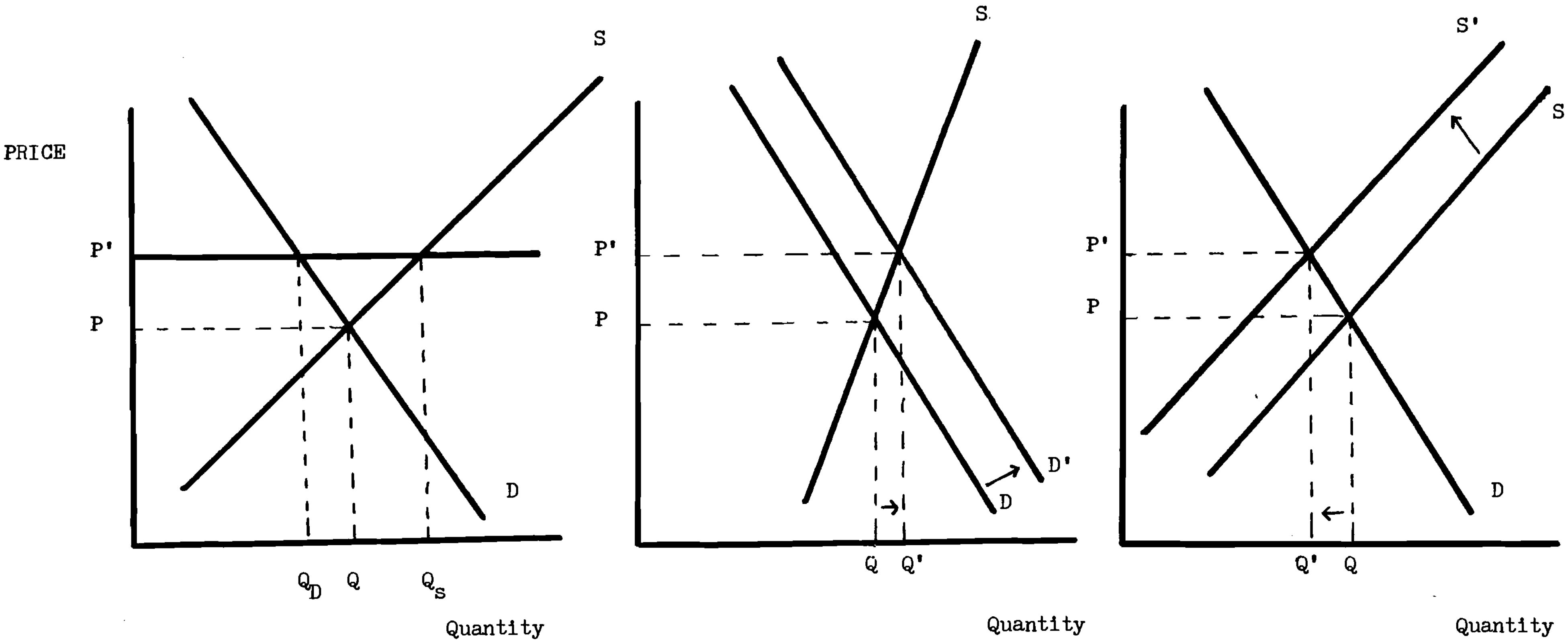
SECTION I

TYPES OF FARM COMMODITY PROGRAMS

Over the years, three basic types of agricultural commodity programs have been used by the federal government to raise farm prices and incomes. As can be seen in Figure 1(a), the first type of farm program, price supports, uses a price floor to increase commodity prices. The floor price, P', is greater than the equilibrium price, P, and therefore, stimulates overproduction. Quantity increases from Q to Q', causing disequilibrium since quantity supplied is greater than quantity demanded.

The second program type represented in Figure 1(b), increases

FIGURE 1



(a) Price floor (b) Demand expansion (c) Production controls

demand to raise farm prices, shown here as a shift from D to D'. These demand expansion measures increase not only quantity supplied and demanded from Q to Q', but also increase commodity price from P to P'.

The third type of program uses production controls to reduce commodity supply in order to increase prices. Figure 1(c) shows the effect of these supply-reducing measures as price rises from P to P' and quantity decreases from Q to Q', due to an upward shift in the supply curve from S to S'.

PRICE SUPPORTS

Price supports, the first type of commodity program, have been used to reduce producers' financial risks by guaranteeing a stable, minimum commodity price through nonrecourse loans. Originally, this measure was designed "to increase and then stabilize commodity prices by setting loan rates above the average weather crop levels at certain percentages of parity prices."[1] This parity price was defined as the price that would give the commodity the same buying power in terms of goods and services bought by farmers that the commodity had in the 1910-14 base period. This standard has been considered over the years as the "fair" price that farmers deserve to be paid for their output. Today, however, this parity price standard has been replaced with a cost-of-production measure.

Recently, the level of price support has varied from year to year since prior to each planting season the Secretary of Agriculture announces a new support price. Farmers who participate in the program

have the opportunity to obtain nonrecourse loans. To do so, the farmer must comply with planting restrictions and store the commodity pledged for the loan in a government-approved facility which is used as collateral for a loan at the support level rate. When the loan comes due, the farmer generally has three alternatives: (1) to deliver the commodity to the CCC as full repayment of the loan, (2) to renew the loan for another year, or (3) to repay the loan in cash and resume control over his crop. The first alternative is chosen only when the market price falls below the support rate, thereby providing farmers with a guaranteed base price. These commodities are then stored and become part of the CCC-owned reserve stocks. The other alternatives are chosen when the market price is above the loan rate and accumulated interest charges. Therefore, price supports have allowed farmers to gain from any price rise without a risk of loss.

DEMAND EXPANSION PROGRAMS

Historically, supply control measures such as acreage reduction and price supports have been the predominant features of agricultural commodity programs. However, programs to increase demand, the second farm program type, can be found in various farm legislation such as the Agricultural Trade Development and Assistance Act of 1954 (P.L. 480, 68 Stat. 454; July 10, 1954), the Food Stamp Act (P.L. 525, 78 Stat. 703; August 31, 1964), and the National School Lunch Act (42 U.S.C.; 60 Stat. 230; June 4, 1946). These programs include research of new uses for farm products, policies to increase foreign demand for U.S. commodities, and measures to increase domestic demand for surplus

crops. Nevertheless, demand expansion measures such as these are not considered by economists as viable long run solultions since they do not attempt to reduce overproduction.

PRODUCTION CONTROLS

The third program type, supply control, raises price and income by influencing the amount of land used for production through acreage reduction programs. In acreage reduction programs, the federal government reduces land usage by paying the producer to voluntarily set-aside or divert to conservation purposes, a certain number of acres normally used for production. Payments are made on a per acre basis and are determined using past yields of the crop that is usually planted on the retired land. The rationale behind this "input control" program is that the less land used for productive purposes will reduce total supply of the surplus commodity, thereby increasing not only the commodity price, but also farm income. Furthermore, by controlling the maximum number of acres which can be used for production, the federal government can try to keep supply more in line with demand on an annual basis, thereby keeping surplus stocks at a minimum.

HISTORICAL BACKGROUND[2]

Present day commodity programs have descended directly from those farm programs implemented in the 1930's. Although these commodity programs have been slightly modified in the past 50 years, structurally thay have remained very similar to the original programs which were

designed to alleviate farm problems which peaked during the Great Depression. Prior to these programs, farmers had experienced extremely low prices and incomes but continued to expand production in an attempt to increase profits.

Immediately upon becoming President in 1929, Herbert Hoover established the Federal Farm Board in the Agricultural Marketing Act (P.L. 11, February 10, 1929) of that year in hopes of helping farmers overcome the depressed conditions which existed in agriculture while the non-farm sector experienced wealth and abundance. Using loans, this board attempted to stabilize prices by controlling surpluses. Loans to farmer cooperatives were made in three ways: (1)acquiring excess supplies, (2)constructing new storage facilities to store surplus commodities, and (3)making advances to growers for their crops in order to support prices. However, due to a limited amount of funds to work with, the board's finances were soon exhausted without accomplishing its goals. After the board was dissolved and the Depression set in, prices fell substantially causing farmers to demand federal legislation either to control production or to limit quantities going to market.

In response to declining net farm income which fell from $6.3 billion to $1.9 billion during the Hoover Administration,[3] the Agricultural Adjustment Act of 1933 (P.L. 10, May 12, 1933) was designed to rescue the small farmer from bankruptcy. It provided provisions to adjust farm production to meet market demand, thereby reducing commodity surpluses and increasing farm prices. The act created the Agricultural Adjustment Administration (AAA) which not only was authorized to enter into voluntary agreements with farmers who were

paid to reduce acreage of the basic commodities,[4] but also was permitted to regulate marketing through voluntary agreements. Furthermore, the act gave the AAA the authority to levy taxes on processors of commodities and to use these proceeds to pay for the cost of expanding markets. However, in 1936 the production controls and the processing tax features were declared unconstitutional by the Supreme Court in the Hoosac -Mill decision (U.S. vs. Butler, 297 U.S. 1). Nevertheless, these features, in addition to others, were incorporated into the Agricultural Adjustment Act of 1938 (7 U.S.C.,52 Stat. 31; February 16, 1938). This legislation introduced the idea of nonrecourse loans to producers under certain market conditions and offered payments to farmers which would provide a return as close to parity as the available funds would permit. In later legislation, these parity prices were replaced with target prices and these returns became known as deficiency payments.

The crisis conditions which existed during the Great Depression for agriculture were relieved with the beginning of World War II. Demand for U.S. farm products rose, reducing U.S. surpluses and driving prices to high levels. Farmers were encouraged to increase production through such patriotic appeals as "Food will win the war and write the Peace",[5] while supply-control mechanisms of earlier legislation were discontinued. The Stabilization Act of 1942 (15 U.S.C., 56 Stat. 767; October 2, 1942) developed from the fear of what would happen to farm prices once the war ended. In order to prevent farm prices from immediately dropping, the act assured farmers that the prices of the basic commodities would be supported at a fixed 90% level of parity for two years after the war ended. However, these fixed price supports

were extended in the Agricultural Act of 1948 (P.L. 897, 62 Stat. 1247; July 3, 1948) and 1949 (P.L. 439, 63 Stat. 1051; October 31, 1949), although the Secretary of Agriculture at that time, Charles F. Brannan, unsuccessfully submitted to Congress a new farm program. The purpose of Brannan's plan was to achieve income equity for farmers by shifting from the traditional parity price standard used in the price support programs to an income standard. It placed a greater emphasis on a free market structure since supply and demand forces would be allowed to determine the price of the commodities. Price supports would be replaced with supplemental payments made by the federal government based on the difference between the farmer's income in the free market setting and an acceptable income level determined by the government. Consumers would be able to purchase food at a cheaper price while all farmers would be guaranteed a minimum income. However, this plan would have substantially increased government cost, which was one of the reasons that it failed in Congress.

Fixed price supports at high levels could not continue as surpluses mounted and prices fell. Once again war, this time the Korean conflict, proved to be beneficial to the agricultural sector by strengthening the demand for farm products. After the war ended, however, fixed price supports again were continued while a debate grew as to whether these supports should be fixed or flexible. Surpluses were accumulating and immediate action was needed as storage facilities overflowed. For example, toward the end of the Korean War in 1952, CCC-owned stocks of wheat were at a postwar low of 256 million bushels while only two years later, stocks swelled to 933 million bushels.[6]

To prevent further overproduction, acreage control measures of the 1930's were re-introduced in legislation passed in 1956. The Soil Bank was established in the Agricultural Act of that year (P.L. 540, 70 Stat. 188, May 28, 1956). This was the first nation-wide effort to bring production of agricultural products in line with demand. It was a large scale, voluntary program aimed at reducing output through both short- and long-term land retirement. The act was divided into two provisions--the Acreage Reserve and the Conservation Reserve. The short-term land retirement plan, the Acreage Reserve, was designed to reduce production of basic commodities by restricting the amount of land used for their production while meanwhile maintaining farmers' incomes. Through formal contracts, participating farmers agreed to take a certain percentage of their land out of production and to not harvest any other crop on the land during that year. In return, the farmer would receive a land-rental payment at least equal to the net income the farmer would have earned from the land put into the reserve. The other provision established the Conservation Reserve which was a long term general land retirement program aimed at conserving soil, water, and wildlife. Farmers were paid to divert all or a part of their cropland to soil-conserving uses under long-term contracts of five to ten years. Payments were two-fold--an annual per-acre rental payment and a cost-sharing payment for carrying out the conservation measures. Because these per-acre rental rates were low, farmers tended to put only their marginal, less productive land into the reserve. Meanwhile, the federal government had paid these land owners for not producing on land which was unfit for growing crops and which possibly would not have been used for production purposes.

Attempts to redirect farm policy occurred during the early part of the 1960's as output per man-hour and output per acre rose. Willard Cochrane, the chief economic advisor for the Secretary of Agriculture during the Kennedy years, formulated a mandatory supply management plan which "would be a deliberate restriction of farm supplies with a view to raising farm prices and incomes."[7] Members of the agricultural committees in Congress introduced Cochrane's idea of federal marketing orders for all surplus commodities in the Cochrane Bill of 1961. These marketing orders were to be a government determined maximum amount that each producer would be allowed to sell. Although the bill did not pass, it did bring to the public's attention the idea of mandatory supply management as a means to reduce surpluses and to raise commodity prices.

In the early 1970's federal farm policy changed in response to excess global demand for food due to rising population and low agricultural production abroad. To meet expanding demand, the competitive market system again was allowed to operate in the agricultural sector with only a few production controls. Programs were implemented which reduced many of the government controls and restrictions, allowing farmers greater flexibility and more decision-making power. The Agriculture Act of 1970 (P.L. 524; 84 Stat. 1358, November 30, 1970) suspended the earlier program measures which included marketing quotas and acreage allotments for wheat, cotton, and feed grains. Instead, the act relaxed planting restrictions by not

including a limit on acreage of any particular crop. However, in order to qualify for the price support program, one supply control provision did require a reduction in the total acreage devoted to all crops, called "set-asides". Program participants were required to set-aside from crop production a percentage of the national land diversion requirement computed by the U.S.D.A. The remaining cropland was then available for the farmer's chosen use. This provision gave farmers more control in decisions affecting their farms and also encouraged increased production as farmers brought land into production which formerly had not been used. Also, exports and prices increased which further encouraged farmers to buy more land and machinery and to increase production.

Farm policy drastically changed in 1972 under the leadership of the new Secretary of Agriculture, Earl Butz. During this period all government-owned storage bins which held surplus stock were sold and many acreage control restrictions were abolished or substantially reduced. Two new concepts, target prices and deficiency payments, were introduced in the Agriculture and Consumer Protection Act of 1973 (P.L.86; 87 Stat. 221; August 10, 1973). Target prices were a minimum level of prices for specific commodities established by the federal government and were based on a pre-determined percentage of parity which was later replaced in 1977 with an average cost-of-production standard. Deficiency payments were paid by the government when the average market price fell below these target prices. These were the first steps to a market-oriented, reduced government farm policy.

However, demand eventually decreased and surpluses again mounted, renewing the need for federal production controls. A number of programs

were initiated by the federal government between 1977 and 1982 but were unsuccessful in significantly reducing commodity overproduction. In 1983 the U.S.D.A. formulated PIK, a type of acreage reduction program, in response to growing farm surpluses which had be caused by weak domestic demand, declining exports, and record high 1981 and 1982 harvests. In the short run, PIK was successful in reducing surplus stocks and production, but its success was attributed more to the drought conditions during this growing season than to the actual program itself.

Although this has been a very brief discussion of farm programs prior to the 1983 PIK program, the similarities of the programs can be detected. The basic philosophy that government intervention in the agricultural sector is needed to adjust commodity supply in order to maintain acceptable prices still dominates present commodity programs. Farm legislation first enacted in the 1930's has been extended to the present with only a few minor modifications. During this period, farm policies have focused on restricting the production and supply of agricultural commodities, thereby raising farm prices and incomes. However, measures to expand demand have been incorporated in some farm legislation as a means of reducing commodity surpluses. Nevertheless, all of these farm programs have been inherently shortsighted and unsuccessful in solving the underlying farm problem of overproduction. As a result of the inability of these programs to encompass the future, inefficiencies and other secondary problems in the agricultural sector have surfaced in the long run which will now be discussed in the following pages.

(1)AGRICULTURAL PRODUCTION CONTROLS CAUSE ECONOMIC INEFFICIENCIES TO ARISE

Although acreage reduction programs and price supports were designed to reduce production and therefore, supply of surplus commodities in the long run, the opposite has occurred. Output has not been significantly reduced in the long run by these measures, but instead has caused inefficient resource combinations. For example, land retirement programs have been criticized as being ineffective in reducing overproduction in the long run for they encourage farmers to intensify production on their unrestricted land. Although the number of acres used for production has been reduced by these programs, output per acre has grown as farmers have increased usage of fertilizer, farm machinery, hybrid seeds, and insecticides as well as using new technology and farming practices, such as reduced spacing between rows. Thus, projected decline in supply due to less cropland used for production has in the long run, been slightly off-set by increased yields per acre. Furthermore, output has not been significantly reduced in the long run for some land which has been retired or diverted has been marginally poor and unproductive. Acres enrolled in the program have been land which normally would not have been used for production. An example of this is the Soil Bank Program which by 1960 had retired approximately 27 million acres.[8] In that year acreage in crops had declined by nearly the same amount of 25.3 million acres.

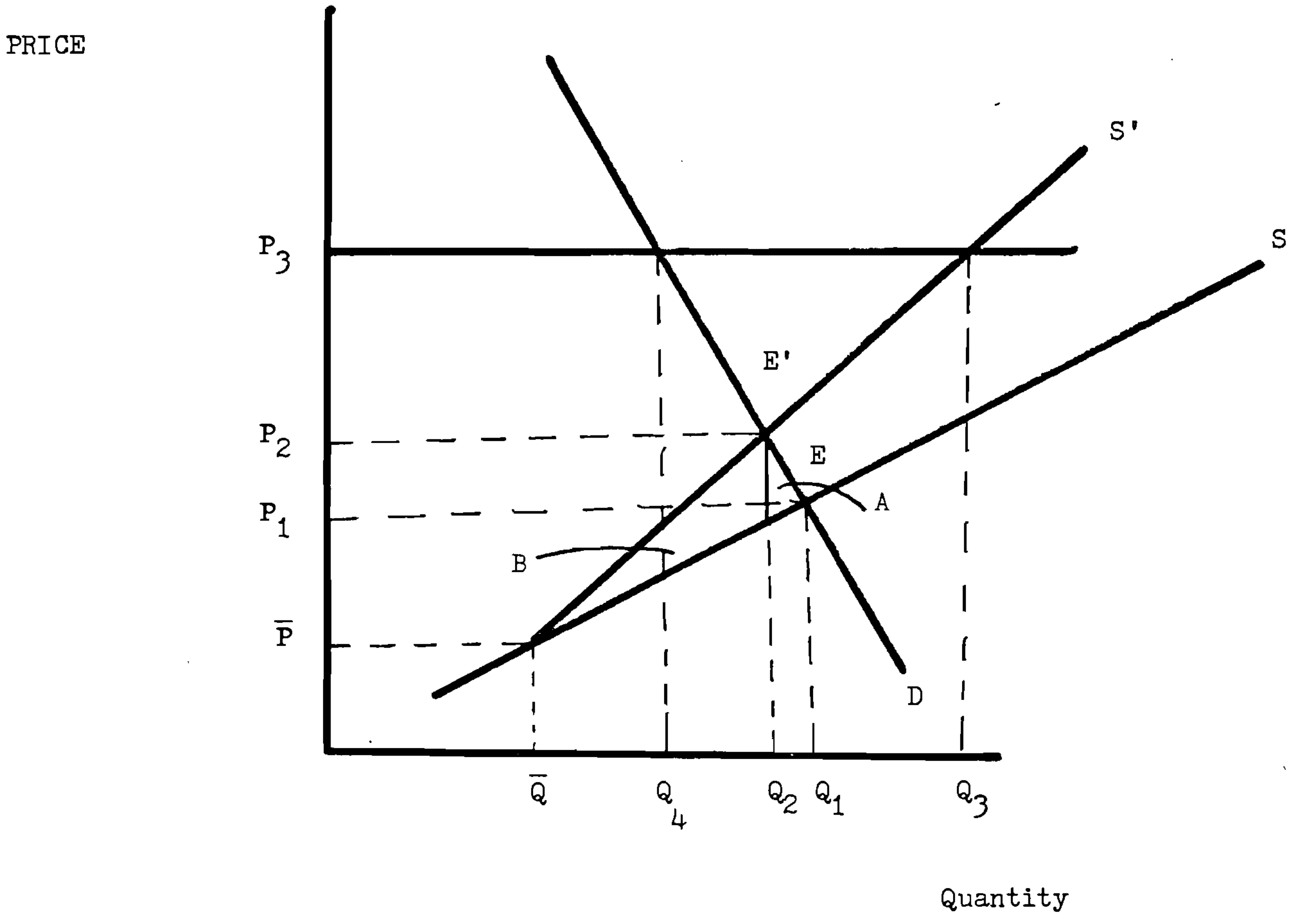
However, the decline in acreage harvested was only 12.1 million acres which is less than half as much as the 28.7 million acres originally enrolled in the program. Although most of the small decline in acreage harvested can be explained by weather conditions returning to normal after a period of droughts, it did appear that in certain areas of the United States, some land that actually was not used for farming was put into the program.

Over the years, price supports and target prices have also stimulated overproduction. Price supports have reduced farmers' risk of financial loss since a minimum loan payment is guaranteed which encourages farmers to produce, rather than to not produce. Also, price supports greater than the equilibrium market price have held and attracted resources to farming, resulting in further accumulation of surpluses and to inefficient allocation of resources. Furthermore, although target prices have allowed a greater market role in determining prices and output, they also have insured the farmer of a minimum deficiency payment and further stimulated production beyond society's needs.

Due to these production controls which require the farmer to substitute other inputs for land, nonoptimal combination of resources results. Inefficiencies arise because the commodity is produced at a higher cost to society since the farmer is using a combination of productive resources below his optimal level. Furthermore, price supports and target prices for surplus commodities stimulate overproduction which also distorts resourse allocation.

Figure 2 [9] exemplifies the effect of production control programs and the inefficiencies which arise from them. In a free market where

FIGURE 2



government does not intervene with agricultural production, the supply of feed grain would be the curve denoted by S. Given the demand for these commodities as D, equilibrium would be at point E where quantity is Q_1 and price is P_1 . Upon implementation of an acreage reduction program such as PIK, the supply curve would rotate up to S' and the new equilibrium would be at point E'. $\bar{Q}$ is the minimum amount of feed grain that would be produced since farmers will always use a certain amount of land for production is the quantity and is the amount the government figures it must cut back in order to reduce quantity to Q_2 . This is due to the fact that acreage reduction programs reduce production less than what is anticipated since farmers will increase productivity per acre and retire their less productive land. In addition, a price floor such as federal price supports which are set above the equilibrium price at P_3 , can stimulate overproduction. At this higher price, quantity supplied now increases to Q_3 , while actual quantity demanded is only Q_4 . Due to overproduction caused by price supports and to the misallocation of resources found in acreage reduction programs, inefficiencies arise. The inefficiencies can be represented by the areas A and B in Figure 2. Area A is the welfare loss to society due to quantity supplied at a level below what is desired. In other words, Q_1 is the socially optimal amount demanded in an unregulated market, but Q_2 is what is actually produced. This area represents the value of goods and services lost through these production controls. Area B is the technical inefficiency due to higher production costs. These higher costs are attributed to inefficient resource combinations caused by the federal land restrictions. Together, these two areas represent the inefficiency

arising from acreage reduction programs which this paper will attempt to measure.

(2) COMMODITY PROGRAMS HAVE INCREASED THE PRICE OF U.S. AGRICULTURAL EXPORTS RELATIVE TO THE WORLD

Acreage control measures have sought to reduce output and trim excess supplies in order to maintain a high price for farmers. Furthermore, price supports have guaranteed a minimum commodity price and have led to higher market prices for all farmers. Consequently, these programs have resulted in an export price for U.S. commodities higher than the relative world price. Potential foreign demand for these products is reduced due to the higher price. The U.S. government has responded by employing various export subsidies. These subsidies make the price of U.S. commodities comparable to world prices and therefore, more competitive. However, policies such as P.L. 480, have increased international trade barriers since other exporting nations feel that the U.S. is "dumping" its surplus commodities in less-developed foreign nations. In retaliation, other exporting nations such as England, have enacted trade restrictions on the U.S.

(3) DISTRIBUTION OF FARM PROGRAM BENEFITS ARE INEQUITABLE SINCE THE LARGEST FARMS GET THE MOST BENEFITS

Benefits from supply control programs are directly linked to the size of the farm and the amount of production. Therefore, the farmer who is able to produce larger quantities of the commodity is eligible to receive a higher loan from the price support program or a greater total deficiency payment since both of these payments are based upon the number of bushels produced or stored. Furthermore, acreage reduction programs favor the larger farmer who is able to set-aside a larger number of acres, thereby receiving a greater total diversion payment. Consequently, a very large fraction of the payments under these farm programs goes to families with incomes that are relatively high by most standards.

U.S.D.A. economists have considered a more equitable system of payments, but a viable alternative has not been found. For example, a flat payment would encourage the small producer to stay in farming, perhaps increasing inefficiency. Furthermore, a maximum income restriction on the benefits would penalize those efficient farmers using economies of scale. Meanwhile, public concern over the present distribution of these payments arises since the possibility that money from low-income, nonfarm households may be being transferred to farm households with higher incomes. More alarming is the fact that these people who are subsidizing the larger, wealthier farmers through their tax dollars, are also consumers who are paying higher food prices caused from the federal farm programs' supply-reducing measures.

(4) LAND PRICES HAVE INCREASED LARGELY DUE TO ACREAGE REDUCTION PROGRAMS

Land values are determined by a number of factors including the desire to invest in land as a hedge against inflation or merely for an investment, the need for prestige, and the desire for security which is associated with owing land. In addition, one of the major factors is the return that is expected from the land. This depends not only upon the application of technology but also upon government price supports and acreage reduction programs. Benefits from these programs have been capitalizd into the price of land, causing the value of farm real estate to rise over the years. For example, a land buyer will be willing to pay more for land which is supported by the federal government through price supports as compared to land used for production of unsupported crops. Therefore, the seller of farm land will obtain a price which reflects not only the value of the land depending on its productivity, but also on its expected benefits from price supports. Consequently, many opponents of these farm programs argue that people such as hired farm labor and tenant farmers who are most in need of these benefits accruing to landowners, do not receive their fair share, therefore supporting their view that a change in agricultural policies is needed.

(5) FARM PROGRAMS HAVE BEEN A GROWING DRAIN ON THE FEDERAL BUDGET

The cost of agricultural commodity programs has increased over the years as these programs have been expanded to include more commodities as well as more farmers. Cash benefits to farmers have grown because

the federal government must offer higher land diversion payments and price supports in order to induce farmers to remove a sufficient amount of farm land as well as supply from the market. In addition, administration costs as well as storage costs have escalated in recent years as government-owned reserve stocks have substantially grown. As a result, the U.S.D.A. has had in the past few years the third largest department budget. For example, in 1982 the U.S.D.A. had a budget of $48.3 billion.[10] It employed 126,832 people directly and helped supervise or pay part of the salaries of 24,832 others. In addition, the U.S.D.A. was the government's biggest lender with nearly $125 billion in loans outstanding of which $20 billion was directly attributed to price supports. Ironically, net farm income is only about half as much as the total amount the federal government spends on commodity programs. In other words, the federal government's expenditures on programs designed to increase farm income are higher than the actual net farm income figure.

SECTION II

Federal government officials are aware of these inherent weaknesses caused by supply control measures. As mentioned earlier, alternative plans have been proposed in the past by a few U.S.D.A. administrators as a way to overcome these inefficiencies. One meausure recently enacted was the 1983 Payment-In-Kind (PIK) Program which introduced a different payment concept to farmers.[11] Although this

program was advertised as a "new" farm program, it was merely another type of acreage reduction program. This shows that once again the federal government consistently has relied upon these measures as a means of solving the oversupply problem in agriculture, even though significant inefficiencies arise. The following section will examine this most recent type of acreage reduction program.

THE 1983 PAYMENT-IN-KIND PROGRAM

In January 1983, the U.S.D.A. announced a new supply control measure, the Payment-in-Kind Program (PIK), in addition to the current voluntary acreage reduction and cash paid land diversion program. As mentioned earlier, PIK was simply another type of acreage reduction program but gave farmers greater incentive to participate, thereby encouraging farmers to further reduce 1983 crop acreage of wheat, corn, sorghum, upland cotton, and rice. Need for this action developed from growing farm surpluses which resulted from a weak domestic and foreign demand as well as from record high harvests in the previous two years. Consequently, this stock build-up caused sharply lower commodity prices, depressed farm income and increased government farm program expenditures.

The distinctive feature of PIK was its payment-in-kind component. As payment for reducing planted acreage, the PIK program paid participating farmers in the actual commodity that would have been planted on acres enrolled in the program. Then, the farmer could sell or privately use on his farm the commodity received as payment.

Furthermore, PIK not only cut production of surplus crops, but also reduced accumulated surplus stocks in both the Commodity Credit Corporation (CCC) held reserves and in farmer-owned reserves (FOR).[12] The PIK program also was designed to achieve the following U.S.D.A. objectives:

"(1) To minimize direct government outlays in support of agriculture

(2) To improve conservation practices

(3) To increase farm incomes

(4) To help to ease storage problems"[13]

Earlier in 1982, the U.S.D.A. had announced a production control program for crops to be planted in the following spring. This Reduced Acreage Program (RAP) required participating farmers to idle up to 20% of their acreage base. Idled acres were required then to be put into conserving uses. This meant that a cover crop had to be planted to protect the land against weeds and soil erosion. Farmers enrolled in RAP were to be paid a cash land diversion payment equal to $1.50 per bushel times their normal yields on the first idled 10% of their acreage base.[14] The remaining 10% of their acreage base enrolled in RAP simply qualified the farmer for CCC loans and for deficiency payments which would be paid if the market price fell below the pre-announced target price.

The PIK program allowed farmers who were participating in RAP to idle an additional 30% of their base acreage. Producers were paid an established percentage of their farm program yield per acre on the acres idled as long as they devoted this land to conservation purposes.

These repayment rates were 95% for wheat, and 80% for corn, sorghum, rice and cotton. For example, if a farmer who produced corn had a normal yield per acre of 100 bushels, his PIK payment would be equal to 80 bushels/acre. Therefore, a farmer could receive a significant amount of the commodity that he normally would have planted on the idled acres, which then could be sold in the open market.

Another alternative available to farmers under the PIK program was the whole-base retirement. This allowed the farmer to idle 100% of his base acreage, thereby not producing crops on any of his land. Participation in this option was determined on a bid basis whereby producers indicated the payback rate necessary to induce them to idle all of their crop base. Farmers could not submit a bid which was higher than the federal payback rate for the commodity which would have been planted on their land. In addition, participation in the whole-base retirement was limited since no more than 45% of a county's acreage base for each of the PIK crops could be idled.

The PIK payments to participating growers were made through two different methods: (1) forgiveness of a loan under the farmer-owned reserve (FOR) or the nonrecouse loan program, or (2) receipt of an entitlement to CCC-owned commodities. In the first alternative, the CCC was allowed to liquidate its grain stocks by the amount forgiven by FOR and nonrecourse loans held by the participating producers in order to meet their PIK payments. In this case, no commodities would actually exchange hands. The second payment alternative allowed those farmers who did not hold FOR or reserve loans, or who did not have enough of a commodity under loan to meet their PIK compensation, to receive CCC stock through a CCC commodity certificate. This did result

in an actual physical movement of grain as well as a transfer of ownership. The recipient farmer then had the option to sell the commodity immediately or to store the crop and sell it at a future date. To promote orderly marketing so that not all of the PIK stock would be dumped on the market at the same time, the CCC agreed to pay up to five months' storage expenses on PIK commodities received by the participating producer.

Although PIK used a slightly different payment approach, it was still an acreage reduction program since farm income and commodity prices were increased by restricting the amount of land used for production. However, PIK did provide greater benefits and participation incentives for farmers as compared to earlier supply control programs. In addition to these standard production control measures which assure farmers a higher price than that found in a free market setting, the PIK program also guaranteed farmers a percentage of their normal yields. Therefore, the risk of financial loss was reduced by PIK since both high prices and yields were pledged by the federal government. In years where weather adversely affects production, such as the recent 1983 growing season, farmers would be much better off under a PIK program than under a regular acreage reduction program since the yield per acre guaranteed under PIK probably would be higher than the actual yield affected by the weather. Therefore, the farmer enrolled in PIK would benefit from receiving a yield greater than the average yield for the season affected by the poor weather. Additionally, the PIK farmer would receive a greater total payment since these guaranteed yields could then be sold at a higher market

price resulting from both the supply-reducing measures and the adverse weather.

Another incentive to enroll in the 1983 PIK program was the dollar amount of benefits which a farmer was eligible to receive. Under earlier programs, a payment limitation of $50,000 was in effect for all farmers agreeing to reduce acreage. However, to provide additional incentives to idle cropland by participating in PIK, Congress abolished this payment limitation. Therefore, the farmer enrolled in PIK could receive a total cash benefit greater than that received from a regular acreage reduction program.

Furthermore, enrollment in the PIK was enhanced by the greater expected increase in farm income resulting from reduced production costs. Variable costs of production would be lower for those farmers participating in PIK since money spent on inputs such as fertilizer, farm machinery, pesticides, seed and farm machinery repairs would be lower due to the smaller number of acres used for production. As can be seen in Appendix I, this allowed PIK farmers to obtain a higher total net farm income as compared to the alternative Reduced Acreage Program (RAP). As a result, farm equity for PIK participants could rise as farm income grew. Therefore, farmers who enrolled in PIK would have better ability to improve their financial position by reducing outstanding farm debt.

THE OUTCOME[15]

The 1983 Payment-in-Kind Program was the largest acreage reduction

program ever sponsored by the federal government. Approximately 80 million acres were taken out of production due to PIK. In addition, the drought conditions experienced by the agricultural sector reduced productivity per acre which further added to PIK's success. As a result, the economic effects of the PIK program were distorted by the weather's influence on crop production. However, in order to obtain estimates reflecting PIK under normal weather conditions, the U.S.D.A. used regression models based on historical data to adjust actual figures. Therefore, PIK statistics used in this study are not actual figures, but merely estimates of PIK.

Overall, PIK did reduce production as well as stocks. For example, corn production was reduced by 1,260 million bushels and ending stocks of corn declined by 83%. In addition, PIK improved conservation practices since approximately 77 million acres were put into conserving uses, resulting in a projected 20% decline in soil erosion. Finally, net farm income increased by $4 billion between 1982-83, largely due to reduced production costs, improved commodity prices and increased government transfers resulting from the program. Hence, some of the U.S.D.A.'s objectives of PIK mentioned earlier were successfully realized.

Although the U.S.D.A. declared PIK a success since it reduced both production and surplus commodity stocks as well as increased farm prices and incomes, the price of success was high. The total administrative cost of the program alone was estimated to be $55.3 million.[16] Most of this can be attributed to the increased workload of the A.S.C.S. county offices which were responsible for administrating the program. These increased activities included such things as

explaining the program's provisions to farmers and farm organizations, accepting and reviewing contracts from the 100% PIK option, and overseeing participating farmers to make sure they were complying with the conservation stipulations. In addition, the CCC had to develop a system for delivering PIK commodities from CCC storage facilities to warehouses close to PIK recipients. Due to the size of the program, this was an extremely difficult and time consuming task. Distribution was further complicated by the imbalance in government stocks. Warehouses to the west of the Mississippi River were filled with PIK commodities while most of the payments were going to farmers to the east of the river. For example, Nebraska had 140 million bushels of PIK corn more than it needed while Ohio was short by more than 45 million bushels.[17] As a result, some farmers were paid in a lower-grade commodity or were forced to travel two or three counties away to receive their PIK payments.

One of the most significant consequences resulting from PIK was its adverse effects on many agricultural input industries due not only to the size of the program, but also to the reduced acreage requirements. For example, the demand for fertilizer, the most severely affected input, declined by nearly 18%. Furthermore, both energy usage and farm machinery repairs were projected to decline 12%, while the demand for seed was expected to fall 13%. Overall, the actual total expenditures for these inputs dropped by an estimated $5.2 billion. However, input expenditures are expected to rise significantly in the 1984 growing season since input usage should increase due to fewer acres taken out of production.

The non-farm sector was also affected by PIK through higher food

prices. The U.S.D.A. has predicted this increase to be only 1% , a very modest estimate. Realistically, this appears to be a low prediction since one of the basic food groups affected by PIK is meat. Higher feed grain prices resulting from PIK will cause livestock producers to reduce their livestock numbers in order to avoid higher production expenses. As a result, the supply of meat in the short run will be high as livestock owners reduce herds by sending more hogs and cattle to slaughterhouses. However, in the long run this supply will be low since the base for future production has been reduced in the short run. Higher meat prices and therefore, increased food prices can be expected in the two to three year period following the PIK program.

SECTION III

As has been emphasized, PIK was a type of acreage reduction program which had greater incentives to participate as compared to other acreage reduction programs. Like earlier programs, PIK payments were the largest for those producers who were capable of producing more, thus inequity did arise. In addition, the government cost of the program which at first was projected to be extremely low, proved to be one of the highest cost commodity programs sponsored by the U.S.D.A. Finally, PIK like earlier acreage reduction programs caused inefficiencies to arise since resources were not combined in a manner

optimal to society. It is these inefficiencies which this paper will now attempt to measure.

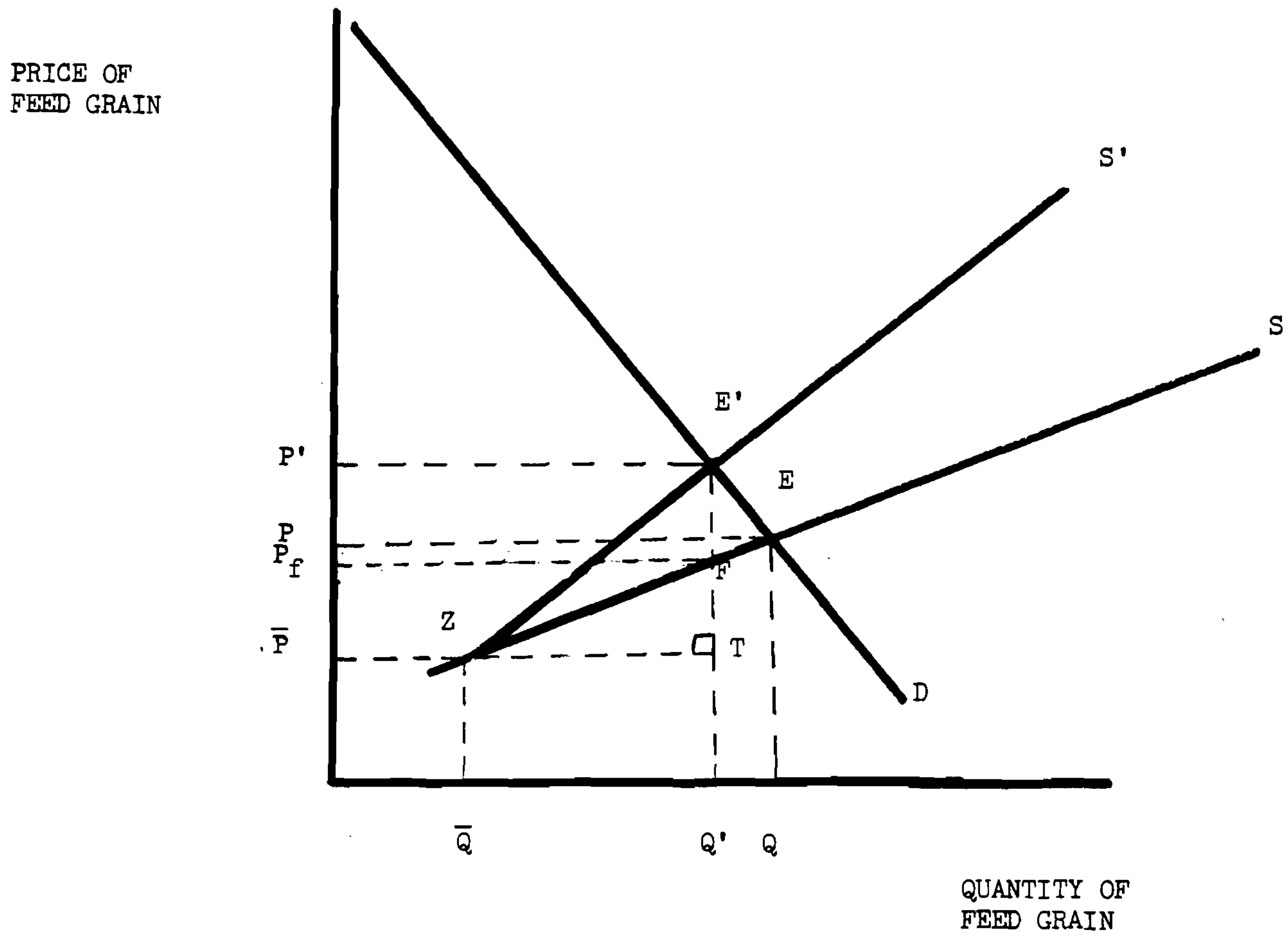
METHOD TO MEASURE INEFFICIENCIES

As noted earlier, the inefficiencies resulting from acreage reduction programs consists of two types: 1) welfare loss to society and 2) technical inefficiency, which together are represented by triangle E'ZE in Figure 3. In order to measure this total area of inefficiency, a demand curve and two supply curves, one representing free market supply where government production controls do not exist and the other reflecting supply affected by acreage reduction programs, must be determined. These curves will form two areas of inefficiencies. Welfare loss to society, shown by triangle E'FE, can be measured by computing the area of the triangle. This can be found by simply substituting points computed by the regression model into the formula for the area of a triangle. The resulting equation representing the inefficiency due to welfare loss to society can be written as follows:

(1) Area A = 1/2 (E'F)(Q'Q)

In order to find technical inefficiency represented by triangle E'ZF, the point where the two long run supply curves intersect, point Z in Figure 3, will be found by setting the two long run supply curve

FIGURE 3



PRICE OF
FEED GRAIN
S'
S
E'
P'
E
P
P_f
F
Z
$\bar{P}$
T
D
$\bar{Q}$
Q'
Q
QUANTITY OF
FEED GRAIN

equations equal to each other. This point of intersection can then be used to measure the area of triangle E'ZF by subtracting triangle FZT from triangle EZT:

$$(2)\ \text{Area B} = 1/2\ (\bar{Q}Q')(P'\bar{P}) - 1/2\ (\bar{Q}Q')(\bar{P}P_f)$$

Total inefficiency caused by acreage reduction programs will therefore, be equal to the sum of the two areas.

THE REGRESSION MODEL

Equations for the supply and demand curves were found using an econometric model which causally related agricultural inputs, production, price, supply and demand. The model used in this study was applied only to the feed grain sector. This sector was specifically chosen because feed grains historically have been a major component of the federal government's surplus stocks and have been one of the basic commodities targeted by acreage reduction programs. Although feed grains used for both consumer and livestock consumption consist of corn, barley, sorghum and oats, they are defined in this model as only corn and sorghum since the federal government has focused on reducing the excess production of these two commodities. Therefore, feed grains as used in this study will include price and quantity data for only corn and sorghum. The data were taken from various Agricultural Statistics printed annually by the Department of Agriculture. In addition, some figures were taken from statistical charts and tables

directly available from the U.S.D.A. and the Agricultural Stabilization and Conservation Service (A.S.C.S.). Observations were made annually from 1965 to 1983 with most of the 1983 numbers being figures projected by the U.S.D.A. The initial year, 1965, was chosen not only due to the availability of data, but also to the growing influence the federal government has had on agricultural production since this base year. Using this data, the demand and supply equations needed to measure the two areas of inefficiency were then determined using ordinary least squares (OLS).

(A) INPUT EQUATIONS

In order to determine the needed supply curves, input equations were estimated for selected inputs used in the production of feed grain. These inputs were chosen not only due to their importance in feed grain production, but also because of the impact acreage reduction programs have had on these factors of production. Others which should be included in this model but were not due to inavailability of data are fuel and energy inputs, machinery repairs, and pesticides.

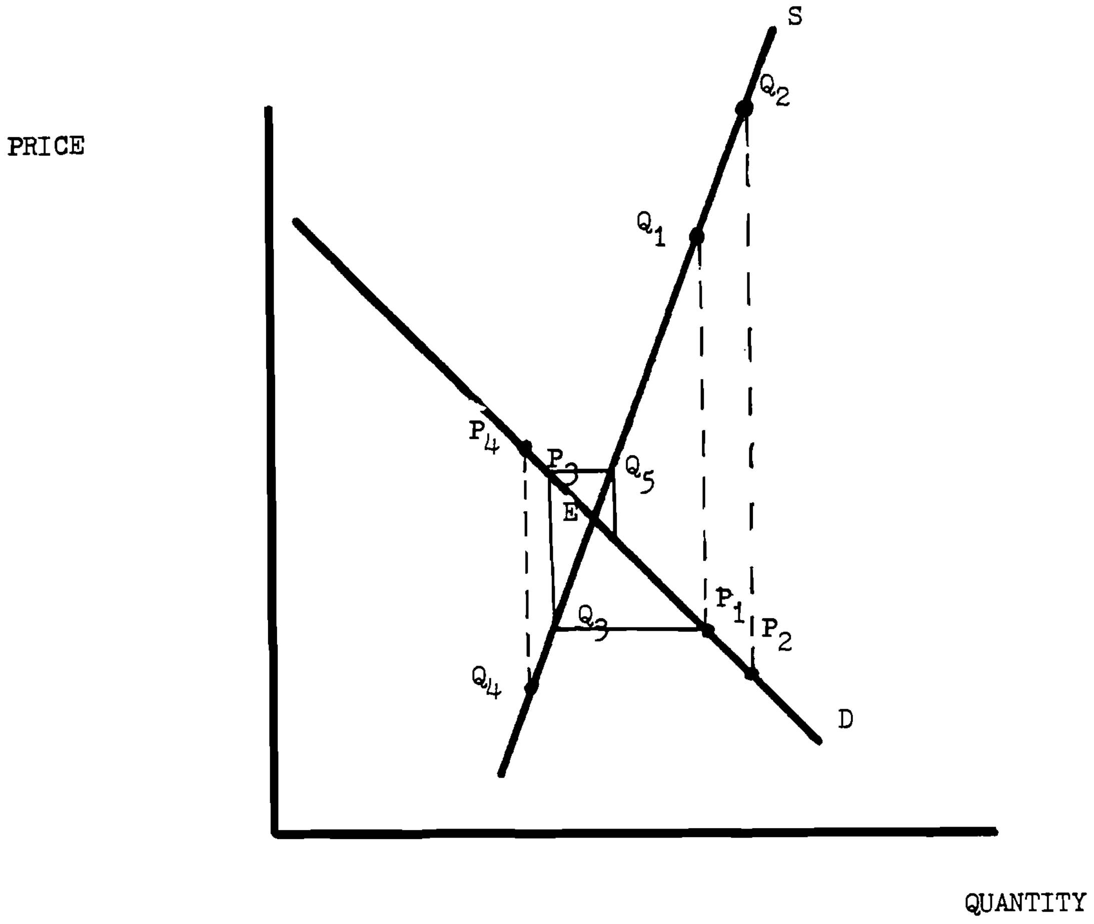
One of the most essential inputs used in feed grain production is land. In this model this factor of production is used to determine not only the demand for the other inputs but also to compute current production. The equation for this input is as follows:

$$(1)\ AC_t = a_1 + a_2LAGP + a_3LAGPS + a_4ACDIV + a_5LAGAC + a_6PSUPP$$

where AC = harvested acreage of feed grain

LAGP = lagged price of feed grain

FIGURE 4



Suppose it takes two years for the supply response in the feed grain sector to be completed. In periods of low prices such as P_1 and P_2, the resulting immediate quantities are Q_1 and Q_2. However, these low prices will not be fully reflected until two years later at Q_3. This smaller quantity (Q_3) results in a higher price, P_3, whose effect will not be seen until two years later at Q_5. This will continue until a long run equilibrium is reached at point E.

In this regression (Equation 2) a drop in quantity in the current year could be represented in this figure as P_3 increasing to P_4 while quantity falls from Q_3 to Q_4.

LAGPS = lagged price of soybeans

ACDIV = feed grain acreage diverted to conservation uses

LAGAC = lagged harvested acreage of feed grain

PSUPP = price support for corn and sorghum

Last year's price of feed grain, LAGP, will help determine the amount of acres producers decide to devote to feed grain production. According to the Cobweb Theorem , farmers' decisions on the amount of production will depend upon last year's price. For example, if last year's price was high, farmers will tend to increase production in the current year. Similar to this is the federal price support for feed grains for if the current price support is high, farmers producing on land which can easily grow corn as well as some other crop, would plant corn since they are guaranteed a higher price. In addition, since soybeans are considered by most farmers as a substitute crop for corn, it can be expected that farmers would devote more acres to feed grain when the price of soybeans is low.

Fertilizer has become an important input used in farming and has been the factor most responsible for increasing yields per acre over the years. The following equation will attempt to determine the demand for fertilizer:

(2) $F_t = b_1 + b_2AC + b_3PF + b_4LAGF + b_5LAGP + b_6PSUPP$

where F = commercial fertilizer

AC = harvested acreage of feed grain

PF = price of commercial fertilizer

LAGF = lagged quantity of fertilizer

LAGP = lagged price of feed grain

PSUPP = price support for corn and sorghum

Acreage of feed grain (AC) was used in this equation as well as in the remaining input equations and was determined from the previous regression equation. (Equation 1) It is included since the amount of cropland devoted to feed grain would directly influence the amount of fertilizer demanded by the producer. That is, if acreage of feed grain is reduced due to the federal acreage reduction programs, the desired quantity of fertilizer will decline. This decline will be only a fraction since farmers will increase usage of fertilizer on their remaining acres in order to increase productivity. In addition, the previous year's price of feed grains as well as their price support are included in all the input equations. This is due to the direct relationship between the previous year's price and current price supports and the selected inputs. For example, if last year's price or this year's price support of feed grain is high, farmers will want to increase current production by (1) increasing the number of acres planted, (2) increasing the use of fertilizer on the land used for production or (3) increasing both the number of acres planted and fertilizer usage. The previous year's quantity of fertilizer is included in the equation to reflect farmers' expectations. For example, if the quantity of fertilizer demanded was low in the previous year, producers will want more fertilizer in the current year to make up for the fertilizer not used on the land in prior years.

Like fertilizer, farm machinery has played an increasingly important role in the history of U.S. agriculture. Automation and mechanization have caused the agricultural sector to be more dependent upon horsepower, fuel, and size. Farm machinery usage is responsible for reducing both hours and work involved in agriculture, adding to the increase in farm productivity. These relationships are represented by the following equation:

$$(3) \quad FM_t = c_1 + c_2AC + c_3PFM + c_4Y + c_5FMST + c_6LAGP + c_7INT + c_8PSUPP$$

where FM = farm machinery

AC = harvest acreage of feed grain

PFM = price of farm machinery

Y = total net farm income

FMST = farm machinery stock

LAGP = lagged price of feed grain

INT = interest rate

PSUPP = price support for corn and sorghum

Theoretically, farm machinery is directly related to total net farm income since the quantity of farm machinery demanded tends to increase in periods of high net farm income. Likewise, interest rates are included in the equation since the financing of such capital expenditures usually involves some type of a loan. The relationship between these two variables is expected to be negative for as interest rates rise, the number of loans will fall, and therefore, the amount of

farm machinery demanded by producers will decline. Furthermore, included in the equation is the stock of farm machinery which is found by the identity:

$$(4)\ FMST_t = LAGFST + FM_t$$

where FMST = farm machinery stock

LAGFST = lagged farm machinery stock

FM = farm machinery

The final input equation used in this model is the equation for hired farm labor. Over the years farm machinery has steadily replaced this input, adding to its decline. Likewise, acreage reduction programs have been accused by farm labor unions of accelerating this decline of labor in agriculture. The proposed equation for labor is:

$$(5) L_t = d_1 + d_2W + d_3AC + d_4FMST + d_5LAGP + d_6PSUPP$$

where L = hired farm labor

W = hourly wage

AC = harvested acreage of feed grain

FMS = farm machinery stocks

LAGP = lagged price of feed grain

PSUPP = price support for corn and sorghum

Wage as well as farm machinery stock is indirectly related to hired

farm labor. It is expected that as the wage or stock of farm machinery rises, less labor will be demanded.

(B)PRODUCTION AND SHORT RUN SUPPLY EQUATIONS

Since output is dependent upon its factors of production, the production function for the feed grain sector proposed in this model is determined by these input equations. This production function can be represented as follows:

$$(6)\quad PROD_t = f_1 + f_2F_t + f_3FM_t + f_4L_t + f_5AC_t$$

where PROD = production of feed grain

F = commercial fertilizer

FM = farm machinery

L = hired farm labor

AC = harvested acreage of feed grain

A log-linear equation such as the Cobb-Douglas production function might be a better equation to use, since the expected production curve should have diminishing marginal products, therefore reflecting increasing returns to scale. However, in order to ease computations later, a regular straight line relationship will be assumed.

This equation which represents current production of feed grain is a part of the total supply of feed grain. This can be seen in the following equation:

(7) SUPPLY: $Q_t = PROD_t + STOCKS_t + IMP_t$

where Q = total quantity of feed grain supplied

PROD = production of feed grain

STOCKS = surplus stocks of feed grain

IMP = feed grain imports

In this equation, Q is the short run total supply and will be a perfectly inelastic supply curve (i.e. a vertical line).

(C) DEMAND EQUATION

Another essential equation needed in order to measure inefficiencies arising from acreage reduction programs is the demand equation. In theory, consumers' and livestock producers' demand for feed grain should determine the demand curve. This equation can be written as follows:

(8) DEMAND: $Q_t = h_1 + h_2P + h_3PSUPP + h_4LAGUT + h_5YD + h_6 LVST$

where P = price of feed grain

PSUPP = federal price support for corn and sorghum

Q = quantity of feed grain

LAGUT = lagged utilization of feed grain

YD = consumer disposable income

LVST = livestock production

By shifting terms, demand can also be represented by the equation for price :

$$(9) \quad P_t = h_1 + h_2PSUPP + h_3Q + h_4LAGUT + h_5YD + h_6LVST$$

The price support for corn and sorghum will affect the price of feed grain directly since a high price support will more than likely cause the market price to be high. Likewise, a large livestock production level and a high feed grain utilization in the previous year will increase the demand for feed grains, thereby raising feed grain prices. On the other hand, a large total quantity of feed grain will draw feed grain prices down since supply exceeds demand.

(D) DETERMINING LONG RUN SUPPLY

The total supply curve of Equation 7 is the short run total supply curve. Therefore, in order to measure the two areas of inefficiency, long run supply curves will need to be determined.

To compute long run total supply curves for both government-influenced and free market settings, it must be realized that an equation for the price of feed grain can be found in terms of last year's price of feed grain plus other predetermined exogenous variables. This is because input equations are all interrelated by

harvested acreage of feed grain (AC) in Equation (1). After making needed substitutions, this equation can be represented as follows:

$$(10)\ P_t = k_0 + k_1 LAGP + k_2 X_1 + k_3 X_2 + \cdots\cdots\cdots\cdots + k_n X_n$$

where P = price of feed grain

LAGP = lagged price of feed grain

X = exogenous variable

An increase in any exogenous variable, say X_1, will have a multiplier effect on P. For example, in the first time period, an increase in X_1 will cause P_t to increase by k_2. However, this increase in P_t will cause P_{t-1} also to increase in the next time period which in turn, causes P_t to increase by an additional $k_1 \cdot k_2$. This process will continue and a multiplier of $k_2(1/1-k_1)$ can be computed.

Using the adaptive expectation approach[20] to obtain a long run total supply curve, equation 10 can be divided by $(1-k_1)$. Next, LAGP can be dropped, resulting in the following equation:

$$(11)\ P_{LR} = m_1 + m_2 X_1 + m_3 X_2 + \cdots\cdots\cdots + m_n X_n$$

where P_{LR} is the long run price and is a function of all the exogenous variables in the model.

This estimated long run price can then be substituted into Equation 9. Solving for Q will give the long run quantity for total supply. Changing the value of one of the variables used in this demand

equation will result in another long run equilibrium price and quantity. The long run total supply curve can then be computed by finding a slope using these figures.

THE RESULTS

The regression equations to be used in this model to help measure the inefficiencies caused by acreage reduction programs have been proposed. However, in most cases after running these regressions, the equations actually used are modified versions of these original equations as can be seen in Appendix I. This paper now will discuss the results of the regression equations used in this model and determine the area of inefficiency caused by acreage reduction programs.

A. INPUT EQUATIONS

The estimated equation for harvested acreage as initially proposed was as follows:

$$(1)\quad AC_t = 87446.99 - \underset{(1.359)}{4.957}\ LAGP - \underset{(1.564)}{4.483}\ PSUPP + \underset{(1.402)}{.358}\ LAGAC - \underset{(.161)}{378.27}\ LAGPS - \underset{(5.305)}{.654}\ ACDIV \qquad \bar{R}^2 = .8344$$

The absolute t-values are given in parentheses which shows that only ACDIV is significant at both the .05 and .10 level even though the independent variables explained approximately 83% of the dependent variable. It is interesting to note that the coefficient for ACDIV is less than one, supporting the earlier proposition that not all land diverted in acreage reduction programs is actually used for productive purposes. In order to obtain a better estimate for harvested acreage, however, last year's price of soybeans was dropped from the equation

which resulted the following:

$$(2)\quad AC_t = 88586.21 = \underset{(2.255)}{5.5386}\ LAGP - \underset{(2.120)}{4.751}\ PSUPP + \underset{(1.563)}{.339}\ LAGAC - \underset{(6.402)}{.643}\ ACDIV$$

$$\bar{R}^2 = .8468$$

By dropping LAGPS, two additional variables, LAGP and PSUPP, became significant at the .05 level in addition to increasing $\bar{R}^2$. However, although significant, the LAGP coefficient is negative, differing from earlier stated expectations. According to this equation, a dollar increase in last year's price of feed grain will cause harvested acreage to decrease by 5.386 million acres. This result contradicts with the Cobweb Theorem which the inclusion of LAGP in the equation was based upon, since the increase in last year's price decreases, rather than increases, harvested acreage. Other regressions tried, however, yielded similar results.

A possible explanation of this negative coefficient could be the variable itself. Perhaps the delayed response needed for the Cobweb Theorem to hold is greater than one year, say two or three years. Therefore, the coefficient for the first lagged price variable may be negative, meaning that harvested acreage decreases with an increase in the previous year's price, but rises when the longer lagged price increases. This long run equilibrium "zoning in" can be seen in Figure 4[21] where an increase in feed grain price lagged two years actually increases current harvested feed grain acreage, while the one year lagged price causes a decrease. Although this may a plausible explanation, it must be noted that the negative coefficient for LAGP also could be due to the model's small number of observations as well

as to inaccurate data. In addition, price of feed grain was unintentionally expressed in current rather than constant dollars. Therefore, incorrect coefficient signs could be caused by the presence of inflation in the model. Despite this imperfection, Equation 2 was used in the model as the estimate for harvested acreage.

The equation for fertilizer as originally proposed was estimated as follows:

$$(3)\ F_t = -196.37 + \underset{(4.8)}{.173}\ AC - \underset{(.117)}{.077}\ PSUPP - \underset{(.029)}{.006}\ LAGF - \underset{(1.130)}{.563}\ LAGP + \underset{(1.632)}{62.74}\ PF$$

$$\bar{R}^2 = .6464$$

According to this equation, AC is the only significant variable and has a positive effect on fertilizer as is expected. However, a few unsupported inconsistencies did result from the regression which are reflected in coefficient signs for PSUPP, LAGP, and PF contrary to what was expected. For example, Equation 3 states that a one dollar increase in the price of fertilizer, other things constant, would cause the demand for fertilizer to increase by 62.736 thousand tons. Clearly, this contradicts one of the basic economic theories which states that there exists a negative relationship between price and quantity demanded. Due to these theoretical disagreements and also to the insignificance of these variables, the regression was ran without these three variables which resulted:

$$\text{(4) } F_t = 9682.083 + \underset{}{\overset{(5.573)}{.130}}\ AC + \overset{(.851)}{.307}\ PSUPP$$

$$\bar{R}^2 = .6345$$

Although the $\bar{R}^2$ is slightly smaller, the coefficients appear to be theoretically correct since an increase in acreage or the level of price support would be expected to cause an increase in the demand for fertilizer. Therefore, despite the loss of three variables from the originally proposed equation, Equation 4 was used in the model as the estimate of the demand for fertilizer.

The earlier suggested equation for the demand for farm machinery was estimated as follows:

$$\text{(5) } FM_t = 5132.42 + \overset{(1.062)}{.021}\ AC + \overset{(.139)}{.08}\ PSUPP - .03\ LAGY + \overset{(.766)}{15}\overset{(.351)}{.71}\ INT$$

$$-\underset{(1.212)}{.319}\ LAGP - \underset{(1.016)}{87.275}\ FMST + \underset{(.328)}{.024}\ PFM$$

$$\bar{R}^2 = 0$$

Like Equation 3, theoretical contradictions did result, in this case for the variables LAGY, INT, LAGP and PFM. For example, according to this equation, if the current interest rate increases while other variables remain constant, the demand for farm machinery will increase by 15.706 units. This contradicts with the negative relationship between investment and interest rate as stated in general economic theory. Three possible explanations for this inconsistency are (1) a wrong interest rate was used in this model, (2) the assumed financing relationship between interest rate and farm machinery does not exist,

and/or (3) data used were inaccurate. The interest rate used in this model was the prime lending rate, a relatively short run rate. Perhaps an intermediate or longer term interest rate would have yielded better results. In addition, farm machinery was believed to be financed through bank loans when the actual financing could perhaps be better accounted for through some other method such as monthly payments to the farm implement store. Finally, farm machinery defined in this model was composed of those machines which could be directly traced to only feed grain production (i.e. grain combines and corn pickers). Therefore, tractors and other motor vehicles, a very large part of farm machinery, were excluded from the model which may be a possible reason for the weak equation.

Another variable which is inconsistent is LAGY, the total net farm income from the previous year. According to Equation 5, other things constant, a one dollar increase in last year's total net farm income would decrease the demand for farm machinery by .03 units. However, demand theory states that an increase income will increase the demand for the product. Again, this can be attributed to insufficient and/or inaccurate data.

A more plausible equation for farm machinery was found using the two most significant variables in the earlier proposed equation which were harvested acreage and the previous year price of feed grain:

$$(6)\ FM_t = -1538.098 + \underset{(.419)}{.004}\ AC - \underset{(1.873)}{.234}\ LAGP \qquad \bar{R}^2 = .0845$$

In this equation, both the explanatory variables are insignificant at the .05 or .10 level, therefore resulting in a low coefficient of determination. Also, LAGP is negative which contradicts earlier expectations that an increase in the previous year's price of feed grain, other variables constant, will increase the demand for farm machinery in the following year since farmers will want to increase production. Although this contradiction exists, it was the best estimate which could be obtained given the data.

The final input equation used in the model was for hired farm labor which as originally proposed was:

$$(7)\; L_t = -3606.045 - \underset{(1.548)}{42.717}\, W + \underset{(.526)}{.013}\, AC + \underset{(.401)}{39.267}\, FMST + \underset{(.985)}{.558}\, LAGP + \underset{(1.644)}{1.906}\, PSUPP$$

$$\bar{R}^2 = 0$$

Despite the insignificance of all the variables, the coefficient signs for the explanatory variables are correct according to earlier expectations, except for FMST. According to economic theory, an increase in capital should decrease labor. Instead, in this equation, it increases labor by approximately 39 laborers for every one million dollar stock increase. One possible explanation for the insignificant variables found in this equation besides possible data problems, is the fact that hired farm labor in the feed grain sector is not as an important factor of production as that found in the citrus as well as in other sectors of agriculture since feed grain production is extremely capital intensive. Another possibility is that since labor

used in the feed grain sector consists more of non-wage, family workers as compared to hired labor[22], a better equation might be obtained by using data for total family workers. If this was the case, wage would not be included in the equation since family labor is not considered hired labor.

Other regressions were run leaving the most insignificant variables out of the equation. These attempts did not yield a better equation since none of the variables were found to be significant. In fact, some regressions which were tried, changed coefficient signs which could not be fully explained. Therefore, because a better equation could not be found, Equation 7 was used in the model as the estimate for labor.

B. PRODUCTION EQUATION

These input equations were used to find production which was estimated using the following equation:

$$(8)\ PROD_t = 1201.784 - \underset{(.543)}{.533}\ FM + \underset{(.774)}{.048}\ AC - \underset{(.110)}{.081}\ L + \underset{(.232)}{.096}\ F$$

$$\bar{R}^2 = 0$$

Because none of the explanatory variables are significant, the coefficient of determination is zero. Furthermore, both FM and L are negative which means that according to this equation, these inputs cause a decrease in production rather than an increase as was expected. Again, these inconsistencies can possibly be explained by inaccurate data as well as an insufficient number of observations. In addition,

some of the variables may be incorrectly used. For example, FMST instead of FM could give a better estimate since the farm machinery stock will also be used in feed grain production. Another possibility is the fact that other inputs such as seed, fuel and pesticides were not included in the equation. Perhaps by including these inputs, a better equation could be obtained. Finally, as mentioned earlier, a log-linear approach used to estimate production would probably result in a better equation since production usually resembles a curve more than a straight line. However, even though these imperfections did arise from this equation, it was still used in the model as an estimate for production.

C. DEMAND EQUATION

Demand was determined using the price of feed grains as the dependent variable :

$$(9)\ P_t = -7550.32 - \underset{(.494)}{.25}\ PSUPP + \underset{(.677)}{.013}\ LVST + \underset{(1.941)}{.383}\ LAGUT - \underset{(1.313)}{.172}\ Q + \underset{(2.24)}{1.610}\ YD$$

$$\bar{R}^2 = .8387$$

Although this equation had a high $\bar{R}^2$, PSUPP was negative. According to the earlier discussion on the secondary effects of supply control measures using price supports, the price of feed grain should increase as the level of price support rises. However, Equation 9 states that a \$1 increase in price supports will cause the feed grain price to fall by \$.25, a very unlikely amount.

A better equation was obtained by dropping PSUPP as well LVST,

resulting in the following:

$$\text{(10)}\quad P_t = -5058.562 + \underset{(1.676)}{.298}\ \text{LAGUT} - \underset{(3.679)}{.274}\ Q + \underset{(3.304)}{1.803}\ \text{YD}$$

$$\bar{R}^2 = .8492$$

In this equation, all the explanatory variables are significant at the .10 level. Furthermore, the coefficient signs for all the variables correctly correspond to economic theory. This equation represents short run price which can be used to eventually find the long run equilium price as shown in Figure 5.

D. DETERMINING LONG RUN SUPPLY

In order to obtain Equation 10 in terms of all the exogenous variables so that the long run supply curves can be found, this procedure was followed:

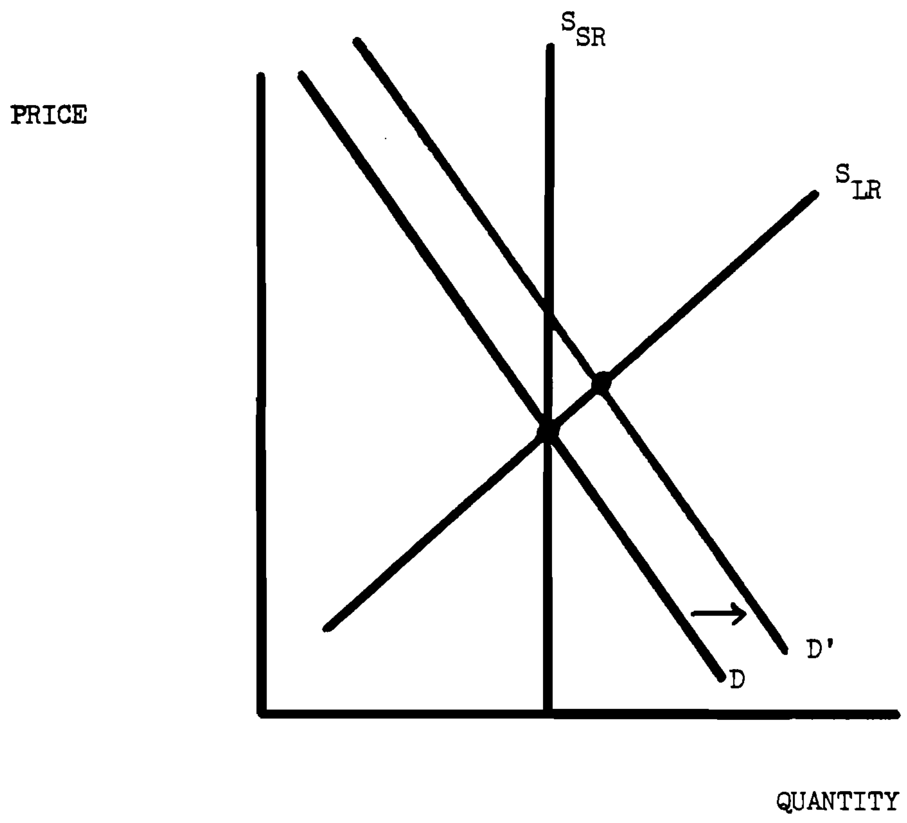
(1) the equation for harvested acreage was substituted into each of the other input equations;

(2) these expanded input equations were substituted in the production equation;

(3) this newly formed production function was substituted into the demand equation.

This expanded equation for feed grain price can be expressed as follows:

FIGURE 5



$$(11)\ P_t = -5239.44 - .1599\ LAGP + .0922\ PSUPP - .00414\ LAGAC + .00785\ ACDIV - .94804\ W + .87132\ LAGFST - .274\ STOCKS - .274\ IMP + .298\ LAGUT + 1.803\ YD$$

The relationship between the important variables, PSUPP, ACDIV, LAGP, and P are all positive which what was expected according to economic theory.

Using the adaptive expectation model, this equation was divided by 1.1599 and LAGP was dropped, yielding the following:

$$(12)\ P_{LR} = -4517.148 + .0795\ PSUPP - .00357\ LAGAC + .00677\ ACDIV - .8173\ W + .751\ LAGFST - .2362\ STOCKS - .2362\ IMP + .2569\ LAGUT + 1.554\ YD$$

Equation 12 is the estimate for the long run price. By substituting price obtained in this equation into the demand equation and solving for Q, a long run quantity corresponding to this price was determined, therefore giving one point on the long run supply curve. However, two points are needed to find the slope and the resulting equation of a line.

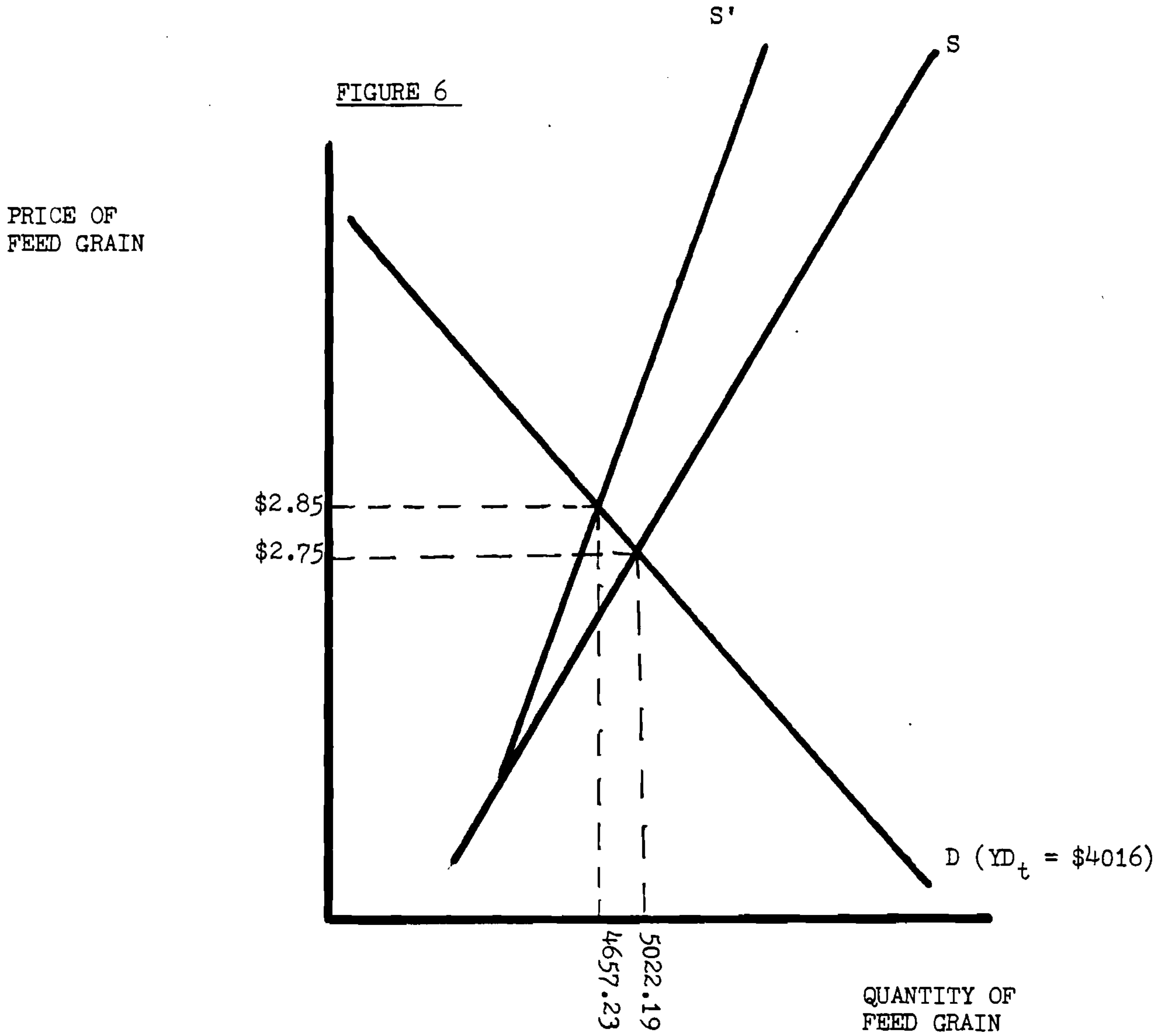
To find a second point on the long run supply curve, demand was shifted by increasing the value of YD used in Equation 12. Both long run price and quantity were found in the same manner as the first point was determined. Connecting these two points then yielded the long run supply curve which is graphically shown in Figure 6.

The free market supply curve was found following exactly the same

TABLE I

	YD = $4016		YD = $4050	
	Price ($/bu)	Quantity (Mil. bu.)	Price ($/bu)	Quantity (Mil. bu.)
Real World	2.85	4657.23	2.90	4698.65
Free Market	2.75	5022.19	2.79	5100.11

FIGURE 6



procedure as that for the supply influenced by production controls except the value for both ACDIV and PSUPP was zero since these policy provisions would not exist in a free market setting.

The results from these two procedures, using the mean values obtained from the given data for the exogenous variables, are seen in Table 1. The relationship between these two supply curves as well as the inefficiencies of acreage reduction programs are shown in Figure 7.

E. MEASURING INEFFICIENCIES

The purpose of this research paper was to measure the two areas of inefficiency caused by the implementation of federal acreage reductions programs. Now that equations for both supply and demand of feed grain have been determined, the procedure to compute the two areas of inefficiency described earlier will be followed.

The welfare loss to society, represented by triangle E'FE in Figure 8, was found using the equation for the area of a triangle. Using the point-slope formula, P was found to be $2.57. Inefficiency represented by Area A was determined as follows:

$$\begin{aligned} \text{Area A} &= 1/2\ (E'F)(Q'Q) \\ &= 1/2\ (.28)(364.9577) \\ &= \$51.094 \text{ million} \end{aligned}$$

To find the technical inefficiency represented by triangle E'ZT in Figure 9, the point where the two supply curves intersect (point Z) was found by setting the two supply equations equal to each other. Price at point Z was found to be $1.54 while quantity is 3569.1928 million

FIGURE 7

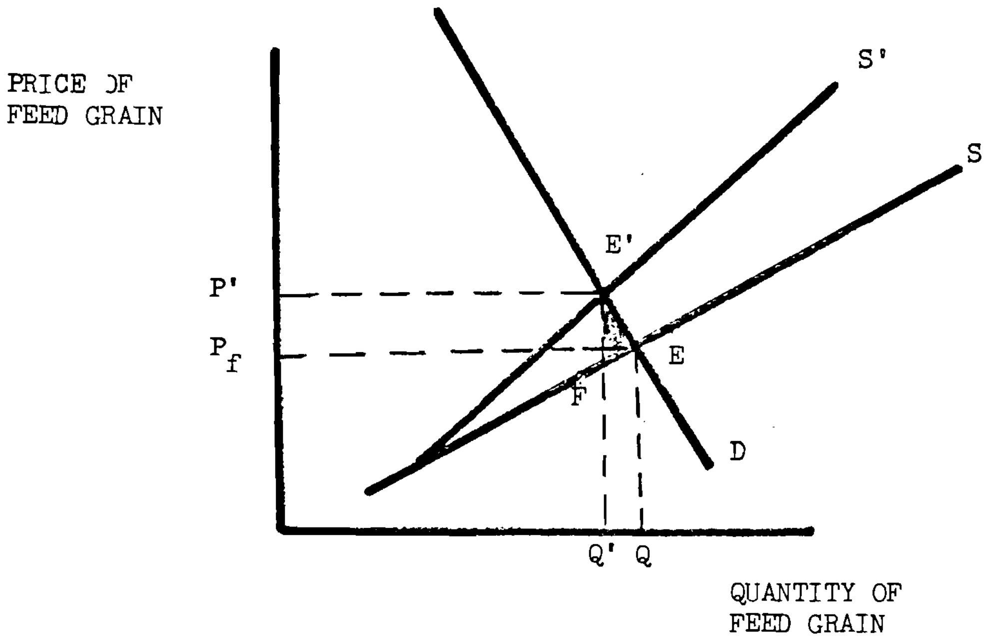
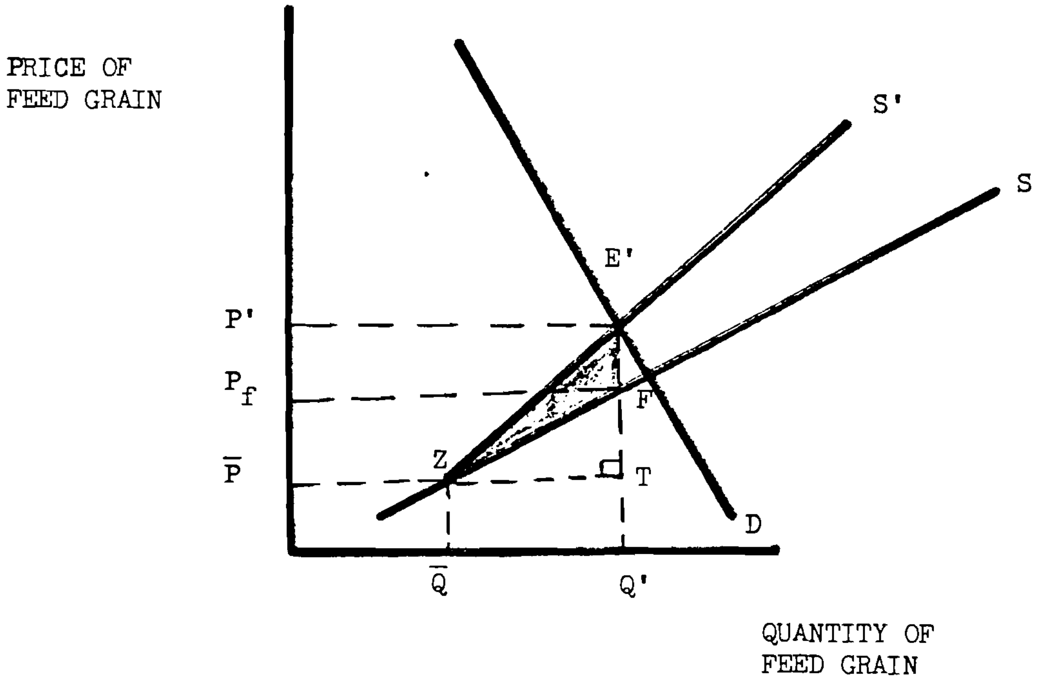


FIGURE 8



bushels. Subtracting the smaller triangle, FZT, from the larger triangle, E'ZT, resulted the measurement for technical inefficiency. This was determined as follows:

Area E'ZF= Area E'ZT - Area FZT

= 1/2 (QQ')(P'P) - 1/2 (QQ')(P'P)

= 1/2 (1088.04)(1.31) - 1/2 (1088.04)(1.03)

= $712.664 - $560.339

= $152.325 million

Using these numbers as the welfare loss to society and technical inefficiency estimates, total inefficiencies caused by acreage reduction programs was found by simply adding the two smaller components as follows:

Total Inefficiency = Area A + Area B

= $51.094 + $152.325

= $203.419 million

CONCLUSION

The purpose of this paper was to measure the inefficiencies caused by federal acreage reduction programs and to use this measurement to support the view that free market policies would be more efficient. Using an econometric model applied to the feed grain sector, a measurement of inefficiency was found. However, the validity of this

estimate is questioned due to problems with some of the regression equations used in the model. Because the reliability of this measurement is not known, the inefficiency estimate does not support the free market positon as much as was anticipated.

Three regressions used in the model were not good equations for the dependent variable since none of the explanatory variables were significant and some of the coefficients had signs contradicting economic theory. These three weak equations existed for the variables FM, L, and PROD. Data problems are the most likely reasons for these weak equations. Because not all data were specifically for the feed grain sector, some inaccuracies could have developed. In addition, some variables such as INT and L, had more than one set of data depending on the way the variable was defined in the model. Insignificant variables could result if the wrong definition and therefore, the wrong data for the variable was used. This could also be caused by failing to deflate all variables in the model as in the case for price of feed grain. Furthermore, some variables which should have been included in a few of the equations were left out due to insufficient data. These equations may have been stronger if data were found so that these variables could be included in the regression. Finally, the number of observations used in this model may have been inadequate, therefore, not allowing the true relationship between the variables to be found.

Although the model was flawed by these three weak equations, a measurement of inefficiency still was able to be computed. It was found in this model that technical inefficiency caused by commodities being produced at a cost to society higher than that found in a free

market, was approximately three times greater than the welfare loss to society. However, this relationship between these two inefficiencies can not be considered a reliable one due to the model's inclusion of the weak input equations for farm machinery and hired farm labor, which both affect the supply curves' slope. Given set demand and free market supply curves, technical inefficiency will be greater than welfare loss to society as the slope of the real world supply curve falls, thereby becoming flatter. This relationship is shown in Figure 10. Therefore, since the slopes of the supply curves are questionable due to the shortcomings of the FM and L equations, the relationship between the two inefficiencies can not be considered true.

Likewise, due to the errors found within the model, the total inefficiency measurement can not be considered a reliable estimate of the true inefficiency resulting from acreage reduction programs. It was found that from 1965-1983, total inefficiency caused by these supply control measures created inefficiencies equal to approximately $203 million. This is a very low and therefore, unrealistic estimate considering the size of acreage reduction programs and the feed grain sector during this time period. Clearly, this measurement of inefficiency caused by government production controls applied to the feed grain sector does not strongly support the free market position of abolishing acreage reduction programs. However, this measurement and therefore, this paper, does prove that inefficiencies, although small, do arise from acreage reduction programs implemented by the federal government.

APPENDIX I

To show how much greater PIK's cash benefits were compared to other acreage reduction programs, a hypothical situation will be considered. Suppose a farmer with a corn acreage of 1,000 acres is trying to decide whether to enroll in just the Reduced Acreage Program (RAP) or in both RAP and PIK. His farm program yield is 120 bushels per acre and the paid land diversion payment is $1.50 a bushel. If the target price for corn is $2.86/bu. and the market price per bushel is $3.10, the following comparison can be made:

RAP

Acreage base (ac)	1,000	
Farm program yield (bu/ac)	120	
% of acreage base diverted	20%	
Paid land diversion payment (100 ac x $1.50 x 120 bu/ac)		$ 18,000
Production of remaining acres (800 ac x $3.00 x 120 bu/ac)		$288,000
Total Gross Income		$306,000
Less: Production expenses (800 ac x $1.75 x 120 bu/ac)		(168,000)
Net Farm Income		$138,000

10-30% PIK

Acreage base (ac)	1,000	
Farm program yield (bu/ac)	120	
% of acreage base diverted	50%	
Paid land diversion payment (100 ac x $1.50 x 120 bu/ac)		$ 18,000
Additional 30% diverted (300 ac x .80 x 120 bu/ac)		89,280
Production on remaining acres (500 ac x .80 x 120 bu/ac)		186,000
Total Gross Income		283,280
Less: Production expenses (500 ac x $1.75 x 120 bu/ac)		(105,000)
Net Farm Income		$178,280

100% PIK

Acreage base (ac)	1,000	
Farm program yield (bu/ac)	120	
% of acreage base diverted	100%	
Paid land diversion payment (100 ac x $1.50 x 120 bu/ac)		$ 18,000
Additional 80% diverted (800 ac. x .80 x 120 bu/ac x $3.10)		238,000
Total Gross/Net farm Income		$256,080

Therefore, assuming the maximum whole-bid of 80%, the 100% PIK option would provide the most cash benefits.

ENDNOTES

(1) Geoffrey S. Shepperd, Farm Policy: New Directions (Ames: Iowa State University Press, 1964), p. 9.

(2) This section is based upon material taken from American Farm Policy, 1948-1973 (University of Minnesota Press, 1976) by Willard Cochrane and Mary E. Ryan and Foundations of Farm Policy (University of Nebraska Press, 1970) by Luther Tweeten.

(3) Don Paarlberg, Farm and Food Policy--Issues of thje 1980's (Lincoln: University of Nebraska, 1980), p. 20.

(4) Originally, the basic commodities were defined as cotton, wheat, corn, rice, tobacco, hogs, and milk.

(5) Roy Ewell, Floyd Corty and Gene Sullivan, Economics--Applications to Agriculture and Agribusiness (The Interstate Printers & Publishers, Inc., 1975), p. 16.

(6) Cochrane, p. 32.

(7) Hendrik S. Houthakker, Economic Policy for the Farm Sector (Washington, D.C.: American Enterprise Institute for Public Policy Research, November 1967), p. 25.

(8) The following numbers are taken from Shepperd, p. 9.

(9) With the help of Dr. Robert Leekley, this figure was based upon work done by Luther Tweeten in "Agricultural Policy: A Review of Leglislation, Programs, and Policy," Food and Agricultural Policy (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1977), p. 104.

(10) The following numbers are taken from Jeffrey H. Birnbaum, "U.S. Farm Programs come Under Attack as Their Cost Soars," The Wall Street Journal, November 10, 1983, p. 1.

(11) The ideal of PIK was not new as it was a payment option used in thje Feed Grain Act of 1961. However, what was new, was the size of PIK payments and the extensive crop coverage of the program.

(12) FOR is a program in which farmers may hold wheat or feed grains off thje market for three or more years and have their commodities financed by loans from the CCC. Storage payments are made to these farmers by the CCC. In addition, FOR loans carry a higher loan rate than CCC nonrecourse loans and are applicable for a longer period of time.

(13) United States Department of Agriculture, Initial Assessment of PIK (Washington, D.C., April 1983), p. 6.

(14) Acreage base is determined from historical planting practices and is used to compute the allowable planting and acreage diversion acres.

(15) The following numbers which are not specifically footnoted are taken from Operational Aspects and Market Effects of the 1983 Payment-in-Kind Program (Washington, D.C., February 1984), p. 5. (unpublished material)

(16) Some expenses include the following:

new form printing and distribution	$6.5 million
travel cost and training	2.7 million

(17) Meg Cox and Betsy Morris, "Distribution of PIK Causing Big Headaches for U.S. and Farmers," The Wall Street Journal, October 14, 1983, p. 31.

(18) The following figures were taken from Operational Aspects and Market Effects of the 1983 Payment-in-Kind Program, p. 58.

(19) See Mordecai Ezekiel, "The Cobweb Theorem," The Quarterly Journal of Economics, February 1938, p. 250-275.

(20) Damodar Gujarati, Basic Econometrics (New York: McGraw-Hill, 1978), p. 265.

(21) This figure was taken from Ezekiel, Figure 4, p. 267.

(22) See Table 575, Agricultural Statistics 1983, p. 400.

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2) Birnbaum, Jeffrey H. "U.S. Farm Programs Come Under Attack as Their Cost Soars." The Wall Street Journal, November 10, 1983, p. 1.

3) Cochrane, Williard and Mary E. Ryan. American Farm Policy, 1948-1973. Minneapolis: University of Minnesota Press, 1976.

4) Corty, Floyd L., Ewell P. Ray and Gene D. Sullivan. Economics: Applications to Agriculture and Agribusiness. The Interstate Printers & Publishers, Inc., 1975.

5) Cox, Meg and Betsy Morris. "Distribution of PIK Corn Causing Big Headaches for U.S. and Farmers." The Wall Street Journal, October 14, 1983, p. 31.

6) Economic Research Service, U.S.D.A. An Initial Assessment of the Payment-In-Kind Program. Washington, D.C., April, 1983.

7) Ezekiel, Mordecai. "The Cobweb Theorem." The Quarterly Journal of Economics, February, 1983, p. 250-275.

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13) Ray, Daryll E. and Earl O. Heady. "Government Farm Programs and Commodity Interaction: A Simulation Analysis." The American Journal of Agricultural Economics, November 1972, pp. 578-590.

14) Shepherd, Georffrey S. Farm Policy: New Directions. Ames: Iowa State University Press, 1964.

15) "Special Program of Payment-in-Kind for Acreage Diversion for 1983 Crops of Wheat, Corn, Grain Sorghum, Upland Cotton and Rice." Federal Register, January 12, 1983, pp. 1476-1483; March 4, 1983, pp. 9232-9237.

16)Steadman, Dennis. "Agricultural Analysis: The 1983 Payment-in-Kind Program." Chase Econometrics, June 1983. pp. 20-35.

17) Tweeten, Luther. "Agricultural Policy: A Review of Leglislation, Programs and Policy." Food and Agricultural Policy. American Enterprise Institute for Public Policy Research, 1977.

18)______________. Foundations of Farm Policy. Lincoln: University of Nebraska Press, 1970.

19) U.S.D.A. "Feed Grains: Summary of 1983 Support Program and Related Information." A.S.C.S. Commodity Fact Sheet, June 1983.

20) U.S.D.A. Operational Aspects and Market Effects of the 1983 Payment-in-Kind Program, February 1984. (unpublished data)

21) Wall, Wendy L. "Quality of Grain Coming to Market is Being Questioned." The Wall Street Journal, October 24, 1983, p. 38.

22) Waterloo, Claudia and Wendy L. Wall. "Random Harvest." The Wall Street Journal, August 26, 1983, p. 1.

23) Vogerler, Ingolf. The Myth of the Family Farm: Agribusiness Dominance of U.S. Agriculture. Westview Press, 1981.