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An Examination of Farm Program Payments on Farm Economic Structure

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AN EXAMINATION OF FARM PROGRAM PAYMENTS ON FARM ECONOMIC STRUCTURE

by

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Abstract

System of input demand functions is estimated to examine the impact of farm program payments on farm economic structure. Influence of farm program payments on input resource use for the time periods corresponding to the thirteen farm bills in effect since 1938 is also examined. Empirical application to Nebraska agriculture sector for the period 1936-2004 indicate positive impact of farm program payments on farm real estate, breeding livestock and other inputs. Negative influence of farm program payment on the use of farm equipment, farm labor, farm inputs, chemicals and energy was observed during the same period.

AN EXAMINATION OF FARM PROGRAM PAYMENTS ON FARM ECONOMIC STRUCTURE

Farm commodity programs, once viewed as temporary and supplementary to agricultural earnings, are increasingly viewed as permanent and of major proportion. Existing literature has examined numerous aspects of agricultural policy including whether farm program payments - have enhanced land owner wealth rather than the welfare of producers; have altered the crop mix; or influenced trade distortions. Recent analyses have also examined the impact of different kinds of program payments on specific crop or region. With the 2007 farm bill discussions concluding, farm program payments have become much more important as a farm policy instrument. While the causes of the switch to different kinds of program are still controversial, as are the predicted outcomes, there is strong interest in the potential effects of farm program payments on farm economic structure.

Current research had addressed crop- and input-specific effects of program payments on farm economic structure, including adverse selection, moral hazard, demand, and the potential environmental and trade effects. This line of research is appropriate and relevant due to the current setting of programs that is crop specific. However, there is a need to examine the overall influence of farm program payments on the resource use or output production mix to provide broader policy analyses and implications. Here, the economic effects of farm program payments on farm economic structure is examined with specific analysis on the farm equipment, farm real estate, breeding livestock, farm inputs, chemicals, energy and other input demand functions. Influence of farm program payments on input resource use for the time periods corresponding to the thirteen farm bills in effect since 1938 is also examined. With this analysis an important contribution from a policy perspective is the ability to examine the potential impacts of farm program payments on the use of farm equipment, farm real estate, breeding livestock, farm inputs, chemicals, energy and other inputs. From our (Shaik et al) earlier analyses we know the positive impact of farm program payments on farm real estate, so we expect to see a positive relation between farm program payments and farm real estate demand. Others have examined the moral hazard issue of circumventing and/or lowering the use of chemical (fertilizers and pesticide use) due to the availability of farm program payments. This would also provide the influence of farm program payments on energy use in agriculture sector. Apart from the overall influence of farm program payments on input resource use, we also examine the changes in the influence of farm program payments on input resource use over the thirteen farm bill periods.

A farm bill refers to a multi-year, multi-commodity federal support law for farm products. Some standing authority for these programs is provided by two permanent laws, the Agricultural Adjustment Act of 1938 and the Agricultural Act of 1949. However, Congress usually amends these provisions, reauthorizes or amends provisions of preceding temporary agricultural acts, and/or puts forth new provisions for a limited time into the future during the farm bill authorization process. Table 1 provides the chronology of major farm bills since 1938.

This paper has two-fold contribution to the existing literature - 1) construct the output, input, and farm government payment Fisher quantity and price indexes for Nebraska agriculture sector from 1936-2004, 2) examines the impact of farm program payments on input resource use, and 3) examines the impact of farm program payments by thirteen farm bill periods on input resource use in system of equations. In the next section the econometric Translog system of input demand equations (includes farm equipment, breeding livestock, farm real estate, farm inputs, chemicals, energy and others) including farm program payments and its interaction by farm bill period is presented. For this analysis Nebraska was specifically chosen due to the availability of dis-aggregate output and input quantity and price data apart from the farm program payment data. Construction of Nebraska agriculture sector input, output and farm program payment data for the period, 1936-2004 is detailed in the third section. Empirical application and results are presented in the fourth section followed by conclusions.

Theoretical Overview

In agriculture sector one observes non-allocable input vector, $\underline{X} = (x_1, x_2, \ldots, x_i) \in \Re_+^I$ used in the production of output vector, $\underline{Y} = (y_1, y_2, \ldots, y_j) \in \Re_+^J$ with the support of farm program payments vector, $\underline{Z} = (z_1, z_2, ..., z_k) \in \Re_+^K$ and $\underline{W} = (w_1, w_2, \ldots, w_i) \in \Re_+^I$ representing the input price vector. Using duality cost framework, a firm's or aggregate sector's objective is to minimize cost with input price $(\underline{w})$ vector capable of producing output quantity $(\underline{Y})$ with the support of farm program payments $(\underline{Z})$ provided by the government. To examine the influence of farm program payments on factor use patterns, we treat farm program payment as output in the cost minimization input demand functions. So, the firm's cost function in the absence of farm program payments can be represented as $C(w, Y)$ and $C(w, Y, Z)$ with farm programs.

This study assumes cost minimizing level of producing output supported by farm program payments under Hicks neutral technical change satisfying the properties as defined in Chambers (1988). The translog cost function can be represented as:

$$(1)\quad \ln C = \alpha_0 + \alpha_y Y + \frac{1}{2}\gamma_{y,y}(\ln Y)^2 + \alpha_z Z + \frac{1}{2}\gamma_{z,z}(\ln Z)^2 + \sum_{i=1}^{I}\alpha_i \ln w_i + \frac{1}{2}\sum_{i=1}^{I}\sum_{h=1}^{I}\gamma_{i,h}\ln w_i \ln w_h + \sum_{i=1}^{I}\beta_{i,y}\ln w_i \ln Y + \sum_{i=1}^{I}\beta_{i,z}\ln w_i \ln Z + \varepsilon$$

where C is the cost function, Y is the output quantity index, Z being the governmental support in the form of implicit farm program payments quantity index and w_i being the input price index.

Utilizing the Shephard's lemma, the logarithmic first order conditions of the cost function given output and farm program payment provide the system of input demand functions for Hicks neutral technology:

$$(2)\quad \frac{\partial \ln C}{\partial \ln w_i} = \frac{\partial C}{\partial w_i}\frac{w_i}{C} = \frac{w_i x_i}{C} = CS_i = \alpha_i + \sum_{i=1}^{I}\gamma_{i,h}\ln w_h + \beta_y \ln Y + \beta_z \ln Z + \varepsilon$$

where CS_i are the cost shares of inputs, $\sum_{i=1}^{8}\alpha_i = 1$ and $\gamma_{i,h} = 0$ due homogeneity assumption, and $\gamma_{i,h} = \gamma_{i,h}$ due to symmetry condition.

To examine the influence of farm program payments by the thirteen farm bills, equation (2) can be extended as:

$$(3)\quad \frac{\partial \ln C}{\partial \ln w_i} = \frac{\partial C}{\partial w_i}\frac{w_i}{C} = \frac{w_i x_i}{C} = CS_i = \alpha_i + \sum_{i=1}^{I}\gamma_{i,h}\ln w_h + \beta_y \ln Y + \sum_{j=1}^{13}\beta_{z,j}\left(\ln Z * FB_j\right) + \varepsilon$$

Thus, the factor cost shares are functions of the input prices, output, farm program payments and farm program payments interacted with farm bill dummies corresponding to the thirteen major farm bills since 1938. With this analysis an important contribution from a policy perspective is the ability to examine the potential impacts of farm program payments on the input resource use.

Nebraska Output, Input and Farm Program Payment Data[1]

The input, output and the farm program payment data for Nebraska agriculture span from 1936 to 2004. Aggregate agricultural output, eight categories of inputs and an aggregate farm program payment are computed and aggregated to be used in the estimation of the model. Aggregated output quantity index is constructed from 23 commodities including 10 livestock commodities, 2 food grains and 6 feed crops and 5 oils and vegetable crops. Similarly eight aggregated input quantity indexes are also constructed from 25 variables including 4 farm equipments, 4 farm real estate including building and structures, 4 breeding livestock, 2 types of farm labor and 11 intermediate inputs. The aggregate farm program payment variable is constructed as only aggregate level data is available from 1936-2004.

Outputs

Prices and quantity data were obtained from *Nebraska Agriculture Statistics Historical Record 1866-1954* and *Unpublished Official Estimates sheet*[2] maintained by the Nebraska Department of Agriculture. For later years data was obtained from NASS website. Annual data on crop output is the quantity produced [yield per acre times total harvested acres for each crop] during the crop year. Crop prices received by farmers, as reported in annual *Nebraska Agriculture Statistics* were used in the construction of output quantity index. The three aggregated crop quantity indexes are

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[1] Source of the input and output data is from "**Statistical Appendix of Nebraska Outputs, Inputs and Environmental bads Data for Dissertation"** of Shaik's Dissertation titled "***Environmentally Adjusted Productivity Measures for the Nebraska Agriculture Sector, 1936-1994***".

[2] Would like to thank Nebraska Agriculture Statistical Services for providing me with the data and also discussing the procedure in the estimation of the series.

food grains [rye and wheat], feed crops [barely, corn, hay, oats and sorghum] and vegetable and oilseed crops [soybean, sunflower, dry bean, potatoes and sugar beet]. In 2004 these crops constitute 100% of the crop data published by Nebraska Department of Agriculture for major and minor crops.

Similarly for livestock commodities, the quantity estimates [pounds of meat produced (gained weight)] for cattle and calves, hogs, sheep & lambs, broilers, eggs, turkeys, and chickens and the marketing year average prices per pound reported in annual *Nebraska Agriculture Statistics* were used to construct the livestock quantity indexes. The price and quantity data on milk, honey and wool output obtained from *Unpublished Official Estimates sheet* was used in the construction of output quantity index. For later years data was obtained from NASS website. The three livestock output quantity indexes constructed are meat animal [cattle and calves, hogs, sheep and lambs], poultry [chicken, broiler, eggs and turkey] and other [honey, wool and milk production].

In case of feed grain and feed crops, part of the grains and feed are fed to animals on the farm where it is grown. The question is whether to adjust the output for onfarm use or add the additional cost of onfarm use as an intermediate input. Based on AAEA recommendations included the feed crops consumed on the farm along with purchased feeds as a measure of intermediate input. The gross production of the feed grains is included as output, and if onfarm use were unaccounted for, the result would be double counting of feed-once as crop production and again indirectly in livestock production.

Inputs

In regards to inputs particular emphasis was given in the construction of capital[3], labor and intermediate inputs. To measure farm equipment[4] contribution to agriculture inputs, first we estimated the capital stock based on the annual capital investment expenditures I_t series published by USDA, ERS internet electronic database. Nebraska share of investments is obtained by multiplying the Nebraska/US ratio of inventory of capital machinery by US investments for each of the four assets. To obtain an implicit quantity index of capital goods purchased $I_t^{'}$, I_t was divided by the individual producer price index[5] for various capital goods. This $I_t^{'}$ gives a time series of the quantity of capital goods purchased, expressed in terms of the cost that would have been incurred under 2000 prices for the capital goods. The perpetual inventory method was used to estimate the level of "capital stock" for four assets, based on a straight-line depreciation pattern. Capital stock is calculated as the weighted (relative efficiency) sum of the past investments.

(4) $$K_t = \sum_{\tau=0}^{\infty} S(\tau)\, I_{t-\tau}$$

where $S(\tau)$ is the efficiency function, I is the expenditures and τ is the age of the capital.

The efficiency function is assumed to be a function of mean service life (age) in straight line depreciation pattern[6] (1 over mean service life). The mean service life

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[3] Consists of Farm equipment, Farm real estate and Breeding livestock.
[4] Consists of Autos, Trucks, Tractors & Agricultural Machinery except tractors.
[5] USDA and Bureau of Labor Statistics publishes producer price index (PPI) annual for different components of capital equipment with base year T=2000 which is comparable to price index paid by the farmers.
[6] Alternative depreciation patterns are also examined, but it did affect the results in the system of input demand functions.

(L), are the Bureau of Economics Analysis [BEA] estimates obtained from *Fixed Reproducible Tangible Wealth in the United States* (1993).

The "rental value" or "user cost" of capital is based on the neoclassical principle that inputs should be aggregated using weights that reflect their marginal products which is estimated in terms of rental value. The rental value is calculated as:

(5) $$RV_t = K_t\left(r + \delta\right)$$

where RV is the rental value, K_t is the capital stock, r is the real interest rate and δ is the depreciation.

The straight-line deprecation value is estimated for the different class of asset as one over 0.98 times life service of 9, 10, 9 and 14 for trucks, autos, tractor and agricultural machinery excluding tractors respectively. Rental value is used to calculate shares to form a farm equipment quantity index.

In the case of farm real estate[7] we disaggregate into three types of land (non-irrigated cropland, irrigated cropland and pasture land) apart from building and structures to be used in constructing of farm real estate quantity index. The cash rents[8] for the three categories are available from 1971 onwards, but for data prior to 1971 cash rents were available only for pastures and cropland. So farm cropland cash rent was used to extrapolate backwards for irrigated and non-irrigated land. Here idle cropland is excluded from the number of acres nonirrigated cropland, since from the perspective of agriculture productivity we need to account only for that land used in agriculture. The annual series was constructed by interpolating between the census

[7] Consist of three types of land, i.e., Irrigated, Non-irrigated and Pastures apart from farm structures.
[8] I would like to thank Dr. Charles Barnard and Dr. John Jones from USDA for kindly providing unpublished data on the historical cash rents.

years. In the case of nonirrigated cropland the interpolation between the census years was based on the regional data published in USDA, ECIFS (1990). The period covered by this report is from 1947-90 and for more current data, AREI, ERS and NASS updates are used. By disaggregating land, we hope to adjust for the changes in the quantity and quality of land in agriculture. Cash rents are used to calculate shares to form a quantity land index. In the case of building and structures the current value of building is published by Jones and Canning (1993). With the recent data provided by computer file update on USDA, ERS internet database. Data prior to 1950 was obtained from *Nebraska Agriculture Statistics Historical Record 1866-1954*. This is used as a measure of capital stock and rental value is calculated following the same procedure as farm equipment with a 35 year life. The rental value is calculated to form a farm real estate quantity index.

In the case of breeding livestock[9], the number of breeding livestock on 1st January was used as the measure of capital stock. The rental value was estimated following the procedure described in the estimation of farm equipment, except that no depreciation rate[10] was used leading to the formation of breeding livestock quantity index.

Data for intermediate inputs[11] categorized into eleven components are drawn from the total production expenditures published in USDA's *Economic Indicators of the Farm Sector* annually from 1949 onwards. For data prior to 1949 we have

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[9] Breeding livestock consist of Cattle, Hogs, Sheep & lamb, Horses and Mules.

[10] The value of the heifer entering the breeding stock is approximately the same as that of the cull cow sent for slaughter at the end of the life period, so depreciation is assumed zero since the farmer has neither gained nor lost.

[11] Intermediate inputs consist of farm inputs - Feed, Livestock & poultry purchases, Seed; Chemicals - Fertilizer & lime, Pesticide; Energy -Fuel & oil, Electricity; and Others - repairs & maintenance, other miscellaneous, interest and Taxes.

extrapolated backwards using the rate of change of the individual variables at the US level to get an estimate for Nebraska.

In the case of feed expenditures, there are two class of feed, purchased commercial feeds, and onfarm[12] use of feed grains. The cost of onfarm use, computed as the price of feed grain times amount fed to the animals on the farm, is available prior to 1970. For the years later than 1970, the average ratio of onfarm use to production was applied to production to come up with the extrapolation of onfarm use. This cost of onfarm use of feed grains was summed up with purchased commercial feed as total intermediate feed expenditures. The price indexes for individual input categories published by USDA are used to form implicit quantity measures[13], share weighted by the expenditure shares to get aggregate quantity indexes.

To account for quantity changes in agriculture labor's contribution to agriculture production, data was compiled on hours worked for hired labor (HL) and unpaid and family labor (UFL). USDA publishes annual data for hours worked and wage rate for hired labor in *Farm Employment and Wage Rates* (1991). Data on hours worked per week was generated by dividing the average monthly wages by wage rate published in *Farm Labor* for 1935-74. For 1974-1980 a simple average of the Nebraska quarterly data on hours worked published in *Farm Labor* is used. This hrs/week was multiplied by 52 to get the annual hours worked for both the categories.

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[12] Another way of estimating is by regressing onfarm use on beef cattle, hog and chicken produced in pounds for the period 1950 to 1970 and predicting the onfarm use for 1971-94 based on the regression estimate, but none of the variables in the regression were significant, so I was forced to use the ratio method to compute the onfarm use.

[13] $d \ln QI = d \ln E - d \ln PI$

Implicit quantity index = logarithmic changes in Expenditures - logarithmic changes in Price Index

Quantity index = Expenditure Share * d ln QI

From 1981-2004, the rate of change in the regional data was used to extrapolate the Nebraska annual series.

Farm program payment implicit quantity index was computed as the logarithmic changes in total farm program payments minus the logarithmic changes in program crop price index. The source of farm program payment data from 1930 to 1949 was obtained from various issues of ***Agricultural Statistics*** and the date from 1949-2004 are available at http://www.ers.usda.gov/Data/farmincome/finfidmu.htm.

Finally Nebraska agriculture sector's aggregate output quantity Fisher index, aggregate farm program payment implicit quantity Fisher index, and eight input price and implicit price indices are computed for the period 1936-2004. Table 2 presents the annual rate of growth by the thirteen farm bill periods and for the overall period, 1936-2004. The farmers in Nebraska increased crop and livestock production with rate of growth of 2.7 percent for the sample period, 1936-2004. During the same period the annual rate of growth in the farm program payments was close to 4 percent. Nebraskans faced higher annual growth rate in input price for all the eight inputs. For the period 1936 to 2004 the annual growth rate of farm labor, farm real estate, breeding livestock and farm input prices was more then 4 percent. Price of farm equipment and energy increased at 3.7 percent annual growth rate for the same period. Annual growth rate of chemical prices had the least increase among the set of inputs.

Empirical Application and Results

To examine the potential effects of farm program payments on farm economic structure the system of input demand equations defined in equation (2 and 3) are estimated using Nebraska agriculture data for the period, 1936-2004. The nonlinear estimates along with probabilities from the share equations of the Translog cost function imposing homogeneity and symmetry in system of input demand equations are presented in Table 3. Results of the system of input demand equations with farm program payments interacted with thirteen farm bill periods are presented in Table 4.

Under the null hypothesis, with degrees of freedom equal to number of restrictions, Hick neutral technical change is tested using the likelihood ratio test statistic[14]. The null hypothesis is examined by estimating system of input demand equations for an unrestricted (with technology, t included) and restricted model (without technology, t). With the likelihood ratio test we are unable to reject the Hicks neutral technical change at a 5% level of significance. The necessary and sufficient conditions for monotonicity are not violated.

The estimates from the system of variable input demand presented in Table 3 indicate farm program payments had positive and significant impact on the use of farm real estate and breeding livestock for the period, 1936-2004. Negative and significant impact of farm program payments on the use farm equipment and farm inputs was indicated during the same period. Farm program payment had a negative but insignificant affect on farm labor, chemical (fertilizer and pesticide) and energy use. The other input was positive but insignificantly affected by farm program payments.

Results of the influence of farm program payments by thirteen farm bills on input resource use are presented in Table 4. The influence of farm program payments on the use of farm real estate was positive and significant for all the thirteen farm bill periods with the exception of the first three farm bill periods. Further the influence

[14] The likelihood ratio test statistic is –2 [restricted model – (–unrestricted model)] and is chi-squared, with the degrees of freedom equal to the number of restrictions imposed.

increased from the fourth farm bill period onwards to the current farm bill period. A similar increasing and significant influence of farm program payments on the use of breeding livestock was indicated from the sixth farm bill period to the current farm bill period, 2002-2004. Farm program payments had a negative influence on the use of farm equipment with the exception of the second and third farm bill period. While farm program payment was significant during the recent three farm bill periods. The lower use of farm labor in agriculture was also supported by the farm program payments for all the thirteen farm bill periods. The influence was significant and significant from the fifth farm bill period onwards to the current farm bill period. Farm program payment had reduced the use of chemicals (fertilizer and pesticide) only during the first two farm bill periods, but was positive and insignificant third farm bill period onwards. At the aggregate level this result suggests the absence of moral hazard i.e., producer do not lower the use of chemicals due to the presence of farm program payments. The remaining variables including energy use and other input use was negative but insignificant.

Overall the empirical state level analysis of Nebraska agriculture sector indicates potential impacts of farm program payments on the farm economic structure. This is based on the estimation of input demand functions accounting for farm program payments variable. A more through investigation of the model as well as estimation procedure would provide clear and robust impacts due to farm program payment on factor use. Further simultaneous estimation of system of input demand and output supply equations along with the profit function would provide the detailed impact analysis of the potential impacts of farm program payment on the factor use as well as shifts in the crop production mix.

Conclusions

This paper examines the potential impacts of farm program payments on Nebraska agriculture sector based on the system of input demand equations using a cost function for the time period 1936-2004. The likelihood ratio tests fail to accept the non-Hick-neutral technical change. So under Hicks-neutral technical change, the overall impacts of farm program payment on agriculture sector based on the system of input demand equations indicate positive (negative) and significant sign on the farm real estate, breeding livestock and other inputs (farm equipment, farm labor, farm inputs, chemicals and energy) for the period 1936-2004. Similar sign on the input resource use was indicated with the exception of chemical use over the thirteen farm bill periods. However, there is increasing and decreasing influence of farm program payments over the farm bill period for the positive and negative sign on the variables respectively.

Further research needs to be explored on the consistency of estimate by testing for unit root/cointegration and accounting for unit roots if any; examine the impact of farm program payment based on the system of input demand and output supply equations.

References

Chambers, R.G. "Insurability and Moral Hazard in Agricultural Insurance Markets." *American Journal of Agricultural Economics*. 71(1989): 604-16.

Nebraska Department of Agriculture., and United States Department of Agriculture, NASS. "*Nebraska Agricultural Statistics,*" Annual Report. Nebraska Crop and Livestock Reporting Service, Nebraska.

Nebraska Department of Agriculture and Inspection., and United States Department of Agriculture. "*Nebraska Agriculture Statistics: Historical Record, 1866-1954,*" State-Federal Division of Agricultural Statistics, Nebraska 1956.

Shaik, S. "*Environmentally Adjusted Productivity [EAP] Measures for Nebraska Agriculture Sector" Dissertation*, Dept. of Agriculture Economics, University of Nebraska-Lincoln, May 1998.

Shaik, S, G. A. Helmers, and J.A.Atwood. "Government Payments and Agricultural Land Values." Mississippi State University Department of Agricultural Economics Staff Report 2005-02, February 2005.

Shaik, S, J.A.Atwood and G. A. Helmers. "The Evolution of Farm Programs and their Contribution to Agricultural Land Values" *American Journal of Agricultural Economics*, 87 (2005): 1190-1197.

U.S. Crop Reporting Board. *Commercial Fertilizers: Annual Summary*, Dept. of Agriculture, Economics, Statistics, and Cooperative Service.

U.S. Department of Agriculture. *Agricultural Statistics* Annual, Washington, D.C. Department of Agriculture, U.S. Govt. Print. Office.

U.S. Department of Agriculture, National Agricultural Statistical Service. "*Farm Employment and Wages, 1910-1990*." Statistical Bulletin N0. 822, March 1991.

U.S. Department of Agriculture. Crop Reporting Board, Statistical Service. "*Farm Labor*." Annual reports.

U.S. Department of Agriculture, National Agricultural Statistical Service. "*Agricultural Chemical Usage, Field Crop Summary*." Annual reports, 1991-1994.

U.S. Department of Agriculture. "*Economic Indicators of the Farm Sector, National Financial Summary*." Economic Research Service, ECIFS 4-3 , 1989.

U.S. Department of Agriculture. "*Economic Indicators of the Farm Sector, Production and Efficiency Statistics.*" Economic Research Service, ECIFS 10-3, 1990.(May 1992).

U.S. Department of Commerce. "*Fixed Reproducible Tangible Wealth in the United States, 1925–89.*" Washington DC: U.S. Government Printing Office, 1993.

Table 1. Thirteen Major Farm Bill periods, 1940-2004

Farm Bill (Period)	Act
FB 1 (1938 - 1947)	Agricultural Adjustment Act of 1938 (P.L. 75-430)
FB 2 (1948 - 1953)	Agricultural Act of 1949 (P.L. 81-439)
FB 3 (1954 - 1955)	Agricultural Act of 1954 (P.L. 83-690)
FB 4 (1956 - 1964)	Agricultural Act of 1956 (P.L. 84-540)
FB 5 (1965 - 1969)	Food and Agricultural Act of 1965 (P.L. 89-321)
FB 6 (1970 - 1972)	Agricultural Act of 1970 (P.L. 91-524)
FB 7 (1973 - 1976)	Agriculture and Consumer Protection Act of 1973 (P.L. 93-86)
FB 8 (1977 - 1980)	Food and Agriculture Act of 1977 (P.L. 95-113)
FB 9 (1981 - 1984)	Agriculture and Food Act of 1981 (P.L. 97-98)
FB 10 (1985 - 1989)	Food Security Act of 1985 (P.L. 99-198)
FB 11 (1990 - 1995)	Food, Agriculture, Conservation, and Trade Act of 1990 (P.L. 101-
FB 12 (1996 - 2002)	Federal Agriculture Improvement and Reform Act of 1996 (P.L. 104-
FB 13 (2002 - 2004)	Farm Security and Rural Investment Act of 2002 (P. L. 107-171)

Table 2. Average Rate of Growth in the Input, Output and Farm Program Payment by Farm Bill Periods

	Quantity Indices		Price Indices							
Farm Bill Periods	**Output**	**Farm Program payment**	**Farm equipment**	**Breeding livestock**	**Farm real estate**	**Farm labor**	**Farm inputs**	**Chemicals**	**Energy**	**Others**
1936 - 1947	4.440	-8.239	2.928	6.322	3.390	11.248	7.727	2.823	2.875	2.998
1948 - 1953	0.671	-2.430	3.075	-1.387	4.129	1.712	-3.518	1.272	0.536	3.421
1954 - 1955	-3.854	-4.232	0.896	0.500	1.696	0.976	1.630	-0.938	0.591	0.262
1956 - 1964	6.489	18.341	2.172	5.123	3.676	1.806	1.603	-0.066	0.445	0.818
1965 - 1969	4.298	2.542	2.727	6.399	7.430	5.361	3.488	-2.553	0.651	1.776
1970 - 1972	4.512	-3.109	2.784	5.621	3.872	3.412	1.942	2.155	1.373	2.021
1973 - 1976	-1.421	-28.079	9.267	-7.174	15.561	5.249	0.553	15.598	12.867	8.665
1977 - 1980	0.820	-12.771	6.872	23.286	7.468	6.487	10.561	5.586	15.232	7.754
1981 - 1984	-0.891	52.453	3.895	-2.999	-4.632	2.957	-0.449	1.024	-0.190	-0.513
1985 - 1989	-0.479	-1.942	1.464	7.159	1.943	3.045	6.214	0.312	-1.649	1.209
1990 - 1995	0.677	-7.695	2.516	0.265	-4.889	3.117	-3.364	3.580	-0.781	2.127
1996 - 2002	1.774	29.285	0.301	5.725	12.424	3.885	4.665	-0.165	2.126	1.986
2002 - 2004	5.324	14.196	2.922	8.547	2.738	1.222	6.367	5.245	9.692	1.686
1936 - 2004	**2.703**	**3.926**	**3.757**	**4.256**	**4.295**	**5.325**	**4.016**	**2.389**	**3.695**	**2.975**

Table 3. Results from the System of Input Demand Functions, 1936-2004

Variables		Farm equipment	Breeding livestock	Farm real estate	Farm labor	Farm inputs	Chemicals	Energy	**Others**
Intercept	Coefficient	**-3.9386**	1.0714	0.2043	1.0132	**-3.4364**	**-16.3551**	**-3.2529**	**25.6940**
	Prob > |t|	0.00	0.11	0.54	0.06	0.00	0.00	0.00	
Farm equipment	Coefficient	**-0.2930**	**0.2795**	**0.2093**	**-0.7831**	**-0.1365**	**-0.6600**	-0.1100	**1.4938**
	Prob > |t|	0.06	0.02	0.00	0.00	0.05	0.03	0.23	
Breeding livestock	Coefficient	**0.2795**	0.2695	-0.0334	0.0971	0.0337	0.1373	-0.0175	**-0.7662**
	Prob > |t|		0.10	0.61	0.21	0.60	0.67	0.83	
Farm real estate	Coefficient	**0.2093**	**-0.0334**	**0.2925**	**-0.0956**	**-0.1715**	**0.3805**	**0.1264**	**-0.7084**
	Prob > |t|			0.00	0.08	0.00	0.03	0.01	
Farm labor	Coefficient	**-0.7831**	**0.0971**	**-0.0956**	**0.8109**	**-0.3558**	0.2157	**-0.3474**	**0.4581**
	Prob > |t|				0.00	0.00	0.27	0.00	
Farm inputs	Coefficient	**-0.1365**	**0.0337**	**-0.1715**	**-0.3558**	0.3505	-0.2455	**-0.2403**	**0.7653**
	Prob > |t|					0.00	0.11	0.00	
Chemicals	Coefficient	**-0.6600**	**0.1373**	**0.3805**	**0.2157**	**-0.2455**	-1.4076	-0.0290	**1.6085**
	Prob > |t|						0.14	0.89	
Energy	Coefficient	**-0.1100**	**-0.0175**	**0.1264**	**-0.3474**	**-0.2403**	**-0.0290**	**1.1999**	**-0.5820**
	Prob > |t|							0.00	
Others	Coefficient	**1.4938**	**-0.7662**	**-0.7084**	**0.4581**	**0.7653**	**-0.5820**	**-0.5820**	**-0.0785**
	Prob > |t|								
Output	Coefficient	**0.3018**	**-1.2454**	**-0.3616**	**-0.5769**	**0.5316**	**2.1284**	0.0798	0.1423
	Prob > |t|	0.03	0.00	0.00	0.00	0.00	0.00	0.42	
Farm program	Coefficient	**-0.0764**	**0.1148**	**0.0722**	-0.0093	**-0.0428**	-0.0377	-0.0374	1.0166
	Prob > |t|	0.03	0.00	0.00	0.61	0.00	0.69	0.08	

Note: Values with bold font indicate significant at 0.05 % level of significances.

Table 4. Results from the System of Input Demand Functions by Farm Bill Periods, 1936-2004

EQUATIONS	Farm equipment	Breeding livestock	Farm real estate	Farm labor	Farm inputs	Chemicals	Energy	Others
Intercept	**-3.3678**	0.9695	**1.5783**	**-0.8699**	**-4.1274**	**-9.6020**	**-2.7422**	**19.1614**
Farm equipment	0.0242	**-0.2793**	**0.1336**	**-0.6386**	0.0260	-0.3401	-0.0299	**1.1041**
Breeding livestock	**-0.2793**	**0.9058**	0.0702	**-0.1729**	-0.0030	0.0555	**-0.3562**	**-0.2201**
Farm real estate	**0.1336**	**0.0702**	**0.3047**	-0.0216	**-0.2224**	**0.3561**	0.1194	**-0.7400**
Farm labor	**-0.6386**	**-0.1729**	**-0.0216**	**0.3579**	**-0.1877**	-0.0636	**-0.2895**	**1.0160**
Farm inputs	**0.0260**	**-0.0030**	**-0.2224**	**-0.1877**	**0.3033**	-0.2108	0.0040	**0.2907**
Chemicals	**-0.3401**	**0.0555**	**0.3561**	**-0.0636**	**-0.2108**	-0.1326	-0.0805	**0.4160**
Energy	**-0.0299**	**-0.3562**	**0.1194**	**-0.2895**	**0.0040**	**-0.0805**	**0.8136**	**-0.1809**
Others	**1.1041**	**-0.2201**	**-0.7400**	**1.0160**	**0.2907**	**-0.1809**	**-0.1809**	**-1.0891**
Output	**0.1829**	**-1.1908**	**-0.6220**	-0.1312	-0.0636	**0.0008**	-0.0252	1.1218
FB1*FPP	**-0.1495**	**0.1553**	0.0426	**-0.0571**	0.0164	**-0.4481**	**-0.0833**	0.5238
FB2*FPP	0.0019	0.0155	0.0290	-0.0179	0.0088	**-0.3836**	0.0012	0.3450
FB3*FPP	0.0109	0.0387	0.0836	-0.0491	-0.0328	0.0388	-0.0223	-0.0677
FB4*FPP	-0.0077	0.0363	**0.0730**	-0.0241	-0.0339	0.0344	-0.0163	-0.0617
FB5*FPP	-0.0117	0.0599	**0.0829**	**-0.0567**	**-0.0320**	0.0605	-0.0302	-0.0728
FB6*FPP	-0.0111	**0.0696**	**0.0815**	**-0.0613**	-0.0291	0.0546	-0.0429	-0.0613
FB7*FPP	-0.0463	0.0715	**0.0884**	**-0.1101**	-0.0225	0.1044	**-0.0696**	-0.0159
FB8*FPP	-0.0392	**0.0814**	**0.0885**	**-0.0970**	-0.0395	0.0486	-0.0104	-0.0325
FB9*FPP	-0.0382	**0.1098**	**0.0870**	**-0.1058**	**-0.0501**	0.0386	-0.0071	-0.0343
FB10*FPP	-0.0442	**0.1031**	**0.0789**	**-0.0732**	**-0.0537**	0.0437	-0.0109	-0.0436
FB11*FPP	**-0.0631**	**0.1382**	**0.0960**	**-0.0802**	**-0.0607**	0.0420	-0.0187	-0.0536
FB12*FPP	**-0.0678**	**0.1510**	**0.0951**	**-0.0636**	**-0.0713**	0.0370	-0.0110	-0.0694
FB13*FPP	**-0.0583**	**0.1572**	**0.0923**	**-0.0698**	**-0.0642**	0.0272	-0.0114	-0.0730

Note: Values with bold font indicate significant at 0.05 % level of significances.