FARM PROGAM PAYMENTS AND FARM SIZE

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Abstract

A simultaneously determined model for farm size and government payments along with the incorporation of a recursive impact of government payments and agricultural returns was used to examine farm size changes nationally and regionally. The results clearly demonstrated resource substitution influences, differences in the nonfarm economy, and agricultural returns in explaining farm size.

Key Words: Farm Size, Farm Programs, Capital-Labor Substitution, Nonfarm Impacts

FARM PROGAM PAYMENTS AND FARM SIZE

The issue of farm size is of major and continuing interest to farm producers, those living in rural areas, and the public in general. Concern over changes in the structure of agriculture is widely expressed and many advocate policies directed to small farms. Generally the policies recommended suggest that increased value added in agriculture along with greater commodity program payments (except to large farms) would reduce farm consolidation.

However, some question this view suggesting that higher returns in agriculture whether achieved from farm profits or government payments increases rather than decreases farm consolidation and reduces the number of farms. Some support a middle course with strengthened payment limitations under continued support to agriculture. From a policy perspective the influence of government payments on farm size is increasingly scrutinized because commodity programs are publicly determined. The nature of the role of agricultural commodity payments to the structure of agriculture, therefore, is of major importance. An interesting facet is the opposite one of how, in contrast, does the structure of agriculture in terms of farm size affect public support for government expenditures to agriculture? Does a farm structure of large farms strengthen, weaken, or have no impact on public support for agricultural support payments? These two issues related to the relation of government supports and farm size is increasingly questioned as the U.S. economy has changed and relatively fewer persons are directly connected to agriculture.

Questions also arise whether current commodity programs affect the structure of farms to the same degree as the past. Presuming an impact of agricultural programs on farm size changes, what have been the relative impacts of current and previous farm bills in this regard?

The economic understanding of farm size changes has traditionally used a long run average cost function framework. In this framework farm size expands when there is opportunity to gain efficiencies from size. Research into the long run average cost of agriculture has, however, generally shown major cost disadvantages of small farms but little cost advantage beyond moderate sized units. Yet, small farms have continued as a significant proportion of the U.S. farm structure, in spite of their perceived inefficiency. Also, farm size changes have been anything but uniform by region, state, and substate aggregates. Kislev and Peterson approached farm size structural issues from the perspective that the price ratio of capital and labor was the major determining factor of farm structure. Thus, as the price of capital decreases relative to labor, capital is substituted for labor and farm size increases. Capital prices in the U.S. economy have declined significantly in real terms. Hence, under technological advances, capital substitution in agriculture has become commonplace. This has enabled farm operators to control more assets replacing labor intensive tasks.

Another factor affecting the farm size structure which has become increasingly obvious is the availability of nonfarm employment opportunities. Where part and full time nonfarm employment opportunities are growing, a small farm structure tends to be stronger than where nonfarm employment opportunities are weak. As a result, where there is few nonfarm employment opportunities, farm producers are forced to expand farm operations to earn comparable earnings. This perspective of the opportunity cost of farm labor stresses the reduced pressure for farm earnings if other family earning potential is high. This is increasingly important in two-spousal working families. In such cases being involved in a small farm may appeal to the family and be "affordable" while fewer families have this opportunity in more rural settings. This perspective is not unrelated to the contention that one reason farm sizes grow is not only because of efficiency reasons but to simply achieve higher incomes.

Agricultural commodity payments are strongly counter cyclical to agricultural crop receipts. Yet both are expected to influence farm size in the same direction. The statistical estimation of both agricultural crop receipts and government payments to farm size have opposite signs when estimated using actual return data. Mixed sign impacts of thee two variables on farm size is not theoretically acceptable. However, an improved estimation structure is where both return variables, when used as explanatory variables, are placed in expectational form. This is done here by 1) the use of lagged observations and 2) the incorporation of the counter cyclical relationship between expected crop receipts to expected government payments and using both return variables in explaining farm size. This procedure enables the true impacts of both return components to be estimated in a consistent manner.

The factors influencing farm size, therefore, include expected government payments. Yet, a simultaneous relationship may exist between government payments and farm size such that farm size changes may also impact government payments. This political-economic relationship may result in a positive impact (increased farm size causing greater government payments) or a negative impact. In the latter case greater political influence of a structure of small farms is expected.

The impact of explanatory variables on government payments would not be expected to be the same across time particularly as farm bills change. Hence, the separation of the impacts of farm bills from other variables impacting government payments is important. These impacts can be approximated through the use of dummy variables corresponding to different time periods for different farm bills. Using this approach, however, may also involve unexplained economic phenomena unique to each time period beyond farm bill impacts.

The forces affecting farm size changes are expected to vary widely across regions in the U.S. In some regions the nonfarm economy is relatively strong while weak in others. In some regions the influence of agriculture in the region's economy is relatively weak and other influences may be more instrumental in influencing farm size changes. Last, government payments vary widely among types of agriculture. For some regions unsupported crops as well as livestock may dominate the agricultural economy. The heterogeneity of regional economies and types of agriculture suggest that regional differences in economic impacts of the nonfarm economy, resource substitution, and government programs may be important to the understanding of farm size changes.

Kislev and Peterson develop a different perspective with respect to increases in farm size. They contend that much of agriculture can be characterized as scale and size neutral. Further they hypothesize that increasing labor opportunity costs have resulted in substantial capital/labor substitution over time. Using time series data, they show that a large proportion of the increase in farm size can be explained as a result of increased real labor costs. Similar analysis at the county level (Atwood, Shaik and Helmers, 1995; Atwood, Helmers and Shaik, 1999; Shaik, Helmers and Atwood, 1999) and state level (Atwood, Helmers and Shaik, 2002) indicated the strong inverse and direct relationship of nonfarm employment and price ratio respectively with farm size.

In a previous analysis (Atwood, Helmers and Shaik, 2002) a panel analysis was directed to factors affecting farm size changes. It provides an analysis of farm size changes using only time, price of capital, and nonfarm employment in a single equation model. However, agricultural returns and government payments received only limited attention in that analysis. Further the analysis did not address a) counter-cyclic nature of government payments and agricultural returns and b) simultaneous impact of government payments and farm size, and vice versa. Here we propose to extend the Kislev-Peterson results accounting for the counter-cyclic relationship and simultaneous impact.

In the next section, a brief discussion of the economic forces impacting farm size including opportunity cost of operating labor and structural forces are presented. The simultaneous equation econometric model of farm size and government payments is presented in the model section. Results of the empirical application to U.S. state-level data with the 48 contiguous states forming the cross-sectional units and the period 1940 to 2002 forming the time series are presented next followed by conclusions.

Objective

The objective of this analysis is to a) quantify the impact of government agricultural support on farm size extending the Kislev and Peterson capital to labor price ratio hypothesis, and b) examine the impact of farm size on government payments.

Economic Forces Impacting Farm Size

Opportunity Cost of Operator Labor

In this analysis the behavioral force of labor opportunity cost in agriculture is stressed. Traditionally opportunity cost of labor is discussed in terms of labor qualities including factors such as education, training, mobility, etc. While not inconsistent with that emphasis, the perspective of labor opportunity cost in this paper stresses the relation between family earnings required in agriculture to achieve a degree of comparability to family earnings in the nonfarm economy.

Where nonfarm employment opportunities are high, less pressure is observed in the expansion of farm operations. This is because farm operators and spouses have more opportunities for part time or full time nonfarm employment. Conversely, with limited nonfarm job opportunities farm operators must secure a greater proportion of family earnings from agriculture. This "target" perspective of how the reliance on agricultural returns (including government payments) is related to outside earnings must be considered as an alternative in viewing farm size changes. Otherwise what is perceived as a strong farm size growth response to low agricultural returns may be assessed as theoretically negative behavior when, in fact, such a response may be entirely consistent with the above described opportunity cost framework.

Structural Forces

A number of forces are hypothesized to impact farm size in agriculture. These can be viewed as comparative static model changes which are set in motion and reach new equilibria in labor and capital markets.

Production function changes resulting from changes in input dependence impacts labor and capital demand functions. Generally, agriculture has become more capital intensive caused, in part, by such changes. Next, a change in relative prices of labor and capital leads to resource substitution changes affecting the demands for labor and capital inputs. The external technological change in the supply function of capital is a contributing force which has led to a greater use of capital in agriculture. It has been the major driving force leading to relatively lower capital prices thereby engaging the above resource substitution process. The growth of the nonfarm employment economy is another factor. It shifts the supply function of labor in agriculture. Most easily viewed in cross section, when sufficient nonfarm job opportunities are available the supply function of labor shifts to the right relative to the case where few employment opportunities occur. In some cases nonfarm employment opportunities may be so strong that a "pull" force on agricultural labor is engaged moving the labor supply function to the left. Finally, the relative earnings of agriculture relative to nonagriculture may be important. Where returns in agriculture are relatively high the derived demand for labor is shifted right and the opposite occurs where agricultural returns are relatively low.

Across time a mix of the above forces has likely impacted labor and capital in agriculture. Variables representing the above forces are analyzed here and quantified in an effort to better understand the strength of the above-described forces. Obviously, the setting of the type of agriculture, the strength of the nonfarm economy, etc. varies by region in the U.S. Thus, it is expected that the analysis of regional impacts would not result in uniform impacts among regions.

Simultaneous Equation Model of Farm Size and Government Payments

The simultaneous equation model was used to examine the factors affecting of farm size and government payments using data from the contiguous 48 states in the U.S. for the period 1940 to 2002. The simultaneous equation econometric model can be represented as:

$$(1)\qquad \begin{aligned} FS_{i,t} &= \alpha_1 + \beta_{1,C}\, c_{i,t} + \alpha_g\, g_{i,t} + \beta_{1,nf}\, nf_{i,t} + \beta_{1,Hrf}\, Hrf1_{i,t} + \varepsilon_{1,i,t} \\ g_{i,t} &= \alpha_2 + \beta_{2,C}\, c_{i,t} + \alpha_{FS}\, FS_{i,t} + \beta_{2,Hrf2}\, Hrf2_{i,t} + \sum_{j=2}^{12} \beta_{2,j}\, FB_j + \varepsilon_{2,i,t} \end{aligned}$$

where FS , is the farm size in acres; c is the expected agricultural returns per acre; g is the expected farm program payments per acre; nf is the nonfarm employment per acre; $herf2$ is the Herfindahl index of farm program crop acreage; $herf1$ is the Herfindahl index of crop and livestock revenue; and FB_j are the farm bill dummy variables with j=1, …, 12 major farm bills introduced since 1940.

To be consistent with the agricultural land value per acre dependent variable, all the variables are standardized to a per acre basis using acres in farms. For details on the sources of the data and construction of expected farm receipts, government payments, farm size, nonfarm employment, herfindahl index used in the analysis see Shaik, Helmers and Atwood, 2005. For the construction of capital stock, rental price of capital and labor price see Shaik, 1999.

Table 1 provides the summary statistics of the variables used in the analysis by U.S. production regions. Average farm size ranged from 108 acres per farm for Appalachia region to as high as 1631 acres per farm for Mountain region with an overall U.S. average of 409 acres per farm. Mountain region realized the least expected government payments of $2.68 per acre compared to $13.04 per acre realized by Delta region. The farm receipt is $26.99 per acre for Mountain region compared to a high of $225.64 per acre in Northeast. Nonfarm employment per acre of 0.0094 and 0.5647 was lowest and highest in Northern plains and Northeast respectively. Crop-livestock revenue herfindahl index was almost equal across all the U.S. production regions. Southeast and Northeast with program crop acreage herfindahl index of 0.2528 and 0.4960 realized the lowest and highest index respectively. This indicates more program crops are raised in Southeast compared to Northeast. Southern plains region and Northeast region with 53.93 and 249.88 million dollars per acre are the lowest and highest use of capital stock respectively. The rental price in million dollars and capital to labor price ratio was highest in Corn belt and lowest in Northeast region.

Four variants of the simultaneous equation model described in equation (1) were examined for the U.S. and ten production regions. Each of the four models had identical functions for expected government payments equation as defined in equation (1).

Four variants of the farm size equation specified in equation (1) used in the analysis of U.S. and ten production regions can be represented by the four models as:

$$Model\ 1 \quad \begin{aligned} FS_{i,t} &= \alpha_1 + \beta_{1,c}\, c_{i,t} + \alpha_g\, g_{i,t} + \beta_{1,nf}\, nf_{i,t} + \beta_{1,Hrf}\, Hrf1_{i,t} + \beta_{1,CS}\, CS_{i,t} + \beta_{1,PCPL}\, PCPL_{i,t} + \varepsilon_{1,i,t} \\ g_{i,t} &= \alpha_2 + \beta_{2,c}\, c_{i,t} + \alpha_{FS}\, FS_{i,t} + \beta_{2,Hrf2}\, Hrf2_{i,t} + \sum_{j=2}^{12} \beta_{2,j}\, FB_j + \varepsilon_{2,i,t} \end{aligned}$$

$$Model\ 2 \quad \begin{aligned} FS_{i,t} &= \alpha_1 + \beta_{1,c}\, c_{i,t} + \alpha_g\, g_{i,t} + \beta_{1,nf}\, nf_{i,t} + \beta_{1,Hrf}\, Hrf1_{i,t} + \beta_{1,CS}\, CS_{i,t} + \varepsilon_{1,i,t} \\ g_{i,t} &= \alpha_2 + \beta_{2,c}\, c_{i,t} + \alpha_{FS}\, FS_{i,t} + \beta_{2,Hrf2}\, Hrf2_{i,t} + \sum_{j=2}^{12} \beta_{2,j}\, FB_j + \varepsilon_{2,i,t} \end{aligned}$$

$$Model\ 3 \quad \begin{aligned} FS_{i,t} &= \alpha_1 + \beta_{1,c}\, c_{i,t} + \alpha_g\, g_{i,t} + \beta_{1,nf}\, nf_{i,t} + \beta_{1,Hrf}\, Hrf1_{i,t} + \beta_{1,PCPL}\, PCPL_{i,t} + \varepsilon_{1,i,t} \\ g_{i,t} &= \alpha_2 + \beta_{2,c}\, c_{i,t} + \alpha_{FS}\, FS_{i,t} + \beta_{2,Hrf2}\, Hrf2_{i,t} + \sum_{j=2}^{12} \beta_{2,j}\, FB_j + \varepsilon_{2,i,t} \end{aligned}$$

$$Model\ 4 \quad \begin{aligned} FS_{i,t} &= \alpha_1 + \beta_{1,c}\, c_{i,t} + \alpha_g\, g_{i,t} + \beta_{1,nf}\, nf_{i,t} + \beta_{1,Hrf}\, Hrf1_{i,t} + \beta_{1,PC}\, PC_{i,t} + \varepsilon_{1,i,t} \\ g_{i,t} &= \alpha_2 + \beta_{2,c}\, c_{i,t} + \alpha_{FS}\, FS_{i,t} + \beta_{2,Hrf2}\, Hrf2_{i,t} + \sum_{j=2}^{12} \beta_{2,j}\, FB_j + \varepsilon_{2,i,t} \end{aligned}$$

The analysis examined farm size changes for the time period 1950-2000 for 10 U.S. regions using a pooled econometric model. The regions and states included are 1) Northeast - Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; 2) Lake States - Michigan, Minnesota, and Wisconsin; 3) Corn Belt - Illinois, Indiana, Iowa, Missouri, and Ohio; 4) Northern Plains - Kansas, Nebraska, North Dakota, and South Dakota; 5) Appalachian -- Kentucky, North Carolina, Tennessee, Virginia, and West Virginia; 6) Southeast - Alabama, Florida, Georgia, and South Carolina; 7) Delta States - Arkansas, Louisiana, and Mississippi;

8) Southern Plains - Oklahoma and Texas; 9) Mountain - Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming; 10) Pacific - California, Oregon, and Washington.

Empirical Results

Pooled U.S. Results

The national results are presented in Table 2 using Model 3. As will be seen because the aggregate national economic relationships involve dissimilar regional relationships the national results must be viewed from that perspective. However, nearly all variables for the national analysis involve hypothesized impacts. Expected cash receipts are significantly negative indicating that as cash receipts rise, pressures for farm consolidation are reduced. The expected government payment variable is not significant at the national level. The ratio of the price of capital to the price of labor has the expected negative relationship and is highly significant. A lower capital price relative to labor leads to farm size expansion. The Herfindahl variable is positive reflecting the spatial importance of large single enterprise farms and smaller diversified agriculture in the data set.

The government payment equation yields the expected relationship for expected crop receipts where counter cyclical forces engage government payments in agriculture. It, along with all explanatory variables in this equation has high statistical significance. The simultaneously determined farm size variable is negative. This political-economic relationship indicates that as farm size increases, government payments are reduced suggesting the possibility that increased farm size reduces support for government payment appropriations. The Herfindahl index is negative engaging the spatial relationship where farms are single enterprise oriented, government payments are relatively lower. The farm bill dummy variables incorporate unrealized government payment influences of each farm bill period as well as other economic influences of those periods and are viewed relative to the first farm bill period of the analysis. For the three following farm bill periods (2, 3, and 4) negative impacts were found followed by three positive, two negative, and three positive impacts. Again, these dummy influences involve government payment differences not explained by the three explanatory variables.

Pooled U.S. Regional Results

The wide differences in regional settings of type of agriculture and strength of the nonfarm economy were previously stressed as a difficulty in assessing the aggregate national estimates. It must be also stressed that similarly, regional analysis involves considerable heterogeneity of agriculture and nonfarm activity among states which compose a region. Further, considerable heterogeneity may exist within a state. this lack of uniformity within analyses units (here regions) may well result in more estimation accuracy in some regions compared to others. Cash receipts were used to represent agricultural net returns. For a partial period the relation of cash returns to net farm returns was examined and the relation found to be very strong.

Each of the four models was found to have performed best in at least one of the ten farm production regions. In Table 3 the results of Model 4 are presented for four production regions. These (Corn Belt, Lake States, Southern Plains, and Northern Plains) represent regions of strong commercial agriculture. However, these regions are not homogeneous with respect to the relative influence of the nonfarm economy. For each region higher returns in agriculture whether derived from cash receipts or government payments lead to increased farm size suggesting that higher agricultural returns increase farm consolidation pressures. The influence of the nonfarm economy differed considerably among these regions. For the Corn Belt and Southern Plains a positive relationship with farm size can be noted suggesting a "pull" on farm labor from nonfarm economic growth. The opposite occurs for the Lake States and Northern Plains where reduced farm size occurs under nonfarm economic growth. In these regions increased nonfarm employment opportunities are presumably in harmony with reducing pressures for farm consolidation. This phenomenon may result from increased nonfarm employment (part and full time) opportunities for operators and spouses providing opportunity to also remain active in agricultural production. The price of capital is negative for each region attesting to the impact of reduced capital prices on farm size expansion. As expected, the Herfindahl index impacts vary by region related to spatial farm specialization characteristics. For the government payment equation, expected crop receipts have the expected negative (counter cyclical) influence on government payments. Except for the Northern Plains, increased farm size is suggested to lead to higher government payments. The Herfindahl index is dissimilar (positive for three regions and negative in the more enterprise-varied Lake States). The positive relationships suggest higher government payments under specialized agriculture. The impacts of farm bill periods are uniformly positive on government payments compared to the mixed dummy results at the national level.

Model 3 which involved the capital/labor price ratio performed well for the largely noncontiguous four regions (Appalachian, Northeast, Pacific, and Southeast) of Table 4. For the Appalachian and Northeast the results for the farm size equation are very similar. Here increased cash returns and government payments lead to reduced farm consolidation pressure. The "pull" of increased nonfarm employment on farm labor leading to increased farm size is evident. The capital/labor resource price ratio performs in its expected manner. For the Pacific and Southeast, different relationships are observed compared to the Appalachian and Northeast regions. Agricultural returns are positively related to farm size in the Pacific and Southeast (similar to the regions of Table 3) with increased nonfarm employment reducing farm size growth. For the Southeast, the statistical estimation precision was less than other regions. Expected cash returns are seen to be positively related to farm size but statistical significance was not observed for expected government payments. The nonfarm employment variable was not statistically significant as was the resource price ratio. Among the regions of Table 4, for the expected government payment equation, only the Southeast region demonstrated counter cyclical phenomenon while the other regions demonstrated either positively significant relationships (Appalachian and Northeast) or a nonsignificant one (Pacific). Only the Southeast demonstrated a significant impact of farm size on government payments (positive). The Southeast region, in general, involved relationships similar to the strongly agriculturally oriented regions of Table 3. For the Appalachian and Northeast regions, numerous negative farm bill period dummies were observed (relative to dummy period 1) while this was less frequent for the Southeast and not observed for the Pacific region.

In Table 5 the results for the Mountain region using Model 1 is presented. Both the capital stock and resource price ratio variables demonstrated the expected resource substitution impacts. Expected cash receipts negatively impacted farm size similar to the national results and six of the eight previous regional results. The farm bill dummies demonstrated both positive and negative impacts.

Last, Table 6 presents the estimates for the Delta region using Model 2. This region also has structural results similar to other strongly agricultural states where agricultural returns are positively related to farm size. The capital stock is, as expected, positively related for farm size. Farm size is negatively related to expected government payments and the farm bill period dummies after initially negative follow with uniformly positive relationships with government payments.

Conclusions

The national or aggregate results of the farm size and government payment equations provides for a national agricultural policy perspective on farm size. Because of the regional differences in results the national results must be viewed with caution because of regional differences in the intensity of agriculture, the strength of the nonfarm economy, the degree agriculture is government supported, etc. Nationally, higher expected agricultural receipts lead to reduced farm size suggesting, in general, that higher agricultural receipts do not enhance farm consolidation. At the national level expected government payments were not found to be significantly important. Nonfarm employment is negative indicating that higher nonfarm employment opportunities retards farm consolidation. For the government payment equation expected agricultural receipts are negative as expected under the counter cyclical nature of the agricultural government payment program. Farm size was found to be negatively related to government payments suggesting that support for commodity programs is reduced as farm size increases. The farm bill period dummies were all significant but differing in sign, negative early and in bills 8 and 9 but positive in periods 5-7 and 10-12.

Regionally, the results are difficult to generalize because of the range of influences related to farm size and government payments. For regions with high levels of agricultural activity agricultural receipts and government payments are positively related to farm size. For this impact these regions include the Corn Belt, Lake States, Southern Plains, Northern Plains, Southeast, and Delta. An opposite impact was observed for the Appalachian, Northeast, and Mountain regions. Nonfarm employment growth led to greater farm size in the Corn Belt, Southern Plains, Appalachian, and Northeast regions while reduced farm size in the Lake States and Northern Plains. The resource substitution variables consistently demonstrated expected effects.

The regional analysis for regional government payments demonstrates an expected negative impact for agricultural returns in predominantly agricultural regions. The impact of regional farm size change on regional expected government payments is mixed but significant in half of the ten regions with most impacts positive. This suggests that regional increases in farm size can well lead to increased government payments. Last, a very wide range of farm bill period impacts were observed by region attesting to the wide differences in importance of the farm bills and other period influences by region.

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Table 1. Means of the Variables by U.S. Production Regions, 1940-2002

U.S. Regions	Farm size (FS)	Expected Government payments (g)	Expected Farm Receipts (c)	Nonfarm Employment (nf)	Crop-Livestock Herfindahl (herf1)	Crop Acreage herfindahl (herf2)	Capital Stock (CS)	Capital to Labor Price ratio (PC/PL)	Rental Price of Capital PC
Appalachia	108.27	5.34	100.79	0.1070	0.5531	0.3160	152.71	44.65	276.30
Corn Belt	191.15	12.95	128.83	0.0961	0.5563	0.3032	201.45	123.49	775.18
Delta	152.57	13.04	120.23	0.0547	0.5475	0.2869	93.96	34.05	206.19
Lake States	185.75	11.01	92.38	0.0950	0.5984	0.2699	233.82	115.78	728.86
Mountain	1631.01	2.68	26.99	0.0144	0.5818	0.3939	78.93	47.75	174.63
Northeast	130.06	5.51	225.64	0.5674	0.5941	0.4960	249.88	20.70	123.73
Northern Plains	666.26	8.09	46.98	0.0094	0.5606	0.2715	77.46	87.36	548.59
Pacific	363.82	5.89	183.49	0.1411	0.5499	0.3237	71.98	43.27	248.01
Southeast	165.92	7.34	147.98	0.1253	0.5757	0.2528	82.23	25.55	148.46
Southern Plains	498.60	6.05	36.91	0.0305	0.5368	0.2904	53.93	93.88	567.64
Average	**409.34**	**7.79**	**111.02**	**0.12**	**0.57**	**0.32**	**129.63**	**63.65**	**379.76**

The units of farm size is in acres per farm, expected government payments and expected farm receipts are in real 1996 dollars per acre, non-farm employment is in number of employed per acre, crop-livestock herfindahl is an herfindahl index of crop and livestock revenues, crop acreage herfindahl is an herfindahl index of program crops acreage, capital stock are in real 1996 Million dollars per acre Capital to labor price ratio is in dollars and rental price of capital is in real 1996 million dollars. The mean of the variables by U.S. production regions are simple averages of the yearly state level data.

Table 2. Estimated Coefficients for the U.S. Farm Size and Government Payment Equations.

	Estimate[2]
Farm Size[1]	
Expected Crop Receipts	-1.771***
Nonfarm Employment	-0.014*
Expected Government Payments	6.544
Price Capital/Price Labor	-3.901***
Hrf	8.557***
Government Payment	
Expected Crop Receipts	-0.007***
Farm Size	-0.005***
Hrf	-6.715***
FBD 2	-2.216***
FBD 3	-4.639***
FBD 4	-2.518***
FBD 5	2.780***
FBD 6	5.675***
FBD 7	3.083***
FBD 8	-2.081***
FBD 9	-2.072***
FBD 10	5.307***
FBD 11	8.169***
FBD 12	6.753

[1] Hrf refers to the Herfindahl index and FBD refer to the 12 historical farm bills.
[2] *, **, and *** refer to .053, .01, and .001 levels of significance.

Table 3. Estimated Coefficients for Farm Size and Government Payment Equations for the Corn Belt, Lake States, Southern Plains, and Northern Plains Regions.

	Corn Belt Estimate[2]	Lake States Estimate[2]	Southern Plains Estimate[2]	Northern Plains Estimate[2]
Farm Size[1]				
Expected Crop Receipts	.248***	.538***	2.238***	1.073*
Nonfarm Employment	.002**	- .051***	.027***	- .690***
Expected Government Payments	3.919***	6.394***	3.643	39.844**
Price Capital	-1.306***	- .428	-13.691**	- 6.545**
Hrf	- .238	- 1.854***	.135	- .794
Government Payments				
Expected Crop Receipts	- .052***	- .104***	- .091***	- .064***
Farm Size	.156***	.011	.007*	- .010**
Hrf	33.150**	- 9.934	13.126***	.659
FBD 2	2.944**	5.803***	- .707	4.631***
FBD 3	4.479**	5.529***	- .417	5.559***
FBD 4	4.883**	7.234***	.876	7.589***
FBD 5	8.492***	14.453***	5.318***	13.577***
FBD 6	10.100***	17.748***	10.163***	16.574***
FBD 7	11.536***	20.675***	9.180***	19.671***
FBD 8	10.784**	24.711***	5.652**	21.884***
FBD 9	9.895**	26.028***	5.822**	23.246***
FBD 10	10.100***	30.820***	9.087***	25.836***
FBD 11	9.147***	32.512***	8.152***	27.378***
FBD 12	7.653***	33.270***	5.251***	29.476***

[1] Hrf refers to the Herfindahl index and FBD refer to the 12 historical farm bills.
[2] *, **, and *** refer to .053, .01, and .001 levels of significance.

Table 4. Estimated Coefficients for Farm Size and Government Payment Equations for the Appalachian, Northeast, Pacific, and Southeast Regions.

	Appalachian Estimate[2]	Northeast Estimate[2]	Pacific Estimate[2]	Southeast Estimate[2]
Farm Size[1]				
Expected Crop Receipts	- .072***	- .033***	.024	.343***
Nonfarm Employment	.035***	.002*	- .003	- .002
Government Payments	- 2.667***	- 3.508***	5.108	-1.754
Price Capital/Price Labor	- 0.257*	- .196**	- .855*	- .554
Hrf	.679*	1.666***	- 5.150*	-1.134***
Government Payments				
Expected Crop Receipts	.007***	.004***	.007	- .087***
Farm Size	.009	- .010	.024	.179***
Hrf	-10.031***	- 4.478***	1.856	-14.871*
FBD 2	- 2.537***	- .754	.752	- 3.946
FBD 3	- 4.024***	- 5.719***	1.693	- 3.517
FBD 4	- 2.567***	- 5.162***	2.611	- .566
FBD 5	1.067	- 4.397***	7.519	7.877
FBD 6	3.185**	- 4.747***	10.752	16.350***
FBD 7	- .194	- 6.568***	9.929	11.819**
FBD 8	- 4.676***	- 8.075***	5.098	4.093
FBD 9	- 5.282***	- 7.682***	4.346	3.411
FBD 10	- 1.297	- 4.678***	9.229	7.351*
FBD 11	.771	- 3.112***	9.740	13.254***
FBD 12	.876	2.787***	7.873	13.198***

[1] Hrf refers to the Herfindahl index and FBD refer to the 12 historical farm bills.
[2] *, **, and *** refer to .053, .01, and .001 levels of significance.

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Table 5. Estimated Coefficients for the Farm Size and Government Payments Equation for the Mountain Region.

	Mountain Estimate[2]
Farm Size[1]	
Crop Receipts	-16.077***
Nonfarm Employment	.218
Government Payments	53.605
Price Capital/Price Labor	- 4.459***
Hrf	15.066
Capital Stock	1.635***
Government Payment	
Crop Receipts	.037***
Farm Size	-.00001
Hrf	-2.268***
FBD 2	- .986**
FBD 3	-1.401**
FBD 4	- .391
FBD 5	1.178*
FBD 6	2.062***
FBD 7	.882
FBD 8	-1.188
FBD 9	-1.206*
FBD 10	1.437**
FBD 11	1.977***
FBD 12	.795

[1] Hrf refers to the Herfindahl index and FBD refer to the 12 historical farm bills.
[2] *, **, and *** refer to .053, .01, and .001 levels of significance.

Table 6. Estimated Coefficient for the Farm Size and Government Payment Equation for the Delta Region.

	Estimate[2]
Farm Size[1]	
Expected Crop Receipts	.229**
Nonfarm Employment	.010
Expected Government Payments	4.422***
Hrf	-2.790***
Capital Stock	1.105***
Government Payment	
Expected Crop Receipts	.026
Farm Size	- .145***
Hrf	13.131*
FBD 2	- 6.612***
FBD 3	- 2.914
FBD 4	3.573
FBD 5	13.510**
FBD 6	23.419***
FBD 7	23.224***
FBD 8	15.879**
FBD 9	19.409**
FBD 10	39.962***
FBD 11	47.279***
FBD 12	42.201***

[1] Hrf refers to the Herfindahl index and FBD refer to the 12 historical farm bills.
[2] *, **, and *** refer to .053, .01, and .001 levels of significance.