Effects of Changes to Farm Program Payment Policies on the Distribution of Payments and Income Inequality of Farm Households

By

Ron Durst and Hisham El-Osta**

Economic Research Service
U.S. Department of Agriculture

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Introduction

In recent years, increasing attention has focused on the distribution of government payments, especially the share of payments that go to large farms and high-income farm households. Farm commodity program payment limits were first introduced in the Agricultural Act of 1970. The Farm Security and Rural Investment Act of 2002 for the first time supplemented program payment limits with a cap on the income farmers could earn and still receive farm program payments. The 2008 Farm Act tightened payment limitations on some producers and replaced the total adjusted gross income (AGI) limit with separate lower caps for the farm and nonfarm components of AGI. This research uses data from the Agricultural Resource Management Survey (ARMS), a survey of farm operator households conducted annually by the U.S. Dept. of Agriculture, to examine the impact of government payments and changes in payments as a result of changes to farm program policies on income inequality among farm households.

Objectives

- To estimate the impact of changes in farm program policies, including payment limits and income caps on payment eligibility, on the distribution of government payments.

- To determine the impact of changes in the distribution of government payments on income inequality among farm operator households.

Methodology

Standard Gini Coefficient and Gini Coefficient Decomposition

The Gini coefficient (G) for the kth income source Y_k, is [see Pyatt *et al*. (1980); Lerman and Yitzhaki (1985); Lerman and Yitzhaki (1989)]:

(1) $$G(Y_k) = 2\,\mathrm{cov}\left[Y_k, F(Y_k)\right]/\bar{Y}_k,$$

where $F(Y_k)$ is the cumulative ranked distribution of Y_k and $\bar{Y}_k$ is the mean of Y, and *cov* is a covariance indicator. Let w_i represent the scaled survey weight that corresponds to the i*th* household such that $\sum_{i=1}^{n} w_i = 1$.

The estimator of $F(Y_k)$ for the weighted sample n is a mid-interval of $F(Y_k)$:

(2) $$\hat{F}_i(Y_k) = \sum_{j=0}^{i-1} w_j + w_i/2 \qquad \textit{where} \quad w_0 = 0.$$

The weighted covariance between Y_k and $F(Y_k)$ is:

(3) $$\xi_k = \mathrm{cov}\left[Y_k, F(Y_k)\right]$$
$$= \sum_{i=1}^{n} w_i (Y_{i,k} - \bar{Y}_k)[\hat{F}_i(Y_k) - \bar{F}(Y_k)].$$

The Gini coefficient for Y_k in the presence of weights is:

(4) $$G(Y_k) = 2\,\xi_k/\bar{Y}_k, \qquad 0 \le G(Y_k) \le 1$$

where $\bar{Y}_k$ is the weighted mean.

Let R_k and ϕ_k denote, respectively, the correlation between Y_k and total income Y and the share of Y_k relative to Y:

(5) $$\mathrm{R}_k = \mathrm{cov}\left[Y_k, F(Y)\right]/\xi_k \qquad -1 \le R_k \le 1$$

and

(6) $$\phi_k = \bar{Y}_k/\bar{Y}.$$

Equations (5) and (6) allow for the derivation of G of total income Y:

(7) $$G(Y) = \sum_{k=1}^{K} G(Y_k) R_k \phi_k \qquad 0 \le G(Y) \le 1.$$

The 'proportional contribution to inequality' by the kth income source, is determined by:

(8) $$P_k = \frac{G(Y_k)\,R_k\,\phi_k}{G(Y)}.$$

The marginal effect M_k of a small change (ε_k) in income source k on G:

(9) $$M_k = \frac{\left[\partial G(Y)/\partial \varepsilon_k\right]}{G(Y)} = \mathrm{P}_k - \varphi_k.$$

Adjusted Gini Coefficient

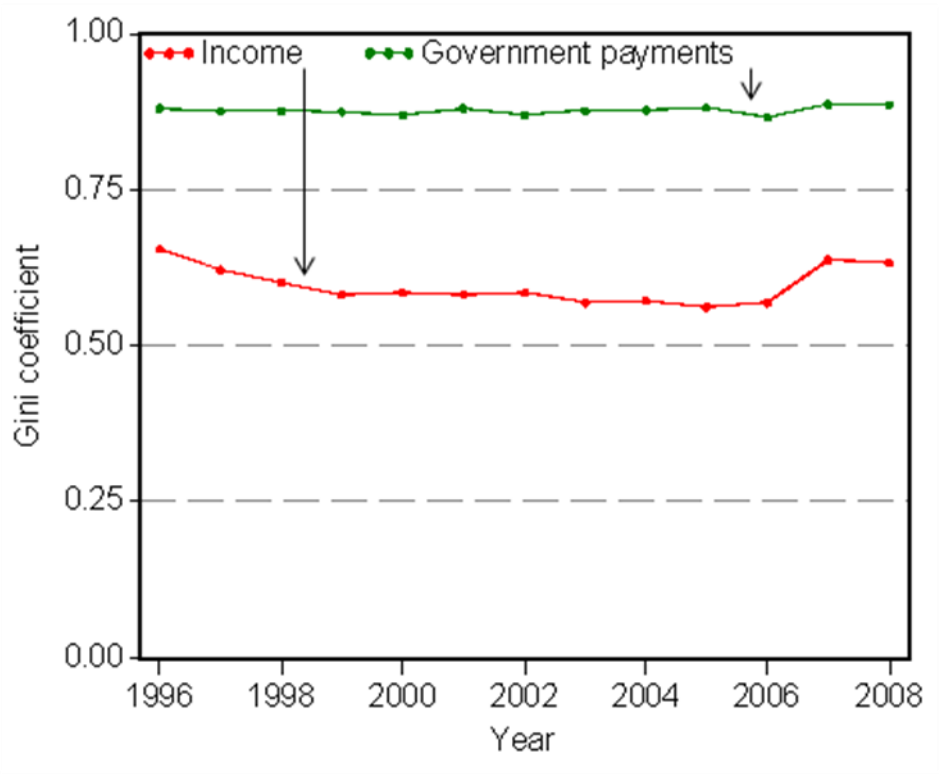
The "adjusted" Gini coefficient $G^*(Y)$, which corrects for the presence of negative incomes in Y, is computed as (Chen *et al*. (1982)):

(10) $$G^*(Y) = \frac{(2/n)\sum_{j=1}^{n} j\,y_j - \frac{n+1}{n}}{\left[1 + (2/n)\sum_{j=1}^{m} j\,y_j\right] + (1/n)\sum_{j=1}^{m} y_j \left[\frac{\sum_{j=1}^{m} y_j}{y_{m+1}} - (1+2m)\right]},$$ where

$$y_j = Y_j/(n\bar{Y}) \quad \text{and} \quad \bar{Y} = \sum_{j=1}^{n} Y_j/n > 0,$$

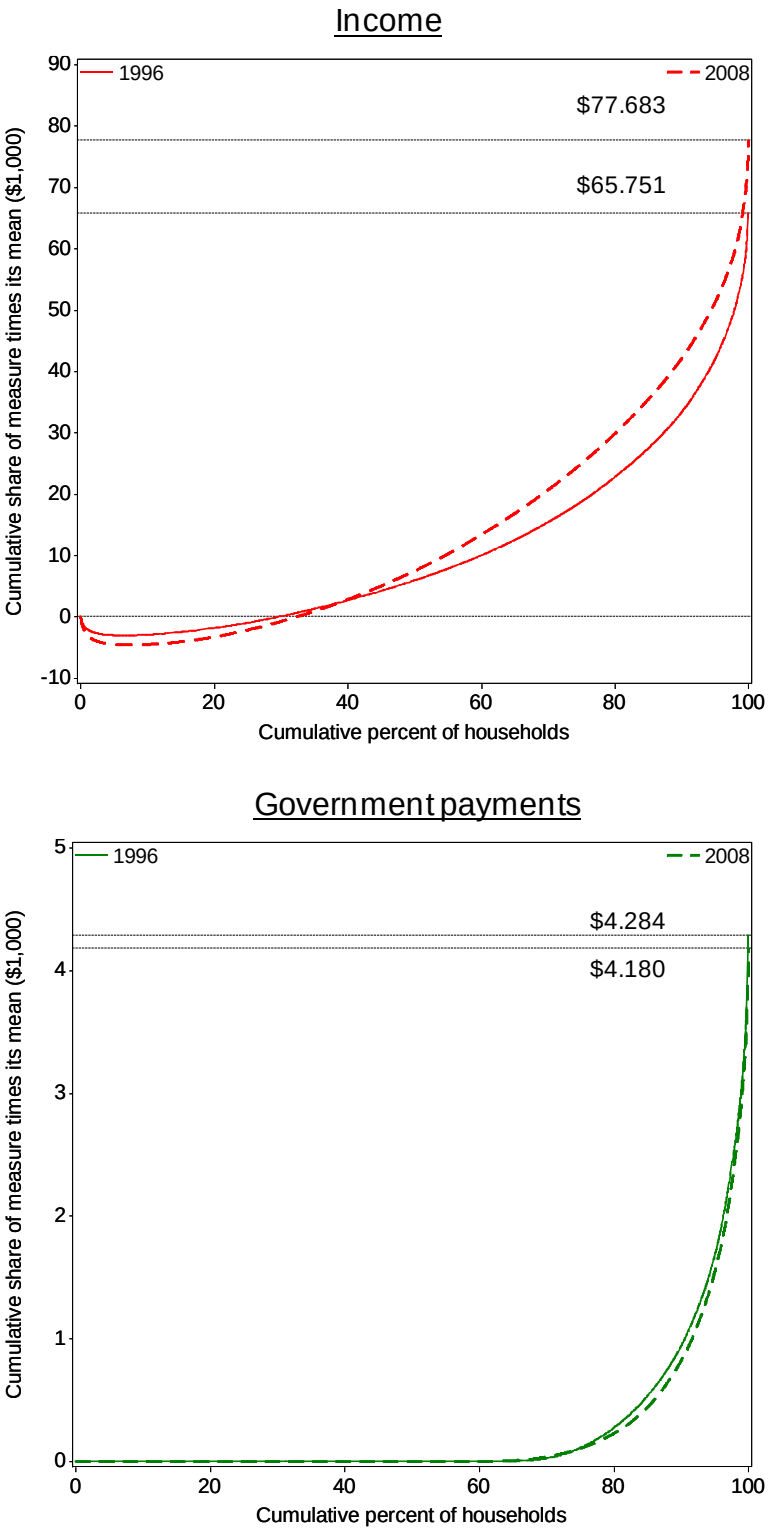
where m, computationally, is determined where the sum of incomes over the first m households is negative and the first $m + 1$ household is positive.

Figure 1: Gini Coefficients of Total Farm Household Income and of Government Payments, 1996-2008



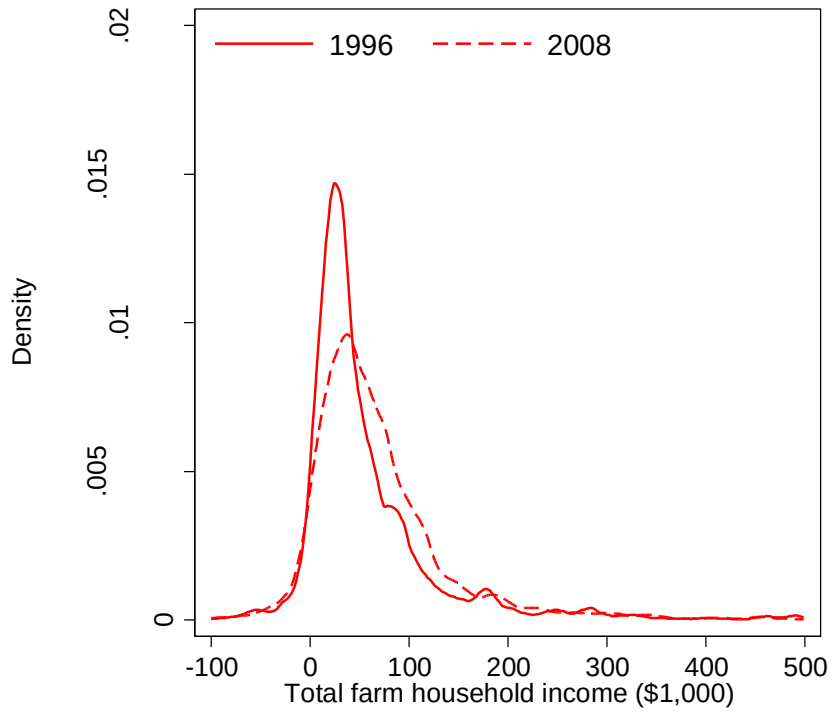
Source: Authors' calculations using1996-2008 ARMS data

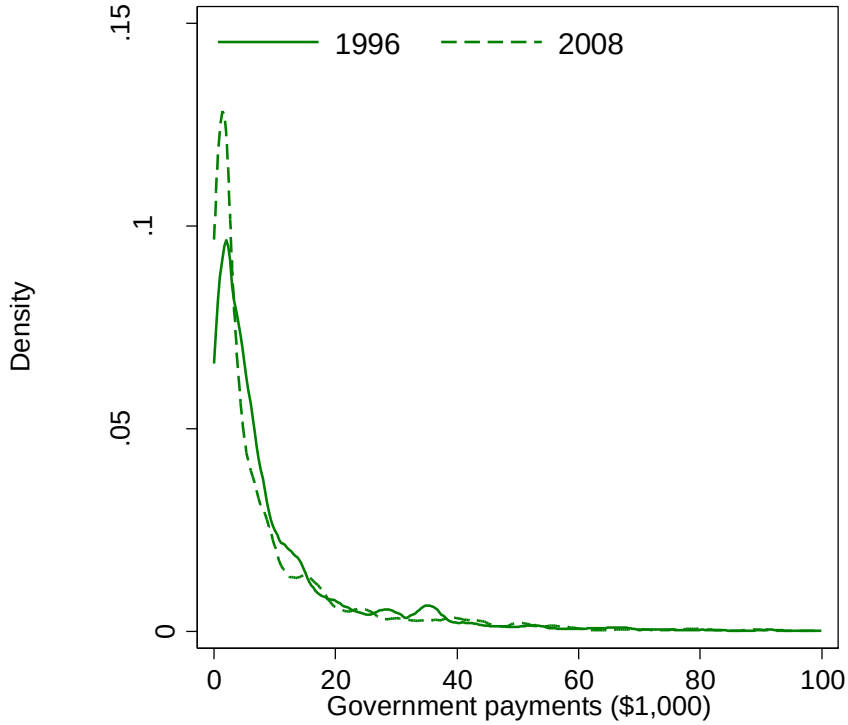
Figure 2: Generalized Lorenz Curves of Total Farm Household Income and Government Payments, 1996 and 2008



Source: Authors' calculations using 1996 and 2008 ARMS data

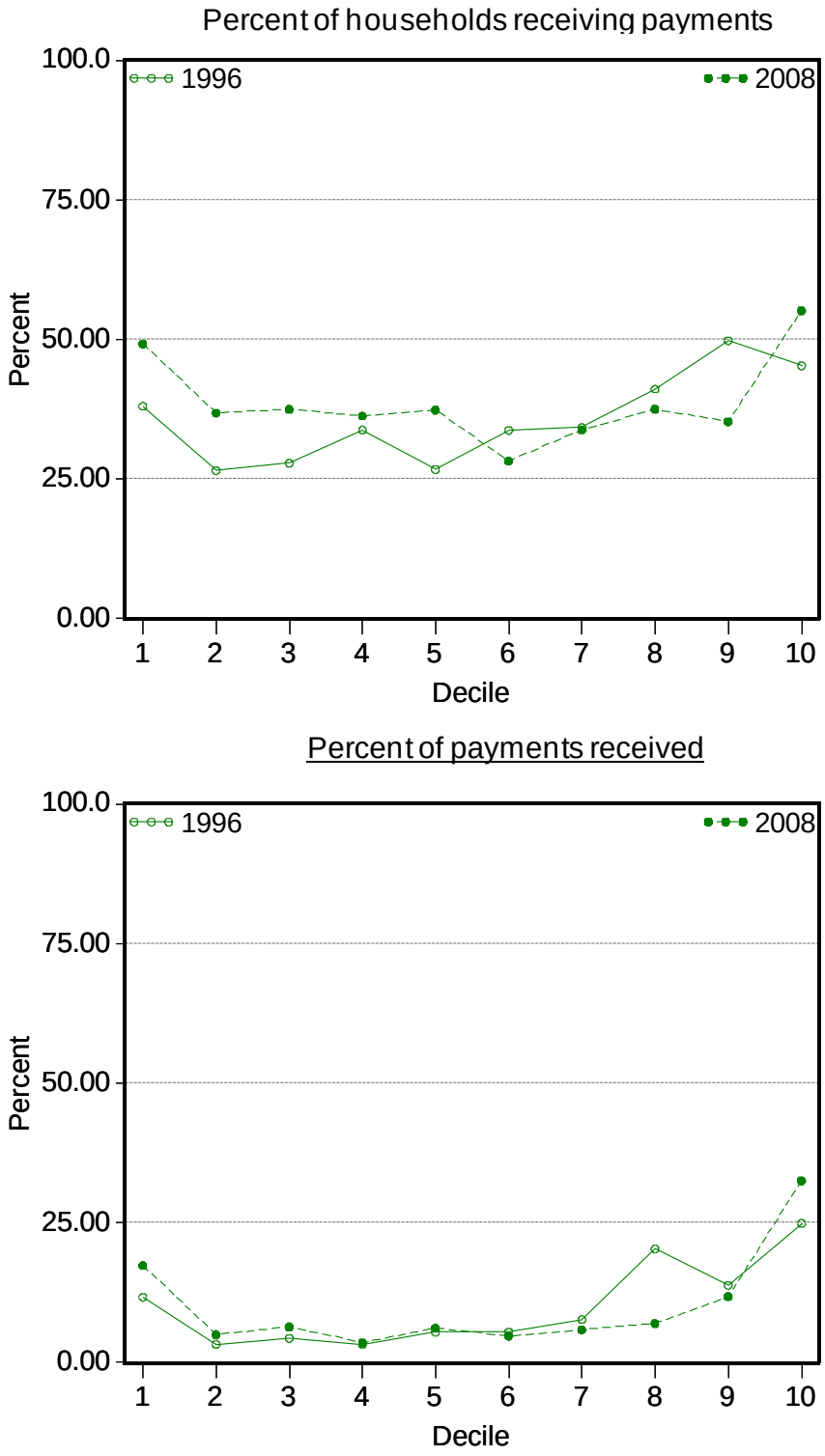
Figure 3: Kernel Density Estimates of Total Farm Household Income and Government Payments1996 and 2008





Source: Authors' calculations using 1996 and 2008 ARMS data

Figure 4: Percent of Farm Households Receiving Payments and Percent of Government Payments Received by Deciles of Total Farm Household Income, 1996 and 2008



Source: Authors' calculations using 1996 and 2008 ARMS data

Table 1: Gini decomposition of farm household income, 2008[1]

	Estimate	Std. Dev
Share in total income (ϕ)		
Total income	1.000	0.000
Farm related income	0.052	0.015
Government income	0.050	0.002
Off-farm wages and/or salaries	0.659	0.020
Interest and dividends	0.051	0.005
Other non-farm income	0.188	0.014
Gini coefficient ($G(Y_k)$)		
Total income	0.647	0.019
Farm related income	7.202	1.967
Government income	0.884	0.003
Off-farm wages and/or salaries	0.638	0.015
Interest and dividends	0.810	0.013
Other non-farm income	0.728	0.014
Gini correlation (R_k)		
Total income	1.000	0.000
Farm related income	0.741	0.014
Government income	0.218	0.034
Off-farm wages and/or salaries	0.747	0.024
Interest and dividends	0.450	0.057
Other non-farm income	0.202	0.057
Proportional contribution to inequality (P_k)		
Total income	1.000	0.000
Farm related income	0.428	0.019
Government income	0.015	0.002
Off-farm wages and/or salaries	0.485	0.028
Interest and dividends	0.029	0.006
Other non-farm income	0.043	0.015
Relative marginal effect (M_k)		
Total income	-0.000	0.000
Farm related income	0.376	0.018
Government income	-0.035	0.003
Off-farm wages and/or salaries	-0.174	0.014
Interest and dividends	-0.022	0.003
Other non-farm income	-0.146	0.008

Data source: 2008 ARMS.[1] Estimates of SE were measured using the Jackknife variance estimation method with 30 drawn samples.
Note: Similar results were found with regard to the 2008 Farm Act provisions.

Findings

- Results suggest that government payments are more unequally distributed than farm household income and that while the inequality of total farm household income improved slightly with the Gini coefficient dropping from 0.655 in 1996 to 0.631 in 2008, the inequality of government payments increased slightly with the Gini increasing from 0.880 in 1996 to 0.887 in 2008 (fig. 1).

- Evidence from generalized Lorenz and Kernel density plots further illustrate the improvement (worsening) in the distributions of income (government payments) between 1996 and 2008 (fig. 2 and fig.3).

- Compared to 1996, a larger share of the top 10 percent of farm households by level of total household income received payments in 2008. These farms received about one-third of payments in 2008 compared to only about one-fourth of total payments in 1996 (fig. 4). The bottom 10 percent also received slightly higher payments.

- Results suggest that the relative marginal effect of an increase in government payments would be a slight reduction in farm household income inequality (table 1).

References

Chen, C., T. Tsaur, and T. Rhai. "The Gini Coefficient and Negative Income." *Oxford Economic Papers*, New Series, 34, 3(Nov. 1982):473-478.

Lerman, Robert J., and Shlomo Yitzhaki. "Income Inequality Effects by Income Source: A New Approach and Applications to the U.S." *Review of Economics and Statistics*, 67(Feb. 1985):151-156.

_____. "Improving the Accuracy of Estimates of Gini Coefficients." *Journal of Econometrics*, 42(September 1989):43-47.

Pyatt, G., C. Chen, and J. Fei. "The Distribution of Income by Factor Components." *Quarterly Journal of Economics*, 95(1980):451-73.