Farm Wealth Inequality Within and Across States in the United States

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This paper uses Theil's (1979) entropy-based measure of inequality and farm-level data to examine changes in farm business wealth (farm equity) of farm households. The farms associated with farm households are grouped by state into ten regions of the United States. The Theil entropy measure is then calculated and used to decompose total inequality of farm wealth into within-state and across-states (between states) inequalities for each region. Results show that since the enactment of the 1996 Federal Agricultural Improvement and Reform (FAIR) Act, inequality in farm wealth among farms within a state has decreased relative to the number of farms per state, across all regions. Further, most of the reduction in farm wealth inequality is attributed to increased equality in the distribution of real estate assets of the farm households, a major component of farm wealth.

Key Words: inequality, Theil's inequality, farm wealth, regional decomposition, farm level, farm household, real estate assets, inventories

This study analyzes changes in the distribution of farm household wealth from 1996 through 2004 using the Theil (1967) measure of inequality and farm-level data from the Agricultural Resource Management Survey (ARMS). This study also measures inequality in farm assets, particularly real estate and non real estate assets, since farm assets are a major component of farm wealth (Mishra et al. 2002). The Theil inequality measure allows for the decomposition of total inequality into variation between farms within each state as well as variation between average farms across states in each region. Study results indicate that inequality in farm household wealth declined from 1996 through 2004. The results reveal that most of the reduction in inequality occurred between farms within the states, across all regions. However, inequality in farm wealth within each state remained much greater than the range in inequality between the average farms across states in each region.

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Over the past quarter-century the economic literature has been inundated with studies on changes in income inequality. Most of these studies support the convergence of income across countries. This convergence has been attributed to many factors including increased international trade, capital movement, technological spillover, and innovations in institutional design. At the same time changes in inequality within countries have been ambiguous. According to some studies the income inequality for the developed economies of the United States and Western Europe actually increased in the 1980s. Further, the textbook paradigm that increased inequality encourages income growth was also contradicted by several empirical studies.

Apart from a general interest in the effect of agricultural income inequality as a component of the general economy, several policy questions particular to the agricultural sector motivate the examination of the dispersion of income and wealth across farm households. First, while it would be difficult to argue that society has a preference for more equal income distribution in agriculture, society may prefer that farm payments have specific effects on farm size. At the very least, from a policy perspective, government policies should not distort the distribution of farm size. However, some may prefer that the majority

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of farm payments go to so-called family farms. These concerns were addressed by Leuthold (1969), who examined the distribution of farm payments across farm sizes. Second, the distribution of farm income may have implications for the efficacy of the government safety net. As stated by Ahearn, Johnson, and Strickland (1985), income maintenance has always been a policy goal, but the heterogeneity of farm households masks the true variability of farm income.

Much of the literature has focused on changes in the dispersion or inequality of income. This study instead focuses on the inequality of farm household wealth for three reasons. First, studies suggest that wealth is actually the mechanism that provides for economic growth. Second, given equal access to capital markets, wealth is actually a better measure of differences in consumption than income. Finally, income for the farm household can be mathematically defined as the rate of return to equity multiplied by the amount of wealth controlled by the household. Each of these linkages between the economic well-being of the farm household and farm household wealth can be demonstrated using the optimal debt model presented by Ramirez, Moss, and Boggess (1997).

Ramirez, Moss, and Boggess (1997) model the optimal debt level for a farm household using an extension of Merton's (1969) lifetime portfolio specification. In this formulation, farm households determine the level of debt that maximizes the present value of expected utility. Following Merton's formulation, they assume that farmers choose the level of debt (or leverage position) to maximize the expected utility, which they model using the power function

$$U[C(t)] = \frac{C(t)^b}{b}, \tag{1}$$

where $U(\cdot)$ denotes utility, $C(t)$ denotes consumption at time t, and b denotes the relative risk-aversion coefficient. Consumption is constrained by an equation of motion for farmer equity, defined as

$$dE(t) = [R_E(t)E(t) - C(t)]dt, \tag{2}$$

where $dE(t)$ denotes the continuous change in the farmer's equity, $E(t)$ is the farmer's equity, $R_E(t)$ is the rate of return on equity, and dt is the increment in time. Expanding the rate of return on equity, change in equity can be expressed as

$$dE(t) = \left\{ \frac{[R_A(t) - K(t)\delta(t)]}{(1-\delta(t))} E(t) - C(t) \right\} dt, \tag{3}$$

where $R_A(t)$ is the rate of return on agricultural assets, $K(t)$ is the cost of debt capital, and $\delta(t)$ is the debt-to-asset ratio. Ramirez, Moss, and Boggess derive the optimal level of farm debt, proportion of equity consumed, and the level of consumption as functions of risk aversion, mean and variance of the rate of return on agricultural assets, and the cost of debt capital,

$$\begin{aligned} \delta^*(t) &= 1 - \frac{[1-b]\sigma_A^2(t)}{\mu_A(t) - K(t)} \\ C^*(t) &= E(t)D^*(t) \\ D^*(t) &= \frac{r - K(t)b}{1-b} - \frac{b[K(t) - \mu_A(t)]^2}{2[1-b]^2\sigma_A^2(t)}, \end{aligned} \tag{4}$$

where $\delta^*(t)$, $C^*(t)$, and $D^*(t)$ represent the optimum debt-to-asset ratio, consumption, and percent of equity consumed in period t, $\mu_A(t)$ is the expected rate of return on assets in period t, $\sigma_A^2(t)$ is the variance of the rate of return on assets in period t, and r is a consumption-based discount rate (assumed constant over time). Thus, the dispersion of farm consumption is dependent (in part) on the distribution of farm equity.

Equation 4 can be extended to incorporate several different policy concerns. For example, the economic well-being of farmers in the United States is dependent not only on returns to agricultural assets, but also on the possibility of off-farm employment. Thus, equation 4 can be reformulated as

$$C^*(t) = D^*(t)E(t) + R_O(t), \tag{5}$$

where $R_O(t)$ is the return to off-farm employment. Further, the rate of return on agricultural assets ($R_A(t)$) is affected by government program payments as well as factors such as urban pressures that increase the price of farmland over time

(Livanis et al. 2006). This conceptual model helps explain why the size distribution of the wealth of farm households changes and why the size distribution of wealth varies across farm households cross-sectionally and over time.

Informational Measures of Inequality

A variety of measures have been used to measure the dispersion of inequality of economic well-being in the farm sector (i.e., the coefficient of variation, Gini coefficients, and Lorenz curves). This study departs from these formulations, applying Theil's measure of inequality (Theil 1979). This approach has several theoretical advantages and allows for the decomposition of the dispersion into within and between-state measures in a given region. This section first presents Theil's measure of inequality and describes how the measure can be used to decompose the overall inequality into among-farms-in-a-state and between-state measures of inequality. We then discuss the advantages of this measure.

Building on the general concept of Shannon (1948) information or entropy, the Kullback-Leibler relative entropy is defined as

$$(6)\quad D(p,q) = \int_E p(x)\ln\big(p(x)\big)dx - \int_E p(x)\ln\big(q(x)\big)dx = \int_E p(x)\ln\left(\frac{p(x)}{q(x)}\right)dx,$$

where $D(p,q)$ is a measure of the difference (or distance) between the two probability measures, and $p(x)$ and $q(x)$ are probability measures defined on x. The discrete form of this measure becomes

$$(7)\qquad \Delta(p,q) = \sum_{i=1}^{N} p_i(x)\ln\left(\frac{p_i(x)}{q_i(x)}\right).$$

In our applications we want to examine a uniform distribution of wealth against an empirical distribution of wealth:

$$(8)\qquad \Delta(p,q) = \sum_{i=1}^{N} p_i(x)\ln\left(\frac{p_i(x)}{1/N}\right)$$

$$= \sum_{i=1}^{N} p_i(x)\ln[p_i(x)+\ln(N)]$$

$$= \ln(N) + \sum_{i=1}^{N} p_i(x)\ln\big(p_i(x)\big).$$

This measure is sometimes referred to as the relative entropy in the signal.

Theil's measure of income inequality is an adaptation of the discrete form of the relative difference measure presented in Equation 7:

$$(9)\qquad I(p,q) = \sum_{i=1}^{N} p_i \ln\left(\frac{p_i}{q_i}\right),$$

where $I(p,q)$ is the measure of inequality (or dispersion) of income, p_i is the share of income[1] in state or region i, and q_i is the share of the overall population in that state or region. Adapting this procedure to examine the inequality in farm wealth, we let p_i be the share of farm wealth in state i and q_i be the share of farmers in state i. $I(p,q)$ is then defined as the dispersion of farm equity. If the share of the number of farms is close to the share of farm equity, then there is little additional information and the information inequality is small. A small inequality means that the distribution of farm wealth, per farm, is uniform across states, and thus the value of $I(p,q)$ approaches 0. Conversely, an increase in the information inequality indicates divergence in farm wealth across the states.

An important aspect of the Theil measure of inequality is its decomposability. To develop this decomposability we divide the overall inequality in Equation 9 into two groups:

$$(10)\qquad I(p,q) = \sum_i p_i \ln\left(\frac{p_i}{q_i}\right) = \sum_i p_i\big[\ln(p_i)-\ln(q_i)\big] = \sum_{i\in G_1} p_i\big[\ln(p_i)-\ln(q_i)\big] + \sum_{i\in G_2} p_i\big[\ln(p_i)-\ln(q_i)\big],$$

[1] The nominal and real informational inequality is identical if inflation is the same across regions.

where G_1 and G_2 are mutually exclusive and exhaustive sets of individuals (states or regions). Defining

$$P_1 = \sum_{i \in G_1} p_i,\ P_2 = \sum_{i \in G_2} p_i,\ Q_1 = \sum_{i \in G_1} q_i, \text{ and } Q_2 = \sum_{i \in G_2} q_i,$$

the equality represented in Equation 10 can be rewritten as

(11)
$$\begin{aligned} I(p,q) &= \sum_{i \in G_1} p_i \begin{bmatrix} \ln(p_i) - \ln(q_i) + \{\ln(P_1) \\ -\ln(P_1) + \ln(Q_1) - \ln(Q_1)\} \end{bmatrix} \\ &\quad + \sum_{i \in G_2} p_i \begin{bmatrix} \ln(p_i) - \ln(q_i) + \{\ln(P_2) \\ -\ln(P_2) + \ln(Q_2) - \ln(Q_2)\} \end{bmatrix} \\ &= \sum_{i \in G_1} p_i \ln\left(\frac{p_i / P_1}{q_i / Q_1}\right) + \sum_{i \in G_1} p_i \ln\left(\frac{P_1}{Q_1}\right) \\ &\quad + \sum_{i \in G_2} p_i \ln\left(\frac{p_i / P_2}{q_i / Q_2}\right) + \sum_{i \in G_1} p_i \ln\left(\frac{P_2}{Q_2}\right) \\ &= \left[P_1 \sum_{i \in G_1} \frac{p_i}{P_1} \ln\left(\frac{p_i / P_1}{q_i / Q_1}\right) + P_2 \sum_{i \in G_2} \frac{p_i}{P_2} \ln\left(\frac{p_i / P_2}{q_i / Q_2}\right) \right] \\ &\quad + \left[P_1 \ln\left(\frac{P_1}{Q_1}\right) + P_2 \ln\left(\frac{P_2}{Q_2}\right) \right]. \end{aligned}$$

Defining the average inequality within each group, i.e., inequality between farms in each state, as

$$(12)\quad \bar{I} = P_1 \sum_{i \in G_1} \frac{p_i}{P_1} \ln\left(\frac{p_i / P_1}{q_i / Q_1}\right) + P_2 \sum_{i \in G_2} \frac{p_i}{P_2} \ln\left(\frac{p_i / P_2}{q_i / Q_2}\right),$$

and the inequality between groups, i.e., inequality between states, as

$$(13)\qquad I_R = P_1 \ln\left(\frac{P_1}{Q_1}\right) + P_2 \ln\left(\frac{P_2}{Q_2}\right),$$

we are left with the decomposition of the inequality measure in a given region as

$$(14)\qquad I = \bar{I} + I_R.$$

Letting p_i equal firm-level wealth (instead of state- or regional-level wealth) and $q_i = 1/N_1$ if $i \in G_1$ or $q_i = 1/N_2$ if $i \in G_2$ (e.g., N_1 is the number of farms in group G_1 and N_2 is the number of farms in group G_2), the decomposability of the inequality measure in Equation 14 can be expanded to the firm level as

(15)
$$\begin{aligned} I = \bar{I} + I_R &= \left[\begin{pmatrix} P_1 \sum_{i \in G_1} \frac{p_i}{P_1} \ln\left(\frac{p_i / P_1}{1 / N_1}\right) \\ + P_2 \sum_{i \in G_2} \frac{p_i}{P_2} \ln\left(\frac{p_i / P_2}{1 / N_2}\right) \end{pmatrix} \right] \\ &\quad + P_1 \ln\left(\frac{P_1}{\frac{N_1}{N_1 + N_2}}\right) + P_2 \ln\left(\frac{P_2}{\frac{N_2}{N_1 + N_2}}\right) \\ &= \left[\begin{pmatrix} P_1 \left(\ln(N_1) + \sum_{i \in G_1} \frac{p_i}{P_1} \ln\left(\frac{p_i}{P_1}\right) \right) \\ + P_2 \left(\ln(N_2) + \sum_{i \in G_2} \frac{p_i}{P_2} \ln\left(\frac{p_i}{P_2}\right) \right) \end{pmatrix} \right] \\ &\quad + P_1 \ln\left(\frac{P_1}{\frac{N_1}{N_1 + N_2}}\right) + P_2 \ln\left(\frac{P_2}{\frac{N_1}{N_1 + N_2}}\right). \end{aligned}$$

Thus, $Q_1 = N_1/(N_1+N_2)$ represents the share of farms in group 1 as depicted in Equation 13 and $Q_2 = N_2/(N_1+N_2)$ represents the share of farms in group 2, as depicted in Equation 13. Equation 15 states that total inequality in a given region is composed of inequality within farms in a state and between states.

As previously stated, a number of inequality measures have been proposed, including the coefficient of variation, Lorenz curves, and Gini coefficients. Given this diversity, it behooves the researcher to justify the choice of inequality measure. To justify our application of the Theil inequality measure, we rely on the axiomatic characteristics developed by Foster (1983), particularly those emphasizing the role of decomposability of inequality. Foster develops four criteria

for measuring inequality: (i) the Pigou-Dalton transfer principle, (ii) symmetry, (iii) homogeneity, and (iv) the population principle.

The Pigou-Dalton transfer principle states that the measure of income inequality must increase if income is taken from a poorer individual and given to a richer individual. This principle would appear fundamental to the concept of equality underlying equity measurement, and further support for it can be found in Atkinson (1970).

The principles of symmetry and homogeneity denote somewhat different concepts in inequality measurement than those found in consumption and production theory. In the measurement of inequality the symmetry criterion states that the inequality measure is unchanged when two individuals trade places (or income levels). The homogeneity criterion states that only relative income dispersion matters (i.e., multiplying all incomes by the same proportion does not change the level of inequality).

While several inequality measures meet the first three criteria (the Pigou-Dalton principle, symmetry, and homogeneity), Foster (1983) shows that the Theil measure of inequality alone satisfies the population principle. The population principle states that replicating the sample (i.e., adding a second dataset with an identical income distribution) should result in no change in the inequality measure. Foster (1983) demonstrates that the decomposability of the Theil measure is a requirement to meet the population principle. In fact, Foster shows in Theorem 2 that

> ... inequality measure *I* satisfies PD [Pigou-Dalton], S [symmetry], H [homogeneity], PP [Population Principle], and WD [Weak Theil Decomposability] if and only if *I* is a positive multiple of the Theil measure of inequality [p. 112].

Hence, given our interest in the inequality of farm wealth within various farms in a state and states within a region, the most appropriate measure of inequality is that proposed by Theil.

Data

The financial accounting concept defines the elements of financial statements for business enterprises and households.[2] Based on Farm Financial Standards Task Force recommendations, the sources of farm assets include (i) real estate, (ii) farm equipment, (iii) other financial assets (such as investment in cooperatives, prepaid insurance, etc.), and (iv) other assets (such as breeding stock, crop and livestock inventory, purchased inputs, etc.). Sources of farm debt include (i) real estate, (ii) non real estate, (iii) short-term debt (includes loans less than one year, accrued interest, accounts payable, and the current portion of term debt), and (iv) long-term debt (includes noncurrent real and non real estate debt). The Agricultural Resource Management Survey (ARMS) of the U.S. Department of Agriculture (USDA) collects farm-level data on, in addition to other information, all the elements necessary to construct total wealth and total debt for the farm business.

Annual ARMS data from 1996, 2000, and 2004[3] are used in this study. This period represents the period after the enactment of the Federal Agricultural Improvement and Reform (FAIR) Act of 1996 and includes observations under the Farm Security and Rural Investment (FSRI) Act of 2002. ARMS is conducted annually by the Economic Research Service and the National Agricultural Statistics Service. It is the primary source of information about the financial condition and economic well-being of farm businesses and of farm households in the United States, and includes data on all the components of farm assets and debt of the farm business. Farm wealth or the equity of farm households is derived in ARMS by subtracting total farm debts from total farm assets.

ARMS uses a multi-phase sampling design and allows each sampled farm to represent a number of farms that are similar, that number being the survey expansion factor (see Kott 1998 and Dubman 2000 for more technical detail). The expansion factor, in turn, is defined as the inverse of the probability of the surveyed farm being selected. The expansion factor can also be referred

[2] The Farm Financial Standards Task Force (FFSTF) in its recommendation published in the Financial Guidelines for Agricultural Producers (Forbes 1991) sets forth a minimum set of requirements for a financial statement that should include balance sheet and income statement information and use financial accounting concepts.

[3] Although data for other years are available, incremental information available is very small and results do not vary in any way. Therefore, we decided to present the results for selected years.

to as the observation's weight. Each version of ARMS has a unique expansion factor that expands the sample to the target population. ARMS collects data to measure the financial conditions (farm income and expenses) and operating characteristics of farm businesses, the cost of producing agricultural commodities, and the well-being of farm operator households. It is important to point out that ARMS is not a longitudinal database. Each year different farms are surveyed, and with weighting schemes the number of farms add up to the U.S. total.

The distribution of farms using ARMS data based on reported farm business wealth categories[4] highlights changes in the spatial and temporal distribution of farm wealth. For example, Figure 1 shows that the distribution of farms in the lower tail of the wealth categories has decreased over the 1996–2006 period, while the percentage of farms in the highest category has increased. The percentage of farms in the $250,000–$999,999 wealth category increased by about 10 percent during the 1996–2004 period, from approximately 43 percent in 1996 to 45 percent in 2004. However, during the same time period the share of farms in the largest category ($1 million or more) increased by approximately 76 percent, from approximately 21 percent in 1996 to nearly 37 percent in 2004.

In ARMS, farm wealth is dominated by farm real estate (76 percent) (Mishra and El-Osta 2005). The average value of farm assets of family farm business increased from $274,396 in 1994 to $677,353 in 2004, an increase of 147 percent. On the other hand, the average farm debt increased from $21,010 in 1991 to $32,408 in 2004, an increase of only 54 percent (USDA, various years). The average wealth of family farm businesses increased from $253,385 in 1996 to about $644,945 in 2003, a 50 percent increase over a decade (USDA, various years). However, regional differences existed in the wealth of family farm businesses (Table 1).

Figure 2 shows the distribution of farms for selected regions and years. One can draw two inferences from this figure. First, across all regions, the percentage of farms in the $250,000 or more wealth categories has increased and the distribution of farms in the lower wealth classes ($50,000 or less) has remained relatively stable over the same time period. Second, the share of farms in the largest wealth category ($1 million or more) is highest in the Pacific region, followed by the Corn Belt and Southeast regions. Further, the figure also shows that an increase in the percentage of farms in the largest wealth category for the Pacific, Corn Belt, and Southeast regions has been accompanied by decreases in the percentage of farms in the $100,000–$249,999 and $50,000–$99,999 wealth categories. These findings are consistent with El-Osta and Morehart's (2002) study of wealth concentration in U.S agriculture. Table 1 shows the mean farm wealth of farm households in various wealth categories for selected regions and years using ARMS micro-level data. These results illustrate the range of variation within a region between years in the selected wealth categories and within a wealth category between regions in each year, and the patterns of differences within a wealth category across regions over time. The table shows that average farm wealth varies within a region and over time.

Results

Table 2 presents the importance of each component (farms within a state and between states) of total inequality in terms of the Theil measure of inequality. In general the results indicate that the distribution of farm wealth changed significantly from 1996 through 2004. Inequality between farms in a state contributed the most, about 95–99 percent, to the total inequality. A similar pattern is observed in all ten regions of the United States. This finding is consistent with the fact that there is considerable variability in farm size, farm assets (real estate, mainly land, and non real estate assets, mainly crop and livestock inventories), and farm debt among farms in a state. Further, aggregation of farms at the state level reduces the variability in the components of wealth and hence reduces the level of inequality in farm wealth when comparing farms within different states and within a given region.

Table 2 shows that total farm-level inequality, across all regions, has decreased over the period

[4] In this study farms were categorized into six different wealth categories. These categories were based on the reported wealth of the family farm business. These categories are (i) $0–$24,999, (ii) $25,000–$49,999, (iii) $50,000–$99,999, (iv) $100,000–$249,999, (v) $250,000–$999,999, and (vi) $1,000,000 or more.

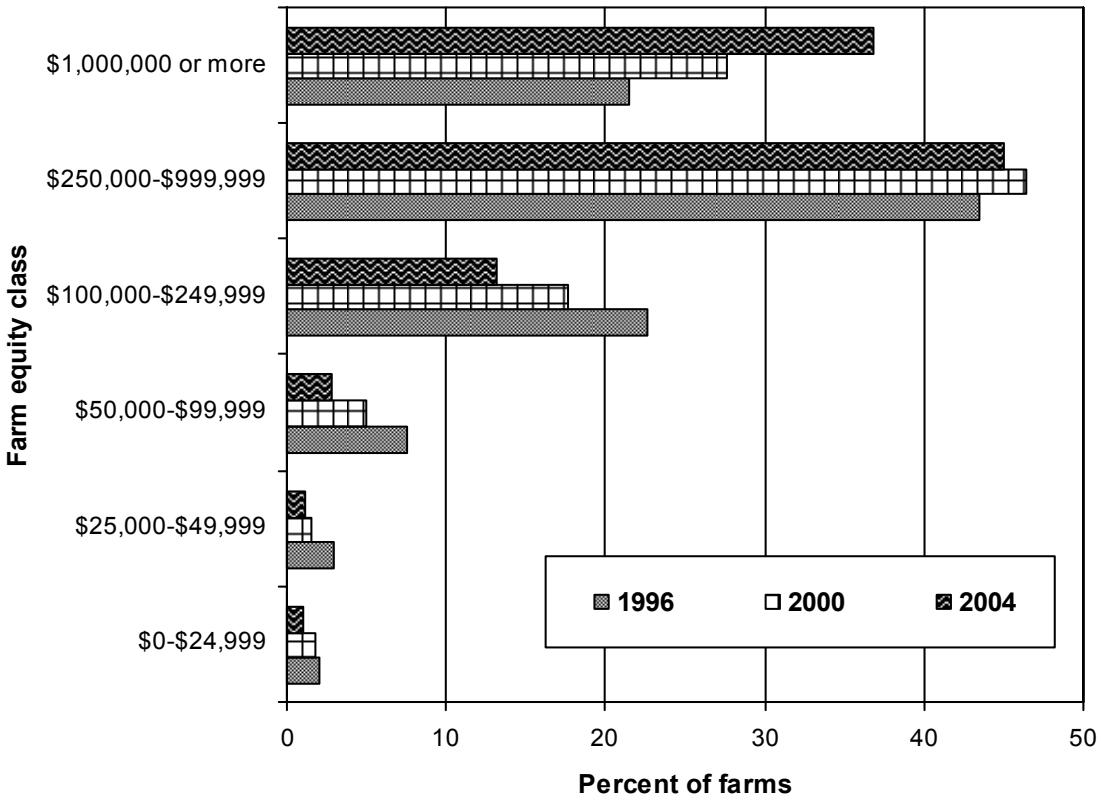

Figure 1. Distribution of Farms by Wealth (Equity) Categories for Selected Years

Source: USDA (various years).

1996–2004. The highest level of total inequality (8.132) was observed in 1996 for farms located in the states belonging to the Southern Plains region, followed by that for farms located in the states belonging to the Northern Plains and Appalachian regions. Table 2 also shows that inequality among farms within states and regions decreased over the 1996–2004 period. For example, within-state inequality for farms located in the Southern Plains decreased by nearly 10 percent during 1996–2000 and by approximately 8 percent during 2000–2004. The largest reduction in overall or total inequality (approximately 15 percent) was observed among farms located in the Northern Plains during the 1996–2000 period, and next largest (about 16 percent) among farms located in the Corn Belt region during 2000–2004. This reduction is mainly due to a significant reduction in the inequality in farmland values across farms located in these states and eventually across states in the region. Further, the general trend for nearly all regions is that both real estate and non real estate assets became more equally distributed since most relative changes from the previous years (1996 and 2000) are negative (Tables 3 and 4).

In general, farmland values reflect farm investors' expectations about future discounted returns both from the market and from government payments on base acres. The FAIR Act of 1996 generally lowered the market price and output distortions introduced by government price support programs. As a result, producers could and did respond more and more to market-based price signals. For example, although the distributions of real estate and non real estate assets became somewhat more unequally distributed in 2000 than in 1996, these distributions became more equally distributed in 2004 versus 2000. However, in the Northern Plains, these distributions became more equally distributed much sooner, beginning in 2000. This may be due to the fact that adjusting the crop mix in the Corn Belt might be easier to do since it largely involves only changing rotations. Some Northern Plains farmers

Table 1. Average Farm Wealth (Equity) by Wealth Categories for United States (selected regions and years)

Year and Wealth Class	United States	NE Region	Corn Belt Region	No. Plains Region	Southeast Region	So. Plains Region	Pacific Region
1996				Dollars			
$0–24,999	10,952	8,037	13,651	15,475	13,514	13,323	13,128
	(163,260)	(134,328)	(51,482)	(158,214)	(149,710)	(153,834)	(55,419)
$25,000–$49,999	38,312	33,345	39,144	39,528	37,072	40,665	30,366
	(128,395)	(56,137)	(65,609)	(139,571)	(96,858)	(68,015)	(79,406)
$50,000–$99,999	76,483	75,461	85,136	73,318	77,079	81,588	72,735
	(303,987)	(208,179)	(242,755)	(334,621)	(203,394)	(458,363)	(317,513)
$100,00–$249,999	157,248	169,792	161,843	166,193	168,035	148,221	157,517
	(777,982)	(699,749)	(807,099)	(519,539)	(745,145)	(691,668)	(828,696)
$250,000–$999,000	480,934	497,043	436,036	516,378	488,893	546,535	450,017
	(2,662,234)	(2,315,504)	(2,224,291)	(2,951,069)	(2,147,716)	(3,067,528)	(2,232,010)
$1,000,000 or more	1,960,312	2,114,375	1,496,590	1,593,102	2,252,954	2,081,584	2,178,909
	(25,683,687)	(17,033,803)	(4,045,568)	(7,801,633)	(71,483,495)	(20,053,145)	(19,443,758)
2000							
$0–24,999	15,237	12,063	10,438	19,903	16,661	19,016	12,527
	(146,898)	(152,758)	(159,904)	(121,060)	(112,196)	(130,252)	(161,423)
$25,000–$49,999	37,353	35,927	34,611	38,982	30,477	37,816	35,657
	(160,379)	(94,035)	(169,091)	(173,872)	(115,702)	(231,189)	(30,310)
$50,000–$99,999	74,991	70,607	77,534	70,168	75,708	77,996	67,370
	(335,753)	(240,592)	(299,677)	(271,360)	(245,687)	(565,456)	(275,343)
$100,00–$249,999	170,308	170,918	170,186	166,447	174,767	170,628	174,426
	(779,952)	(789,819)	(923,808)	(694,129)	(740,109)	(922,924)	(681,848)
$250,000–$999,000	482,390	473,355	477,028	531,538	462,417	477,496	486,879
	(2,670,654)	(2,456,385)	(3,362,758)	(2,431,020)	(2,509,143)	(2,696,956)	(2,893,290)
$1,000,000 or more	2,216,974	1,850,045	1,703,605	1,769,218	1,987,398	2,107,994	2,584,451
	(45,939,514)	(12,122,282)	(11,077,196)	(15,684,409)	(10,426,904)	(57,570,066)	(40,234,247)
2004							
$0–24,999	12,603	14,207	12,892	14,269	12,905	17,706	7,424
	(82,274)	(10,092)	(88,956)	(94,782)	(46,925)	(43,933)	(54,530)
$25,000–$49,999	37,995	42,283	38,632	39,064	37,005	32,171	35,361
	(92,974)	(47,424)	(123,467)	(44,179)	(110,563)	(95,226)	(40,735)
$50,000–$99,999	73,850	70,233	73,191	78,692	79,790	75,126	78,632
	(205,555)	(33.667)	(192,115)	(130,711)	(138,826)	(257,018)	(96,154)
$100,00–$249,999	175,543	186,930	168,334	180,747	176,612	167,862	190,333
	(577,694)	(663,579)	(633,938)	(367,348)	(413,259)	(727,500)	(308,975)
$250,000–$999,000	498,828	521,408	487,929	517,489	508,507	464,835	547,216
	(1,979,001)	(3,314,736)	(2,129,388)	(1,776,762)	(1,594,974)	(2,216,927)	(1,442,263)
$1,000,000 or more	2,359,521	2,163,014	2,029,878	1,984,215	2,599,478	1,820.430	3,142,021
	(24,211,332)	(26,314,552)	(12,818,943)	(10,387,558)	(17,436,686)	(12,482,444)	(27,127,005)

Source: USDA (various years).
Note: Numbers in parentheses are standard deviation.

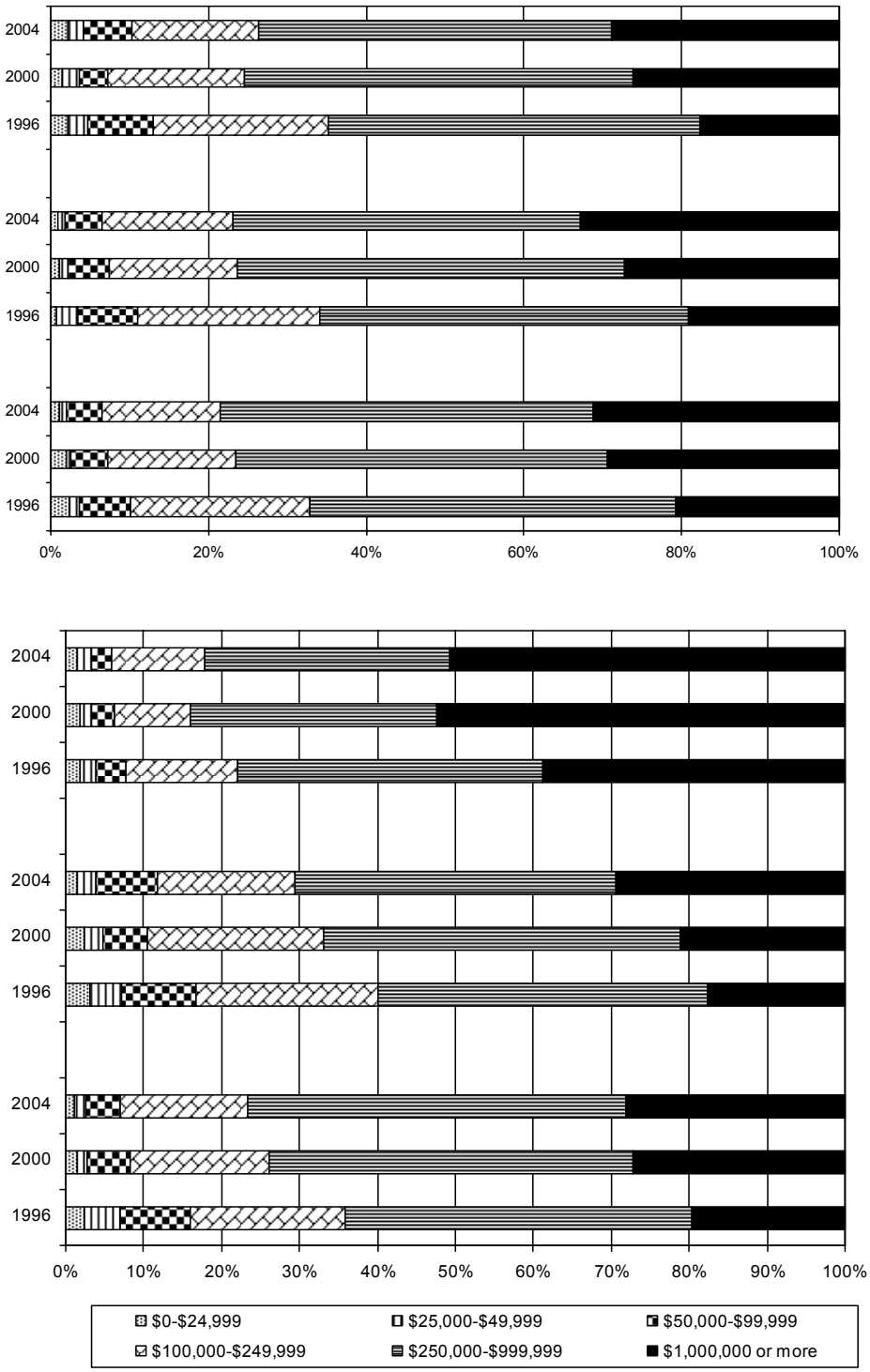

Figure 2. Distribution of Farms by Farm Wealth Categories (selected regions and years)

Source: USDA (various years).

Table 2. Total Inequality of Farm Wealth by Farms (Within and Between States) and Its Decomposition (by region and various years)

	1996		2000				2004			
Region	Within State	Across States	Within State	Across States	Change in 1996–2000 Within State (%)	Change in 1996–2000 Across States (%)	Within State	Across States	Change in 2000–2004 Within State (%)	Change in 2000–2004 Across States (%)
Northeast	6.859	0.241	6.738	0.026	-1.76	-3.70	6.688	0.049	-0.74	88.46
Lake States	7.316	0.027	6.752	0.009	-7.71	800.00	6.218	0.012	-7.91	33.33
Cornbelt	7.147	0.001	7.366	0.069	3.06	-14.81	6.219	0.056	-15.57	-18.84
Northern Plains	7.617	0.081	6.459	0.029	-15.20	-44.23	5.849	0.022	-9.44	-24.14
Appalachian	7.643	0.052	6.871	0.004	-10.10	-73.33	6.909	0.021	0.55	425.00
Southeast	7.121	0.015	6.815	0.011	-4.30	-64.52	6.211	0.005	-8.86	-54.55
Delta	7.482	0.031	6.850	0.008	-8.45	700.00	6.231	0.031	-9.04	287.50
Southern Plains	8.132	0.001	7.347	0.001	-9.65	-92.86	6.769	0.000	-7.87	-100.00
Mountain	6.541	0.014	6.981	0.179	6.73	1276.92	6.834	0.125	-2.11	-30.17
Pacific	6.859	0.013	6.981	0.069	-2.34	-15.85	5.770	0.056	-17.35	-18.84

Source: Authors' calculations using ARMS data (USDA, various years).

Table 3. Inequality in Real Estate Assets Among Farms in a State (by region and various years)

Region	1996	2000		2004	
	Within State	Within State	Relative Change in Within State (1996–2000)	Within State	Relative Change in Within State (2000–2004)
			Percent		*Percent*
Northeast	6.439	6.694	3.96	6.633	-0.91
Lake States	7.336	6.643	-9.45	6.177	-7.01
Cornbelt	7.175	7.311	1.90	6.177	-15.51
Northern Plains	7.605	6.298	-17.19	5.798	-7.94
Appalachian	7.629	6.846	-10.26	6.849	0.04
Southeast	7.089	6.836	-3.57	6.184	-9.54
Delta	7.571	6.911	-8.72	6.310	-8.70
Southern Plains	8.123	7.411	-8.77	6.779	-8.53
Mountain	6.586	6.799	3.23	6.843	0.65
Pacific	7.175	6.799	-5.24	5.688	-16.34

Source: Authors' calculations using ARMS data (USDA, various years).

Table 4. Inequality in Non Real Estate Assets Among Farms in a State (by region and various years)

Region	1996	2000		2004	
	Within State	Within State	Relative Change in Within State (1996–2000)	Within State	Relative Change in Within State (2000–2004)
			Percent		*Percent*
Northeast	6.759	7.156	5.87	7.066	-1.26
Lake States	8.030	6.999	-12.84	6.766	-3.33
Cornbelt	7.740	7.953	2.75	6.766	-14.93
Northern Plains	7.925	6.805	-14.13	6.329	-6.99
Appalachian	7.982	7.082	-11.28	7.224	2.01
Southeast	7.450	7.066	-5.15	6.463	-8.53
Delta	7.972	7.130	-10.56	6.313	-11.46
Southern Plains	8.520	7.585	-10.97	7.129	-6.01
Mountain	6.983	7.795	11.63	6.835	-12.32
Pacific	7.740	7.795	0.71	6.401	-17.88

Source: Authors' calculations using ARMS data (USDA, various years).

argued in the mid-1990s that planting flexibility did not really provide them much benefit since they had more limited alternatives and were already planting the best crop—wheat. However, this may have changed somewhat as more soybeans are now planted in that region, perhaps because new varieties of soybeans have provided more cropping options.

Decomposing the overall inequality into dispersion between farms within-state and across-states (between states) for a given region, one can derive additional insight.[5] Variations between states tend to reflect macroeconomic factors such as changes in farm structure (i.e., farm size, farm type). Variations within-state reflect microeco-

[5] It should be noted that the time period for this analysis (1997–2004), thirteen years, is not large enough to have a significant impact on number of farms in country or between regions. In general, number of farms has been stable, around 2.2 million over the last 15 years.

nomic conditions (such as farmland prices), which tend to be correlated among states in a region. Since farmland comprises about 80 percent of farm household wealth, changes in farm wealth are largely driven by changes in farmland supply and demand. Therefore, changes in the between- and within-state distribution of farm wealth suggest the extent to which farmland markets are becoming increasingly integrated across farms in the states and across states.

Changes in Inequality Within State

Overall, the inequality between farms within a state accounted for nearly 97 percent of the reduction in the total inequality in farm wealth between 1996 and 2004. The within-state inequality of farm wealth or equity ($\bar{I}$ in Equation 12) for each of the ten Economic Research Service (ERS) regions is presented in Table 2. There is a consistent pattern that emerges from this table; for example, within-state inequality in all regions has declined over the period 1996–2004, but the rate of decline varies with a region. In general, a reduction in farmland values and crop and livestock inventories inequality were the reasons behind the decline in the inequality in farm wealth among farms located in various regions. However, during the 1996–2000 period, within-farm inequality increased in the Corn Belt (3 percent) and Mountain (about 7 percent) regions. This is partly due to the rising inequality in real estate assets (or farmland values) of about 2 percent (Table 3), and increased levels of inequality in crop and livestock inventories (3 percent) (Table 4) within farms in the Corn Belt region. However, rising inequality in crop and livestock inventories (about 12 percent) outpaced inequality in farmland values (3 percent), and rising farmland values were a reason for increased farm wealth inequality within farms located in the Mountain regions (Tables 3 and 4).

Table 2 also presents the inequality in farm wealth of farms located in the Northeast, Mountain, and Pacific regions. Farms in the Northeast and Appalachia regions tend to be small and agriculture labor-intensive. Beginning in 1997, the inequality in farmland values and inventories of crop and livestock has been increasing among farms in the Northeast (Tables 3 and 4). This rise could be partly due to the growth in farmland values driven by urban pressure (Livanis et al. 2006) and to global trade (Blandford 1999). This growth in farmland values provides unrealized capital gains, thereby enhancing farm wealth. In addition, increased off-farm income from suburban employment opportunities may have also contributed to the growth in farm equity. However, in recent years within-state inequality in farmland values and crop and livestock inventories has decreased, leading to an overall decline in inequality in wealth among farms located in the Northeast region.

The Pacific and Mountain regions show a very similar pattern over time. The inequality in farm wealth within farms located in the Mountain region increased from 6.541 in 1996 to 7.160 in 2000, an approximately 9 percent increase over the period 1996–2000. This was due to rising inequality in farmland values and crop and livestock inventories. For example, during this period farms in the region observed a 3 percent rise in inequality in real estate assets (mainly farmland) coupled with a 12 percent rise in inequality in non real estate assets, such as crop and livestock inventories. However, during the 2000–2004 period, inequality in non real estate assets decreased by approximately 12 percent (Table 4), more than compensating for the rise in farmland values, less than 1 percent (Table 3). Farms located in the Pacific region (California, Oregon, and Washington) saw their share of equity rise because of increased foreign and domestic demand for grains, fruits, and vegetables. Within-farm wealth inequality in the Pacific region decreased by almost 17 percent, from 7.05 in 2000 to 5.826 in 2004. This is due to rising equality in farmland values and crop and livestock inventories. Table 3 shows that inequality in farmland values decreased by approximately 16 percent over the period 2000–2004, whereas inequality in crop and livestock inventories decreased by about 18 percent (Table 4). One plausible explanation is that farms in this region produce fruits and vegetables and high value crops, which have domestic as well as foreign markets, and also that the region's agricultural sector is expanding, such as in dairy farming and value-added through dairy farming. Another possible explanation for a 16 percent decrease in the within-state Theil entropy measure (2000–2004) in the Pacific states may be the influence of urbanization and other non-farm factors affecting the demand for and price of farmland in the Pacific states.

Changes in Inequality Between Farms Across State

The inequality in farm wealth across states (I_R) in a given region accounted for 1 percent or less in the total inequality between 1996 and 2004. During this period, agriculture in the United States went through significant structural changes. The average size of farms increased through consolidation. These changes were partly due to a more open and global economy, greater capital and labor mobility, and the deregulation of capital markets. The expansion/consolidation of agriculture resulted in a more even distribution of wealth across the regions relative to the number of farms in each state. Table 2 shows that during the 1996–2000 period, between-farm inequality across states increased for Mountain states, Lakes states, and the Delta region. On the other hand, during the 2000–2004 period, between-farm inequality across states increased for the Appalachian and Delta regions. However, in absolute terms these changes are very small and have a low impact on the total inequality in farm wealth (Table 2). This suggests that since 1996 the regions have been becoming more similar, and/or that macroeconomic and structural differences in agriculture have declined.

Since 1994 the distribution of farm assets (a major component of farm wealth) became more uniformly distributed between regions. This is consistent with a regime shift from 1996 to the present. Under the FAIR Act, farmers were able to make more market-oriented planting and cropping decisions. As a result, short-run assets (inventories, purchased inputs, and other farm financial assets) and real estate (long-term) were reallocated across crop portfolios, and net returns and farm wealth became more uniformly distributed across regions [Blank, Erickson, and Moss 2005 (p. 222), Blank et al. 2004 (pp. 1302–1304)]. Also, the Food Security and Rural Investment Act of 2002 (or 2002 Farm Bill) builds on previous policy and institutionalizes an improved safety net for farmers through a new countercyclical income stabilization program. The FSRI Act continues the series of fundamental changes in commodity and other agricultural policies designed to move the sector toward more market-oriented decisions. Program changes for dry peas, lentils, dairy, and peanuts suggest increases in production of these commodities. Additional market effects may result from countercyclical payments, direct payments, and provisions of the 2002 Farm Act that permit the updating of base acreage and payments yields. These payments may provide indirect incentives that influence production decisions and overall agricultural output.

Summary and Conclusions

This study analyzes the change in the distribution of farm wealth in farms within state and between states for a given region, using Theil's measure of inequality. It uses farm-level data from the USDA's Agricultural Resource Management Survey (ARMS) for the years 1996, 2000, and 2004. Theil's measure is used in this study because of its consistency and the desirable properties it has compared to other measures of inequality, Gini coefficients, or the coefficient of variation. Most of these desirable properties result from the decomposability of the Theil measure. Specifically, the aggregate Theil measure can be decomposed into regional inequality measures that obey the Pigou-Dalton transfer, symmetry, and homogeneity principles required of inequality measures. This decomposition allows for analysis of inequality across and within regions. This allows for the comparison of macroeconomic factors affecting the inequality across regions with microeconomic factors that typically affect the inequality within each region.

In general the results indicate that the distribution of farm wealth has changed significantly from 1996 through 2004. The highest level of total farm-level inequality (8.146) was observed in 1996 for farms located in Texas and Oklahoma in the Southern Plains region of the United States, followed by farms located in the Northern Plains, Appalachian, and Delta regions. This study shows that total inequality among farms in various states has decreased over the 1996–2004 period. However, during the same period, total inequality increased for farms located in the Corn Belt and Mountain regions of the United States. This is mainly due to a rise in the inequality in farmland values in these regions (2 and 3 percent, respectively). Further, results also show that within-farm inequality, ranging from approximately 95 to 99 percent, contributed more to the total ine-

quality. Under the 1996 FAIR Act, farmers were freer to make more market-oriented planting and cropping decisions. As a result, short-run assets (inventories, purchased inputs, and other farm financial assets) and real estate (long-term) assets were reallocated across crop portfolios. Consequently, net returns and farm wealth became more uniformly distributed within farms in a state and across states. Additionally, the 2002 Farm Act may also provide incentives to expand production in nontraditional commodities, such as dry peas and lentils, and to increase profitability and farm wealth.

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