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Abstract

Changes in individual states' agricultural production diversity and variance of cash receipts were measured over the 30-year period 1960 through 1989. Diversity was measured using a general index, of which the inverse Herfindahl and the Entropy are special cases. Cash receipt variability was measured using a heteroscedasticity correction process. Although 38 states experienced an increase in cash receipt variability, only 14 states also experienced a decrease in diversification. Thus, it appears that an increase in cash receipt variability was not due to a reduction in diversification for most states.

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Introduction

Diversity has become a popular concept in agriculture. Debates have occurred on whether the genetic material of our crops is sufficiently diversified to meet environment challenges and whether we are losing species (Wilson). Discussions on diversity and sustainability have also occurred at the individual farm and regional levels (Paoletti, Stinner, and Lorenzoni). The farm economic boom of the '70s and the financial crisis of the '80s demonstrated that specialization at the farm or state level can produce benefits from economies of size, but financial risks can increase. Those events motivated a study undertaken by the Economic Council of Canada to measure the diversification of prairie agriculture and how it is impacted by various policies (Schmitz).

In diversification discussions, a knowledge of the potential benefits and costs of further diversification are paramount. To estimate these benefits and costs, it is necessary to measure the extent of diversification. Only then can a linkage be established between diversification efforts and benefits. Previous diversification changes can be related to measures of welfare to determine the relationship between diversity and welfare. Similarly, diversity measures can be related to structural changes in order to determine what structural changes might be altered in order to increase diversity. If policy is initiated to increase diversity, it is also useful to be able to measure whether diversity is indeed increased.

This study concentrates on measuring agricultural production diversity. Individual state diversity is measured annually over the period 1960 through 1989. An attempt is made to determine the benefits of diversification by comparing diversification changes to changes in the variability of cash receipts over the same time period.

To measure diversity, commodity cash receipts by state are used. This measures diversity across commodities but fails to differentiate diversity by production practice. Although various production practices might not reduce commodity price variability, they could reduce yield and cost variability. Unfortunately, data are not available to differentiate by production practices. Likewise, cash receipts are a gross rather than a net measure. A more appropriate measure would be value added or net income. Again, these data are not available.

There are also calls for diversification into further processing or value added activities (Reed and Marchant). Even diversification of resources out of agriculture is an option. Those are useful efforts, but this article concentrates on diversification within production agriculture.

Measuring Diversification

Various indices have been devised to measure diversification, and their mathematical properties are extensively discussed in Patil and Taillie. Hannah and Kay state that most common indices are special cases of the form

$$I_\phi = \left(\sum_{i=1}^{n} S_i^\phi\right)^{1/(1-\phi)}$$

where S_i is the share of the i^{th} item and ϕ is a parameter, $\phi \geq 0,\ \phi \neq 1.$ For $\phi = 2$, the index becomes $1/\sum_{i=1}^{n} S_i^2$, or the inverse of the Herfindahl index, commonly used in economics to measure disparity. For the limit as ϕ approaches 1, the index becomes the Entropy index, $-\sum_{i=1}^{n} S_i \ln S_i$, where ln is the natural log.

This general index measures both the number of items and the evenness of item shares, with the parameter ϕ determining the weighting of emphasis on number of items versus evenness. The higher the ϕ value, the greater the emphasis on evenness. A parameter value of $\phi = 0$ simply counts the number of items.

The upper limit value for the index for any phi parameter employed is the number of items. This upper value occurs only if shares are equal ($S_i = S_j$ for all i,j). As more unevenness occurs, the index value at any ϕ parameter becomes smaller, although the rate of decrease in the index value as production becomes more concentrated in a few commodities is greater at higher ϕ parameters (Hill). This study uses a ϕ value of 100. The data used are from 25 commodity groups, with many states producing each of the 25 commodities, so evenness is a more differentiating attribute than the number of commodities.

The data were compiled by Robert William of ERS-USDA and are available in a computer spreadsheet file. A general discussion of data collection can be found in the annual series, *Economic Indicators of the Farm Sector, State Financial Summary*. For each state and year from 1960 through 1989, cash receipts for the 25 leading U.S. commodities are available. To compute the index, a 26th commodity as the residual of total cash receipts was computed for each state. The 25 commodities comprise all but 10 percent of U.S. cash receipts over the 30-year period. That percent of unrepresentation varies significantly by state, ranging in 1988 from a low of 1.12 percent for Iowa to a high of 41.44 percent for

Oregon. Unlike Iowa, Oregon produces many fruits, nuts, and vegetables that are not among the top 25 commodities. In general, the 25 commodities cover most of what many states in the Midwest, Plains and Southeast produce. That is less true for the states on the coasts and in the Southwest.

The use of only 25 commodity groups when more commodity groups are available was a pragmatic necessity when considering the cost of tabulating printed data for multiple states and commodities over 30 years. Excluding commodities introduces bias into the analysis, but the degree of bias can be measured by comparing, for 1988, the results obtained here with earlier analyses by Tauer which included all commodities. The current index (using 25 commodities) and the previous index using selected commodities are very similar for most states. For Alabama, the current index value is 2.61, while the previous index value was 2.59. Even in states where the percent residual was over 10 percent, the indices usually are comparable in value. Examples include Alaska, with a current index value of 2.19 and a previous index value of 2.20, and New Mexico, with a current and previous index value of 1.79. Exceptions are California, with a current index value of 3.45 versus a previous index value of 8.15, as well as Oregon, Washington, and West Virginia. Except for West Virginia, these are all Pacific Coast states. A numerical correlation of the current and previous index for the 50 states is .81; removing California, Oregon, Washington, and West Virginia increases that value to .99. In general, it appears that for most states little is lost using only the top 25 commodities to measure diversity.

Diversification Results

Individual state diversification indices from 1960 through 1989 are available from the authors. Plotted index values for each state suggest that diversity may have varied for a number of states, with increases and decreases over different intervals, implying a process other than linear would be necessary to fit the observations. However, a nonlinear approach would have complicated a systematic approach to a general conclusion for each state concerning change over the 30-year period. Thus, to conclude whether an individual state experienced a general decrease or increase in diversification over the study period, a trend line of the form $D_t = \gamma + \delta t$ was filled for each state, where D_t is the annual diversification value and t represents years (t=1, 2,..., 30). When the Durbin-Watson statistic was lower than 1.50, an autoregressive process of order 1 was added to that state's regression. The results are summarized in Table 1. A two-tailed test of the null hypothesis $\delta = 0$ at $\alpha = .10$ is used to determine whether a state experienced an overall increase or decrease in diversification. By that standard, 15 states experienced a decrease in diversification, 10 experienced an increase, and 25 saw no change. These are summarized in Table 4.

Although 15 states experienced a decrease in diversification, the greatest decline was 10 basis points a year recorded in Georgia. Rhode Island decreased 9 basis points a year; Alabama, 7; and Illinois and New Jersey, 5. Many other states experienced a decrease of two to four basis points yearly. A five basis point reduction annually means a reduction in the diversification index of 1.5 points over the 30-year period.

New Hampshire experienced the greatest increase in diversification, averaging 24 basis points per year. Arizona increased 12 basis points a year, and North Carolina and South Carolina both increased 11 basis points a year. A number of other states had increases of 4 basis points per year.

As expected, states that are contiguous and have comparable agriculture have similar values of diversification that changed similarly over the 30 years. An example is Kansas, with an intercept of 2.28 and slope of -.01, and Nebraska, with an intercept of 2.21 and slope, also, of -.01.

Measuring Variability of Cash Receipts

In order to determine any relationship between a change in a state's diversification and any variation in its cash receipts over the 30-year period, it was necessary to measure the variance of each state's total cash receipts. The procedure specified by Just and Pope for estimating stochastic production functions was utilized, but rather than output, a state's total cash receipts, deflated by the CPI (1960=100), was specified as the dependent variable. Time rather than inputs was specified as the independent variable. This specification allowed the determination of the change in mean cash receipts and variance of cash receipts over time.

The Just and Pope procedure is essentially an heteroscadasticity correction process. The general specification is

$$R_t = f(t,\alpha) + h(t,\beta)\ \varepsilon_t$$

where R_t is annual cash receipts, t is time, α is the parameters of the mean function, β is the parameters of the variance function, and ε_t is a stochastic term such that $E(\varepsilon_t) = 0,\ Var(\varepsilon_t) = 1,\ E(\varepsilon_t \varepsilon_T) = 0$ for all $t \neq T$. OLS estimates of α are unbiased and consistent but asymptotically inefficient (Just and Pope). To improve asymptotic efficiency, Just and Pope propose estimating $h(t,\beta)$ and using this estimate to form GLS estimates of $f(t,\alpha)$.

Following Just and Pope, we use the functional form

$$h(t,\beta)\ \varepsilon_t = \beta_0 t^{\beta_1}\ \varepsilon_t$$

where $\beta_1 > 0$ indicates an increase in cash receipt's variability (variance) over time while $\beta_1 < 0$ indicates a reduction. The value of β_0 establishes the initial variance. As Just and Pope, and McCarl and Rettig state, the correct constant term is found by multiplying the constant $\hat{\beta}_0$ by $e^{-.6502}$=.5219.

Although one might expect deflated cash receipts to display a geometric growth rate, plots for a number of states showed various patterns. Thus, a polynomial of the third degree was used to estimate f, after initial attempts with a quadratic failed to converge for many states, using the iterative process described below:

$$f(t,\alpha) = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t^3.$$

Griffiths and Anderson suggest an iterative approach to estimating the functions f and h which is utilized here. Buccola and McCarl show that the small sample accuracy of Just and Pope's procedure is improved using that procedure.

The following steps were involved:

(1) R_t was regressed on t, t^2 and t^3 to generate estimates of α_0, α_1, α_2, and α_3.

(2) Predicted values of $\hat{R}_t$ from step (1) were subtracted from R_t to give an initial set of residual estimates $\hat{\mu}_t = R_t - \hat{R}_t$. Logged absolute values of $\hat{\mu}_t$ were then regressed on log of t,

$$\ln|\hat{\mu}_t| = \ln \beta_0 + \beta_1 \ln|t| + \ln|e_t|$$

giving estimates of β_0 and β_1.

(3) $R_t / \beta_0 t^{\beta_1}$ was regressed on $1/\beta_0 t^{\beta_1}$, $t/\beta_0 t^{\beta_1}$, $t^2/\beta_0 t^{\beta_1}$ and $t^3/\beta_0 t^{\beta_1}$ where β_0 and

β_1 are taken from step (2). This generated revised estimates of α_0, α_1, α_2, and α_3.

(4) New predicted values of $\hat{R}_t$ from using step (3) were found and deducted from R_t to give a revised set of residual estimates. Logged absolute values of these residuals were regressed on the log of t as stated in step (2).

(5) Sequences (3) and (4) were repeated until the estimates of α and β converged. Convergence was determined when the new estimates did not differ from the previous estimates by more than 5 percent.

Variance Results

For most states, five iterations were necessary for convergence (Table 2). A few states required more iterations, and six states (California, Indiana, Kansas, Maine, Nevada and North Carolina) did not converge even after twenty iterations. For those six states, a fifth degree polynomial was used (Table 3). The equations fit the states' data very well, with R^2 values generally in the high .9 range except for a few states.

The cubic function for mean receipts allowed flexibility in fitting a function to each state's cash receipts over the 30-year period. For most states, the quadratic coefficient on time was positive and the cubic coefficient was negative. About one-half of the linear terms were negative. The standard errors on the mean terms were relatively small, indicating a good fit for most states.

The six states with the fifth degree polynomial had mixed signs on the linear, quadratic and cubic terms, but in all cases, the fourth power term was negative and the fifth power term was positive. The sign on the log of time in the variance component of the regression was positive in four of the six states.

Thirty-eight states experienced an increase in the variability of their cash receipts over the 30-year period, eleven states experienced level variation and only one state, Massachusetts, experienced a decrease. These results indicate that most states experienced an increase in cash receipts variability over the 30-year period. Colorado, Nebraska and Oklahoma, all cattle producing states, experienced the largest increase in cash receipt variance, along with Indiana, North Carolina and Oregon.

Of interest here is the relationship between the change in diversification over the 30-year period and the change in variability of cash receipts. Table 4 sorts the states by change in diversification and change in variance. Fourteen states experienced both a decrease in diversification and an increase in the variance of cash receipts. However, nine states experienced both an increase in diversification and an increase in cash receipts variability, and another fifteen states experienced constant diversification and an increase in cash receipt variability.

These results do not necessarily indicate a cause-and-effect relationship between diversification and cash receipt variability. However, the fact that many contiguous states are similarly grouped would indicate that these groupings may not be random and that similar changes have occurred in those states. Examples include Illinois and Indiana, Alabama and Georgia in the diversification decrease, variance increase group; Colorado and New Mexico in the diversification constant, variance increase group; Iowa and Minnesota in the diversification increase, variance increase group; and North Dakota and South Dakota in the diversification constant, variance constant group. The cluster analysis performed by Sommer and Hines to group states by similar agriculture also pairs these respective states. At the same time there are a few states not grouped that one might expect to be grouped.

Examples include Kentucky and Tenessee; Connecticut and Massachusetts; and Maryland and Virginia.

Summary and Conclusions

The diversification of production agriculture in each of the fifty states was measured over the period 1960 through 1989 to determine which, if any, states became less or more diversified over that period. Fifteen states became less diversified and ten states became more diversified with twenty-five states remaining constant.

To determine the relationship between a state's diversification and variation in its cash receipts over the 30-year period, the change in variance of each state's total cash receipts was also measured. Thirty-eight states experienced an increase in cash receipt variability, eleven states experienced no change, and one state saw a decrease.

Although 38 states experienced an increase in variance, less than half of those (14) experienced both a decrease in production diversification and an increase in variance of cash receipts. This may be a concern for these states, but in general, most states have not seen a decrease in diversification and an increase in cash receipts variability.

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Table 1. Trend Line Analysis of Diversification Indices.

State	Intercept	Slope	AR(1)	R^2	DW
Alabama	5.23	-0.07	0.56	0.65	2.16
	(11.14)	(-3.03)	(3.39)		
Alaska	2.91	-0.02	0.80	0.61	1.97
	(2.97)	(-0.42)	(6.15)		
Arizona	0.43	0.12	0.89	0.81	1.65
	(0.14)	(1.18)	(8.78)		
Arkansas	4.37	-0.03	-0.57	0.33	2.24
	(6.44)	(-0.79)	(3.49)		
California	4.41	-0.03		0.22	1.52
	(23.54)	(-2.77)			
Colorado	1.50	0.01	0.76	0.70	1.60
	(6.39)	(0.80)	(7.61)		
Connecticut	3.67	-0.01	0.43	0.20	1.73
	(24.54)	(-0.89)	(2.32)		
Delaware	2.08	-0.02	0.50	0.71	2.03
	(24.29)	(-3.99)	(2.95)		
Florida	3.73	0.02	0.55	0.46	1.67
	(12.04)	(1.49)	(3.35)		
Georgia	6.67	-0.10	0.68	0.64	2.65
	(7.47)	(-2.18)	(4.91)		
Hawaii	1.56	0.03	0.45	0.56	2.16
	(8.56)	(3.17)	(2.69)		
Idaho	4.20	-0.01	0.51	0.32	1.95
	(11.73)	(-0.57)	(3.03)		
Illinois	4.16	-0.05	0.54	0.71	1.86
	(14.21)	(-2.96)	(2.87)		
Indiana	4.16	-0.02		0.18	1.80
	(31.10)	(-2.48)			
Iowa	2.73	0.04	0.55	0.70	1.86
	(12.76)	(3.20)	(3.34)		
Kansas	2.28	-0.01	0.66	0.56	1.38
	(7.80)	(-0.90)	(4.70)		
Kentucky	2.35	0.06		0.76	2.19
	(19.78)	(9.48)			

-continued-

Table 1. Trend Line Analysis of Diversification Indices (continued).

State	Intercept	Slope	AR(1)	R^2	DW
Louisiana	4.52 (4.80)	0.01 (0.11)	0.63 (4.15)	0.40	1.85
Maine	3.84 (11.41)	-0.00 (-0.23)	0.27 (1.40)	0.07	1.48
Maryland	4.01 (61.89)	-0.03 (-8.78)		0.73	2.27
Massachusetts	3.40 (20.05)	-0.01 (-0.70)	0.53 (2.99)	0.27	1.74
Michigan	3.52 (15.27)	0.03 (2.22)	0.51 (3.01)	0.53	1.83
Minnesota	4.22 (11.88)	0.04 (1.97)	0.55 (3.30)	0.56	2.22
Mississippi	3.22 (4.69)	0.04 (1.02)	0.62 (4.04)	0.55	2.07
Missouri	3.30 (12.75)	0.03 (2.38)	0.50 (3.05)	0.52	2.03
Montana	2.25 (14.67)	-0.00 (-0.38)	0.43 (2.44)	0.20	1.94
Nebraska	2.21 (10.51)	-0.01 (-0.73)	0.64 (4.29)	0.46	1.46
Nevada	1.46 (9.39)	0.02 (2.82)	0.47 (2.57)	0.54	1.72
New Hampshire	-7.18 (-0.12)	0.24 (0.27)	0.97 (7.70)	0.70	1.89
New Jersey	4.28 (54.07)	-0.05 (-12.02)	0.15 (0.77)	0.88	1.98
New Mexico	1.42 (3.44)	0.02 (0.91)	0.79 (7.15)	0.67	1.95
New York	1.91 (32.31)	-0.00 (-1.50)	0.59 (3.49)	0.56	1.95
North Carolina	1.42 (2.92)	0.11 (4.56)	0.68 (4.81)	0.88	2.06
North Dakota	2.13 (3.06)	0.03 (0.93)	0.78 (5.82)	0.59	1.84

-continued-

Table 1. Trend Line Analysis of Diversification Indices (continued).

State	Intercept	Slope	AR(1)	R^2	DW
Ohio	5.23	-0.03		0.18	1.55
	(26.88)	(-2.44)			
Oklahoma	1.85	0.00	0.64	0.62	1.87
	(7.10)	(0.05)	(5.57)		
Oregon	2.93	0.00		0.00	1.53
	(19.92)	(0.16)			
Pennsylvania	2.37	0.00	0.42	0.19	2.16
	(32.13)	(0.13)	(2.41)		
Rhode Island	4.63	-0.09	0.80	0.89	2.21
	(6.65)	(-2.93)	(8.41)		
South Carolina	3.34	0.11	0.48	0.67	2.16
	(6.29)	(3.74)	(2.72)		
South Dakota	2.19	0.00	0.36	0.13	1.89
	(15.36)	(0.18)	(1.96)		
Tennessee	4.69	-0.01	0.61	0.39	1.69
	(7.41)	(-0.32)	(3.91)		
Texas	3.24	-0.04	0.61	0.75	1.67
	(10.44)	(-2.69)	(3.87)		
Utah	1.66	-0.01	0.37	0.23	1.83
	(33.58)	(-3.20)	(2.02)		
Vermont	1.32	-0.00	0.58	0.44	2.00
	(31.22)	(-0.94)	(3.39)		
Virginia	5.61	-0.01		0.03	1.60
	(26.94)	(-0.96)			
Washington	3.82	0.04		0.31	1.62
	(20.55)	(3.58)			
West Virginia	4.47	-0.04	0.35	0.40	1.74
	(14.17)	(-2.54)	(1.85)		
Wisconsin	1.91	-0.01		0.57	1.51
	(71.19)	(-6.08)			
Wyoming	1.67	-0.01	0.45	0.41	1.86
	(17.00)	(-1.82)	(2.54)		

* 10% significance level.
** 5% significance level.
*** 1% significance level.

Table 4. Sorting of States.

Diversification	Variance of Cash Receipts: Increase	Constant	Decrease
Increase	HI IA KY MN MO NC NV SC WA	MI	
Constant	AK AZ AR CO FL ID LA MS NE NH NM NY OK OR PA	CN KS ME MT ND SD TN VA VT	MA
Decrease	AL CA DE GA IL IN MD NJ OH RI TX UT WI WY	WV	

AL = Alabama
AK = Alaska
AZ = Arizona
AR = Arkansas
CA = California
CO = Colorado
CT = Connecticut
DE = Delaware
FL = Florida
GA = Georgia
HI = Hawaii
ID = Idaho
IL = Illinois
IN = Indiana
IA = Iowa
KS = Kansas

KY = Kentucky
LA = Louisiana
ME = Maine
MD = Maryland
MA = Massachusetts
MI = Michigan
MN = Minnesota
MS = Mississippi
MO = Missouri
MT = Montana
NE = Nebraska
NV = Nevada
NH = New Hampshire
NJ = New Jersey
NM = New Mexico
NY = New York

NC = North Carolina
ND = North Dakota
OH = Ohio
OK = Oklahoma
OR = Oregon
PA = Pennsylvania
RI = Rhode Island
SC = South Carolina
SD = South Dakota
TN = Tennessee
TX = Texas
UT = Utah
VT = Vermont
VA = Virginia
WA = Washington
WV = West Virginia
WI = Wisconsin
WY = Wyoming

Table 2. Regressions of Mean and Variance of Cash Receipts.

	Mean					Variability			
State	Constant	Time	$Time^2$	$Time^3$	R^2	Constant**	Ln Time	R^2	Stage of convergence
Alabama	504633.44	7395.59	988.57	-40.37	1.00	7.78	1.09	0.60	5
	(67.47)	(1.35)	(1.53)	(-2.21)		(17.69)	(6.53)		
Alaska	4612.60	-210.27	14.37	-0.13	0.94	4.67	0.46	0.14	5
	(22.56)	(-2.55)	(1.97)	(-0.75)		(8.16)	(2.13)		
Arizona	445981.81	5389.80	809.65	-34.89	0.91	9.58	0.39	0.13	9
	(16.58)	(0.53)	(0.93)	(-1.74)		(19.19)	(2.04)		
Arkansas	649332.01	34332.80	357.83	-43.55	0.98	9.20	0.74	0.33	5
	(25.75)	(2.53)	(0.26)	(-1.26)		(17.31)	(3.68)		
Colorado	639987.47	-16267.66	5750.48	-175.85	1.00	7.26	1.33	0.33	10
	(68.48)	(-2.02)	(5.34)	(-5.40)		(7.70)	(3.71)		
Connecticut	148008.43	-18.06	-196.38	4.74	0.82	8.21	-0.09	0.01	7
	(30.88)	(-0.01)	(-2.32)	(2.76)		(18.49)	(-0.55)		
Delaware	109450.37	-414.51	198.15	-5.07	0.96	7.68	0.51	0.22	5
	(23.76)	(-0.21)	(1.11)	(-1.19)		(15.93)	2.81		
Florida	769448.03	24533.51	1333.88	-49.67	0.94	9.57	0.44	0.13	5
	(25.60)	(2.07)	(1.28)	(-2.04)		(17.25)	(2.07)		
Georgia	697923.91	29547.72	289.85	-38.57	1.00	8.52	0.89	0.51	5
	(52.54)	(3.59)	(0.33)	(-1.65)		(19.70)	(5.42)		
Hawaii	148612.91	4698.51	-88.31	-2.84	0.91	7.84	0.50	0.11	10
	(13.24)	(1.00)	(-0.21)	(-0.28)		(10.96)	(1.82)		
Idaho	435459.99	-12638.77	3076.74	-86.46	1.00	7.70	1.03	0.50	5
	(54.55)	(-2.26)	(4.81)	(-4.90)		(15.14)	(5.34)		
Illinois	1991687.60	16272.88	5568.79	-227.40	0.98	10.07	0.68	0.19	10
	(28.59)	(0.46)	(1.63)	(-2.66)		(14.65)	(2.60)		

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Table 2. Regressions of Mean and Variance of Cash Receipts (continued).

State	Mean					Variability			
	Constant	Time	$Time^2$	$Time^3$	R^2	Constant**	Ln Time	R^2	Stage of convergence
Iowa	2373599.00	51599.06	6438.13	-294.79	0.97	10.45	0.57	0.19	10
	(23.44)	(1.13)	(1.52)	(-2.86)		(17.76)	(2.55)		
Kentucky	575584.70	7603.46	1533.37	-57.56	0.96	9.41	0.45	0.16	8
	(24.69)	(0.82)	(1.87)	(-2.99)		(18.52)	(2.32)		
Louisiana	350138.39	24419.21	-89.54	-24.23	0.99	7.94	0.90	0.29	5
	(35.14)	(3.93)	(-0.13)	(-1.36)		(11.47)	(3.42)		
Maryland	275237.62	1065.49	397.38	-13.57	1.00	6.87	0.92	0.28	4
	(81.64)	(0.50)	(1.72)	(-2.20)		(9.36)	(3.28)		
Massachusett	183049.43	-9164.42	417.09	-6.70	0.94	9.14	-0.41	0.13	10
	(20.65)	(-4.89)	(3.55)	(-3.03)		(17.25)	(-2.03)		
Michigan	738756.83	-13225.73	2582.47	-74.85	0.95	9.45	0.39	0.09	5
	(25.07)	(-1.25)	(2.84)	(-3.57)		(15.81)	(1.69)		
Minnesota	1447361.50	-27977.63	8343.84	-252.11	1.00	8.45	1.03	0.29	20
	(58.34)	(-1.61)	(4.20)	(-4.60)		(10.41)	(3.35)		
Mississippi	583975.80	25862.86	-526.71	-14.67	0.87	10.21	0.30	0.15	5
	(14.22)	(1.83)	(-0.45)	(-0.56)		(29.33)	(2.25)		
Missouri	1122636.00	-16993.81	4757.56	-154.22	1.00	8.84	0.88	0.40	10
	(58.34)	(-1.45)	(3.81)	(-4.69)		(16.72)	(4.35)		
Montana	354917.53	12105.94	447.21	-30.66	0.70	9.81	0.25	0.04	7
	(9.14)	(0.94)	(0.43)	(-1.32)		(15.78)	(1.08)		
Nebraska	1198109.50	-18131.07	8964.38	-263.99	1.00	8.05	1.35	0.54	8
	(83.52)	(-1.45)	(5.33)	(-5.16)		(13.14)	(5.78)		

-continued-

Table 2. Regressions of Mean and Variance of Cash Receipts (continued).

State	Mean					Variability			
	Constant	Time	$Time^2$	$Time^3$	R^2	Constant**	Ln Time	R^2	Stage of convergence
New Hampshire	57691.31	-784.25	-44.71	1.46	1.00	5.90	0.50	0.13	5
	(67.29)	(-2.20)	(-1.39)	(1.91)		(9.36)	(2.07)		
New Jersey	309204.21	-13579.03	385.71	-3.33	1.00	7.06	0.44	0.10	10
	(81.59)	(-9.05)	(2.92)	(-1.08)		(10.81)	(1.78)		
New Mexico	227384.86	4887.26	859.13	-33.74	1.00	7.56	0.98	0.34	8
	(63.14)	(-0.62)	(2.89)	(-3.60)		(13.34)	(3.82)		
New York	849842.75	1247.29	295.67	-18.49	1.00	7.93	0.75	0.34	3
	(116.30)	(0.32)	(0.74)	(-1.82)		(15.30)	(3.82)		
North Dakota	510352.19	4910.15	3037.66	-108.95	0.66	9.85	0.43	0.07	10
	(7.53)	(0.19)	(1.31)	(-2.01)		(12.89)	(1.48)		
Ohio	1004360.50	-6313.25	3233.16	-108.24	1.00	8.58	0.94	0.34	10
	(63.17)	(-0.62)	(2.89)	(-3.60)		(13.34)	(3.82)		
Oklahoma	755725.91	-58426.02	8614.41	-235.03	1.00	6.84	1.60	0.49	10
	(106.95)	(-8.39)	(7.94)	(-6.58)		(8.43)	(5.18)		
Oregon	414836.36	-1521.36	1041.30	-30.56	1.00	6.41	1.41	0.56	8
	(131.45)	(-0.54)	(2.64)	(-2.51)		(10.46)	(6.02)		
Pennsylvania	830152.03	-21840.00	2584.52	-62.49	1.00	8.28	0.67	0.39	5
	(98.90)	(-5.22)	(6.36)	(-6.17)		(19.96)	(4.24)		
Rhode Island	22393.16	-521.78	-20.45	1.24	1.00	4.77	0.77	0.40	4
	(77.04)	(-3.24)	(-1.24)	(2.95)		(10.12)	(4.32)		
South Carolina	350582.83	891.42	450.47	-20.23	0.92	9.26	0.34	0.11	3
	(18.07)	(0.13)	(0.77)	(-1.53)		(19.55)	(1.86)		

-continued-

Table 2. Regressions of Mean and Variance of Cash Receipts (continued).

	Mean					Variability			
State	Constant	Time	Time^2	Time^3	R^2	Constant**	Ln Time	R^2	Stage of convergence
South Dakota	460753.38 (4.20)	62646.65 (2.20)	-2187.02 (-1.08)	10.63 (0.25)	0.58	10.87 (14.35)	-0.05 (-0.16)	0.00	15
Tennessee	521743.13 (16.55)	-4760.87 (-0.50)	1533.41 (2.07)	-48.87 (-3.04)	0.73	9.74 (17.84)	0.15 (0.74)	0.02	3
Texas	2380190.50 (20.25)	-66039.14 (-1.29)	13171.01 (2.81)	-376.53 (-3.34)	0.95	10.63 (14.59)	0.54 (1.94)	0.12	5
Utah	163000.56 (45.13)	-2509.75 (-1.37)	440.33 (2.46)	-12.45 (-2.78)	0.99	7.13 (10.59)	0.69 (2.69)	0.20	10
Vermont	125873.13 (35.02)	-2485.93 (-2.21)	316.31 (3.57)	-8.87 (-4.57)	0.95	7.72 (13.45)	0.19 (0.87)	0.03	5
Virginia	464899.75 27.13)	-3865.88 (-0.64)	748.50 (1.48)	-21.30 (-1.86)	0.95	9.06 (16.49)	0.32 (1.55)	0.08	4
Washington	578104.78 (69.02)	-10603.46 (-1.60)	3346.74 (4.08)	-95.07 (-4.00)	1.00	7.59 (13.51)	1.19 (5.58)	0.53	8
West Virginia	110881.42 (37.70)	-4106.11 (-3.96)	169.06 (1.95)	-2.57 (-1.31)	0.98	7.23 (13.26)	0.32 (1.56)	0.08	10
Wisconsin	1116845.80 (79.14)	-13744.46 (-1.72)	4347.17 (5.27)	-126.16 (-5.92)	1.00	8.45 (11.94)	0.80 (2.97)	0.24	10
Wyoming	158129.31 (15.23)	-533.09 (-0.13)	550.10 (1.49)	-17.96 (-2.07)	0.90	8.42 (12.71)	0.45 (1.80)	0.10	20

t-statistics are in parentheses.
*Had not converged at iteration 20.
**Constant term not corrected by $e^{-.6502}$.

Table 3. Regression of Mean and Variance of Cash Receipts for Previously Nonconverging States.

State	Mean							Ln			Stage of
	Constant	Time	$Time^2$	$Time^3$	$Time^4$	$Time^5$	R^2	Constant*	Time	R^2	convergence
California	2979762.90	278701.57	-69516.00	7727.47	-328.12	4.63	1.00	9.87	0.71	0.26	9
	(27.71)	(2.73)	(-2.78)	(3.30)	(-3.57)	(3.65)		(16.44)	(3.13)		
Indiana	1015728.00	137319.20	-36344.08	3939.55	-165.62	2.32	1.00	7.47	1.31	0.43	10
	(43.27)	(4.74)	(-4.12)	(4.06)	(-3.87)	(3.58)		(9.96)	(4.60)		
Kansas	1603221.70	-238114.18	36772.27	-1341.70	-1.27	0.46	0.67	11.83	-0.01	0.00	5
	(4.15)	(-1.04)	(0.86)	(-0.41)	(-0.01)	(0.33)		(26.23)	(-0.03)		
Maine	202930.19	-978.87	-579.16	131.63	-7.76	0.13	0.70	10.10	-0.23	0.05	20
	(3.47)	(-0.03)	(-0.11)	(0.35)	(-0.63)	(0.88)		(20.46)	(1.23)		
Nevada	54679.86	-6420.01	1123.66	-41.53	-0.05	0.01	0.98	6.41	0.61	0.22	7
	(17.72)	(-2.33)	(1.73)	(-0.70)	(-0.02)	(0.46)		(11.28)	(2.82)		
North Carolina	942717.95	134618.01	-33063.86	3350.97	-136.89	1.90	1.00	6.67	1.56	0.62	9
	(87.21)	(9.41)	(-6.96)	(6.01)	(-5.29)	(4.68)		(11.05)	(6.77)		

*Constant term not corrected by $e^{-.6502}$.

AGRICULTURAL DIVERSITY AND CASH RECEIPT VARIABILITY FOR INDIVIDUAL STATES

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