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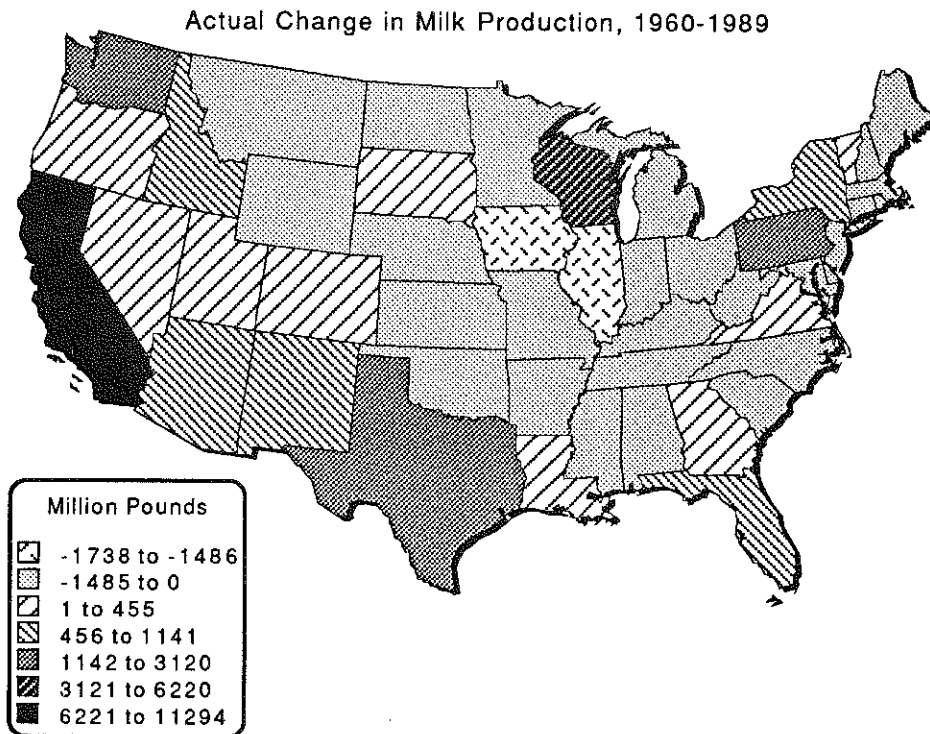
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National and State Trends in Milk Production

by

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Preface

The authors are members of the Department of Agricultural Economics at Cornell University. Andrew Novakovic is the E.V. Baker Associate Professor of Dairy Marketing and Policy. Kevin Jack is an Extension Associate, and Maura Keniston is a Research Specialist. This manuscript was prepared for publication by Wendy Barrett and Debbie DeCamillo (graphics by Wendy Barrett and Maura Keniston).

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NATIONAL AND STATE TRENDS IN MILK PRODUCTION

INTRODUCTION

In 1989, Novakovic and Keniston reviewed the dairy market characteristics of states and regions of the United States.¹ Since then, USDA has revised its estimates of milk production, production per cow, and cow numbers by state and for the U.S. over the period 1983 to 1989. Following usual procedures, USDA revised its statistical estimates for 1983 to 1987 to make them more consistent with the 1987 Census of Agriculture. The 1988 and 1989 revisions are not based on census information per se, but were made to be more consistent with the revisions for 1983 to 1987. In some cases the revisions were fairly substantial. This paper revisits and extends the discussion of milk production for the U.S. and by state which we made one year ago.

THE NATURE OF USDA REVISIONS TO MILK PRODUCTION ESTIMATES

National Estimates

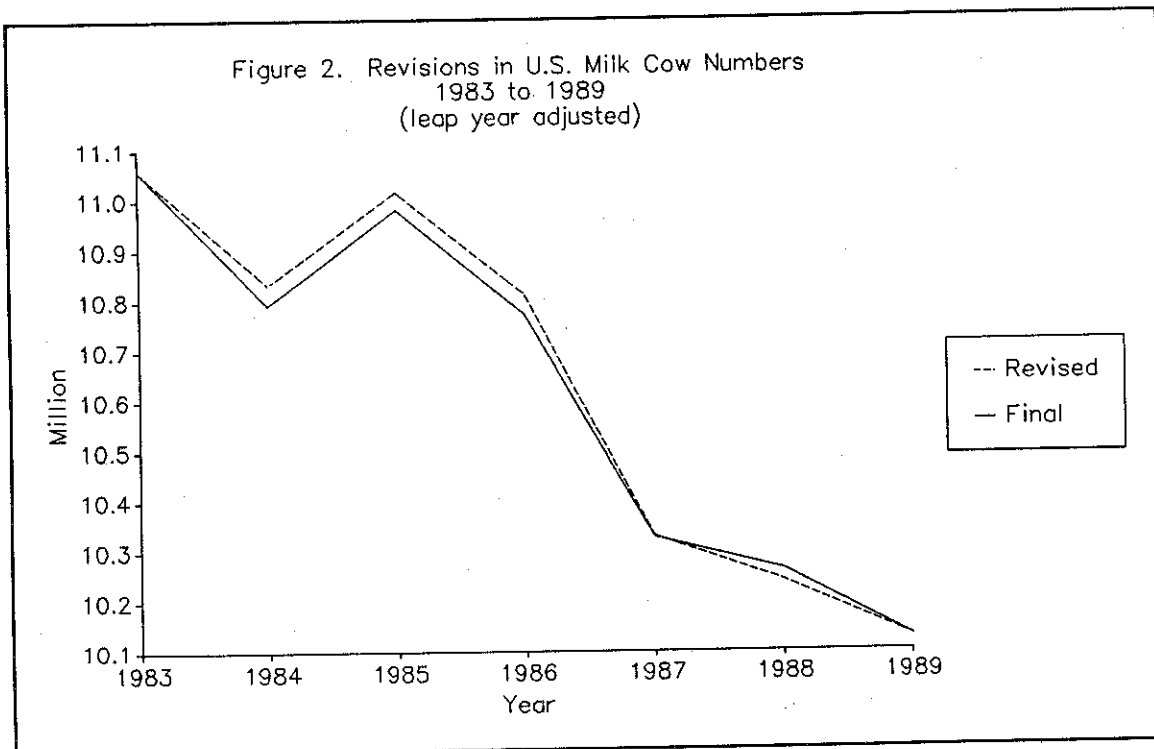
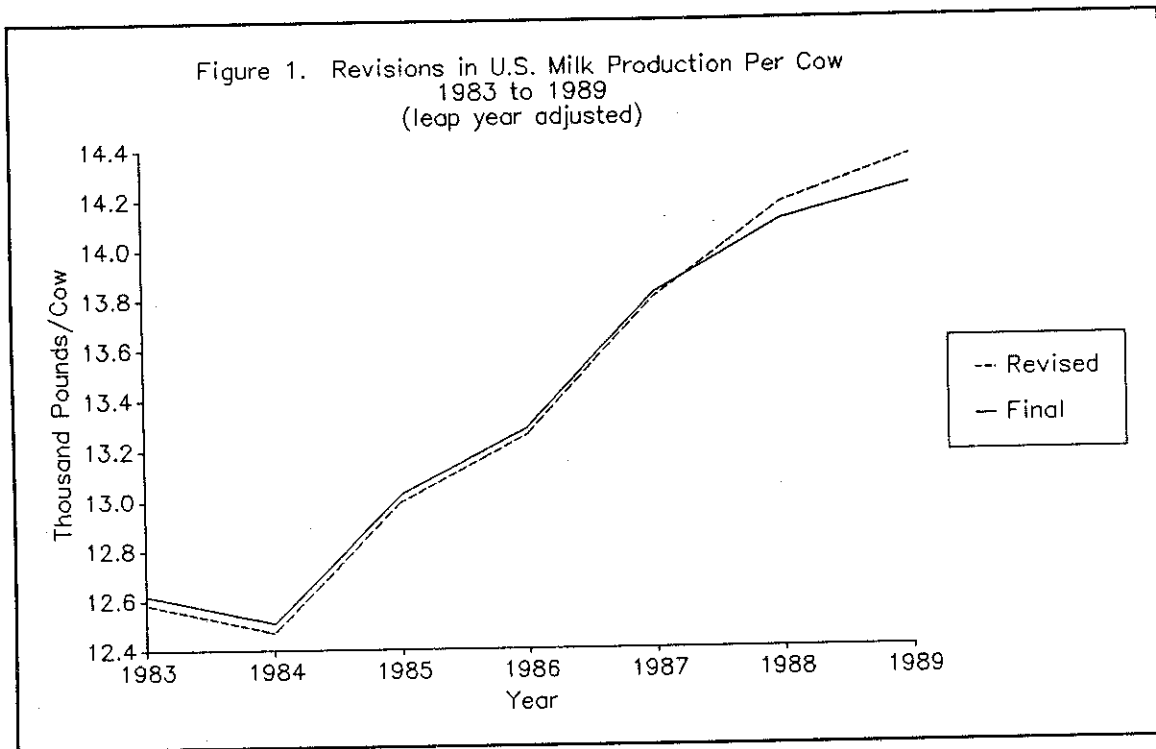
Estimates for cow numbers, production per cow and total milk production for the entire United States were not changed a great deal in the latest round of USDA final revisions, as illustrated in Figures 1 to 3. U.S. production per cow estimates were revised upward an average amount of 29 pounds/year for 1983-1987. The estimate for 1988 was lowered by 68 pounds. In contrast, yearly estimates for number of milk cows during 1983-1987 were lowered by an average of 31,000 animals with the estimate for 1988 moved up by 23,000. At the end of all this, we find that yearly estimates of total national milk production for 1983 through 1988 were increased for one year (1987) and decreased for the rest. On balance, this represents an average downward revision of 133 million pounds, or less than one-tenth of 1% of the average milk production during this period.

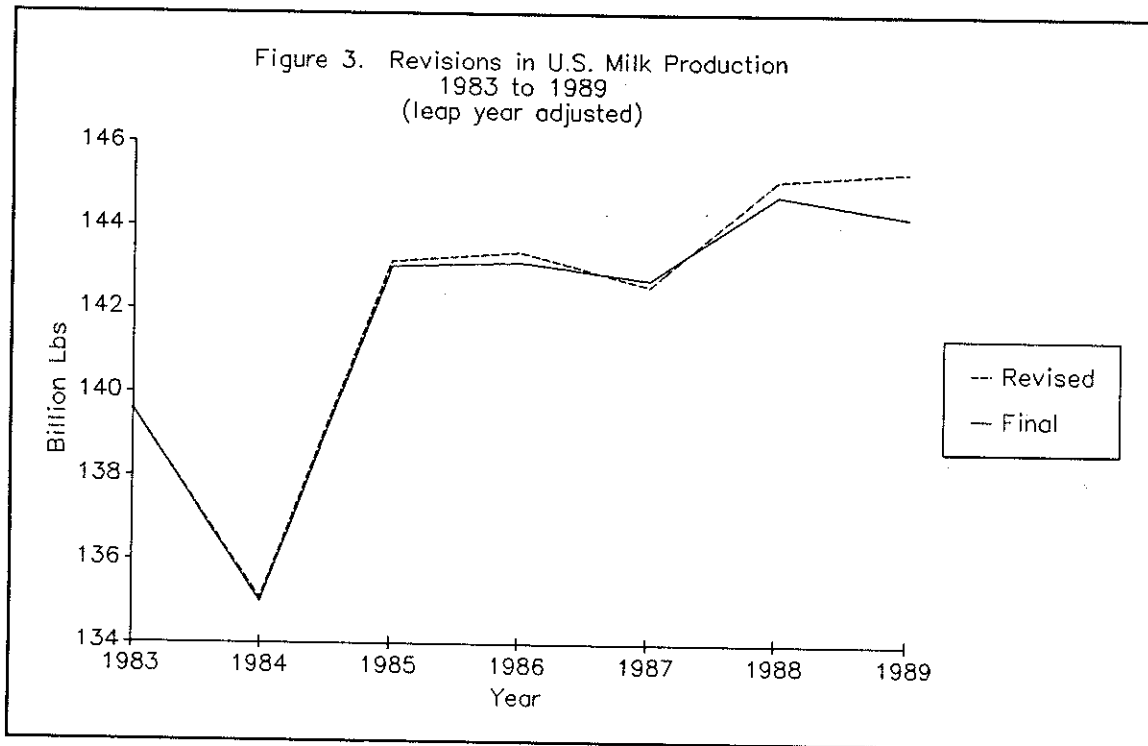
The 1989 revisions, however, were on a much greater scale, perhaps reflecting that the 1989 numbers being revised were the first round, preliminary numbers, while the 1983 to 1988 numbers had already been revised at least once before. The 1989 U.S. revised production per cow was 114 pounds lower than previously reported. Cow numbers were unchanged, leaving total milk production 1.09 billion pounds lower.

State Estimates

Over half of the states (29) experienced revisions for at least one year between 1983 and 1988. A majority of the state-level revisions for 1983 through 1988 did not entail any changes in total milk production estimates.

¹ Andrew M. Novakovic and Maura Keniston, Regional Differences in the Dairy Industry and Their Use in Evaluating Dairy Surpluses, A.E. Ext. 89-3, Dept. of Agr. Econ., Cornell University, January, 1989.





Instead, they involved revision of the two individual factors which determine total milk production, cow numbers and production per cow. In these cases, as one factor was revised upward, the other was correspondingly revised downward by the same percent, the result being a constant total production figure. When total production estimates were actually changed, downward revisions outnumbered upward revisions by an almost 2 to 1 majority. For all states, lower cow numbers and higher per cow production were the most common revision, as reflected in the aggregate U. S. totals outlined above. If a state experienced any type of revision, the original estimate of milk production per cow was always part of the change (in other words, cow numbers were never changed by themselves).

Despite the modest changes in the national figures outlined above, certain revisions in individual state situations merit special attention. For example, prior to its recent revision, USDA production estimates had indicated that Washington and Iowa were jockeying for ninth place during the 1980s, and that Washington had overtaken Iowa in 1987. The final estimates indicate that Washington has not overtaken Iowa, although the gap is very narrow.

The most striking adjustments are found in the 1983-1988 estimates for per cow milk production. Ranking the ten largest dairy states by preliminary and revised estimates of 1988 per cow milk production illustrates the net result of the changes outlined above. As shown in Table 1, only three of the ten states held the same ranking prior to and after the USDA revisions. California and Washington swapped places at the top. New York moved up three places to fourth; Texas fell from sixth to tenth.

Table 1. Revisions in Milk Production per Cow in the Ten Largest Dairy States, 1988.

<u>State</u>	<u>Revised Estimates</u>		<u>Preliminary Estimates</u>		<u>Change</u>
	<u>Rank</u>	<u>Amount</u>	<u>Rank</u>	<u>Amount</u>	
		(pounds)		(pounds)	
Washington	1	17,946	2	18,361	-415
California	2	17,181	1	18,403	-1,222
Michigan	3	14,937	3	14,937	0
New York	4	14,413	7	13,900	513
Pennsylvania	5	14,232	5	14,232	0
Wisconsin	6	14,205	6	14,407	-202
Ohio	7	13,632	8	13,139	493
Minnesota	8	13,299	9	12,983	316
Iowa	9	13,160	8	12,267	893
Texas	10	12,997	6	13,940	-943

Estimates of production per cow in California were revised downward for every year between 1984 and 1988. On average, these downward revisions amounted to over 1000 pounds per year for 1986, 1987 and 1988. Similarly, Texas' estimates were lowered for all years between 1985 and 1988, with a loss of over 900 pounds for 1988. On the other hand, Iowa experienced gains of almost this magnitude in both 1987 and 1988. Ohio and New York registered the largest overall upward adjustments in per cow production with average gains of 627 and 440 pounds per year, respectively, for the period 1983 through 1988.

CURRENT STATUS AND TRENDS IN MILK PRODUCTION

The Last Fifteen Years (and More)

One hundred years ago New York was the leading milk producing state and there were more dairy farms in the Northeast than we now count for the country as a whole. At that time Wisconsin was the sixth largest milk producing state, and California was not even in the top ten.

Fifty years ago, Wisconsin was firmly entrenched as the leading milk producing state; New York had slipped to third (behind Minnesota); and California had climbed to ninth place. While ascending to the position of leading milk producing state during the late 1800s and the early 1900s, Wisconsin increased its milk production relatively more rapidly than California has been doing over the last two decades.

Wisconsin is still the leading milk producing state today, but California has become the number two state. New York drifted back into third place after regaining second position in the 1950s and 1960s. This historical shifting in ranking and shares of the top ten dairy states is shown in Table 2.

Table 2. Shares of U.S. Milk Production Among the Largest Milk Producing States, 1889 to 1989.

<u>State</u>	<u>1889</u>	<u>1909</u>	<u>1926</u>	<u>1946</u>	<u>1966</u>	<u>1989</u>
	(percent)					
Wisconsin	5.8	8.9	16.0	12.7	15.1	16.6
California	a/	3.1	3.7	5.0	7.2	13.4
New York	12.7	10.5	7.4	6.6	8.8	7.7
Minnesota	a/	5.5	7.5	7.4	8.4	7.0
Pennsylvania	7.1	5.5	4.6	4.4	5.9	6.9
Texas	a/	3.2	3.4	a/	a/	3.6
Michigan	4.3	4.7	4.3	4.6	4.2	3.6
Ohio	6.3	4.8	4.4	4.4	4.1	3.2
Iowa	9.3	6.6	5.6	5.7	4.7	2.9
Washington	a/	a/	a/	a/	a/	2.8
Illinois	7.1	5.3	4.8	4.7	a/	a/
Top 2	22.0	19.4	23.5	20.1	23.9	30.1
Top 5	42.5	37.0	41.3	37.4	45.4	51.7
Second 5	21.5	21.1	20.4	21.5	18.5	16.1
Top 10	64.0	58.1	61.7	58.9	63.9	67.8

^a Not among the top ten at this time.

From 1975 to 1989, U. S. total milk production increased at a simple compound growth rate of about 1.5% per year. Growth trends can be analyzed in several ways. We try to smooth out the ups and downs of annual production figures by statistically estimating a straight-line trend through data from 1975 to 1989.² Based on this simple trend analysis, production increased at a rate of about 2207 million pounds per year.

² A simple OLS regression was performed where the dependent variable was annual milk production and the independent variable was the year. Annual production was adjusted to a 365 day basis for leap years. The results are sensitive to the time period selected. Nationally, milk production declined from 1964 to 1969; from 1969 to 1972 it increased; it fell sharply in 1973 and flattened out through 1975; from 1975 to 1983 it increased; after 1983, it fell in 1984, 1987, and 1989, but otherwise increased. Although any national production trend that includes the 1980s will be positive, how much production trends upward will be affected by when the time series is started and when it

(Footnote Continued)

Table 3 summarizes the growth trends of individual states using the same method of analysis. Annual increases in pounds per year are based on a straight-line trend from 1975 to 1989. This annual trend is also shown as a percentage of the annual average milk production for the 15 years from 1975 to 1989.

Table 3. Annual Trend in Total Milk Production Among the Top Ten Dairy States, 1975-1989.^a

<u>State</u>	<u>Average Annual Increase</u>	<u>Percent of Average Production from 1975 to 1989</u>
	(million pounds)	
California	604.6	4.11
Wisconsin	383.9	1.68
Pennsylvania	233.1	2.60
Washington	129.9	4.04
Minnesota	119.5	1.20
Texas	116.5	3.02
New York	113.7	1.03
Michigan	61.1	1.20
Ohio	41.5	0.91
Iowa	7.0	0.18
U.S.	2207.1	1.66

^a Production trends were calculated from annual production adjusted for leap years.

California has experienced the largest rate of growth, both in actual pounds and as a percentage of average production during this fifteen year period. Wisconsin ranks second in terms of annual total milk production expansion since 1975, but when measured as a percentage of average production it is only slightly above the national average. Washington, Texas, and Pennsylvania are the only other top ten dairy states to possess percentage growth rates above the U. S. national average, all three being well above it.

(Footnote Continued)

ends. State level trends are similarly affected. Our use of 1975 to 1989 data is arbitrary. It covers a long enough period that the effects of very short term ups and downs are reduced, and it is a time when national production was basically trending upward at a large rate. With these caveats in mind, any further interpretations or suggestions for future growth patterns must be made with appropriate caution.

Texas passed Ohio for the seventh spot in 1988 and captured sixth place in 1988, bumping Michigan to eighth. This rise through the ranks is partly attributable to Texas' fast growth rate (on average, over 4% per year) during the 1980s, but it is also helped by continuous production declines in Ohio and Michigan since 1987.

At the other end of the spectrum, Iowa has experienced the lowest growth rate among the top ten dairy states since 1975, indicative of the long-standing trends of dairy industry contraction in the Corn Belt. At one time Iowa was among the very top milk producing states (Table 2), but its share of U.S. production declined steadily since the 1940s. In the late 1970s and early 1980s it seemed only a matter of time before Washington would overtake Iowa for the ninth rank. As previously indicated, the recent revisions indicate that Iowa has stayed slightly ahead of Washington, but more surprising is the substantial increases in Iowa production in the late 1980s. From 1975 to 1988, Iowa milk production fluctuated in a range from 3.8 to 4.0 billion pounds. In 1989 it broke this pattern and jumped from 4.0 to 4.2 billion pounds. In fact, it rose 8.3% from 1986 to 1989. It remains to be seen whether this will be a temporary blip in the ups and downs of Iowa milk production, or if it presages further growth.

Current Size and Rank

Several perspectives on the current size and share of milk production by state are illustrated in the next three figures.

Figure 4 illustrates the relative magnitude of milk production by state for 1989. In this figure the 17 states having milk production in excess of 2 billion pounds are specifically noted. Within the top 17, there is a large spread, with the bottom of the spectrum having one-tenth the production of Wisconsin, the first ranked state. There are notable gaps between first and second, second and third, fifth and sixth, and tenth and eleventh ranked states.

The current size of each states, based on 1989 milk production, is also illustrated on the map in Figure 5.

Figure 6 provides a different visual perspective on the scale of milk producing regions. Each region is chosen simply to have contiguous states totaling approximately equal regional production. Wisconsin's milk production represented exactly one-sixth of the U.S. total in 1989; hence the U.S. is divided into six regions in Figure 6. Regional groupings can be manipulated to be somewhat larger or smaller, depending on where the somewhat arbitrary borders are drawn. We tried to achieve the most balanced grouping possible. Ideally, one would have to give a little of Washington to the Western region, a little of Minnesota to the Mideastern region, and part of Pennsylvania to the Southern and Mideastern. Even recognizing a little bit of arbitrariness in how these regions were selected, this demonstrates how large a geographic area is required in the Southeast or the Mountain and Plains states to match production in the largest state.

Figure 4. Milk Production In 17 States and All Others, 1989.
Billion Pounds

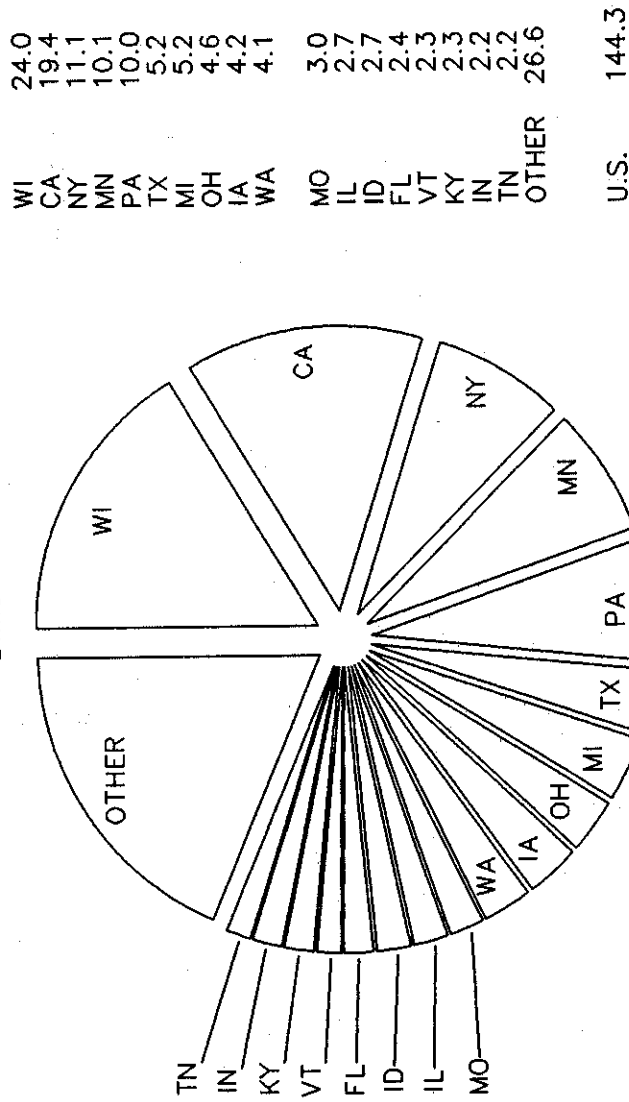


Figure 5. State Milk Production as a Percent of U.S. Total Production, 1989.

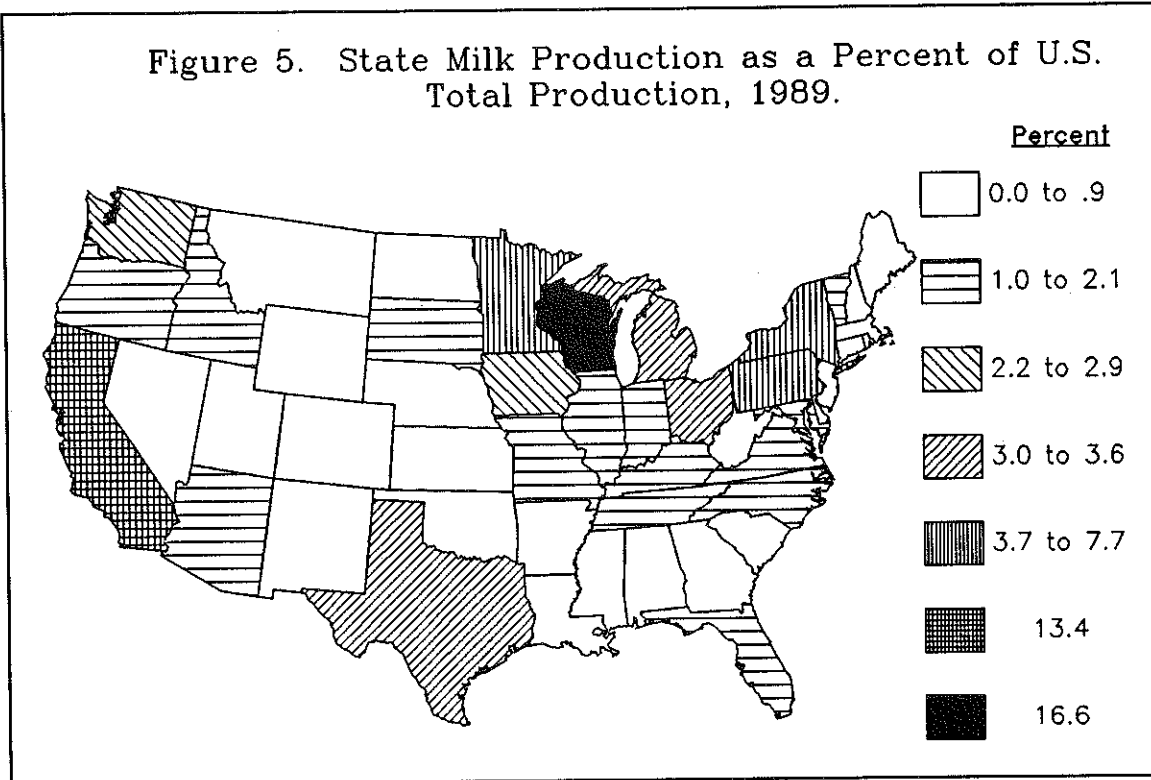
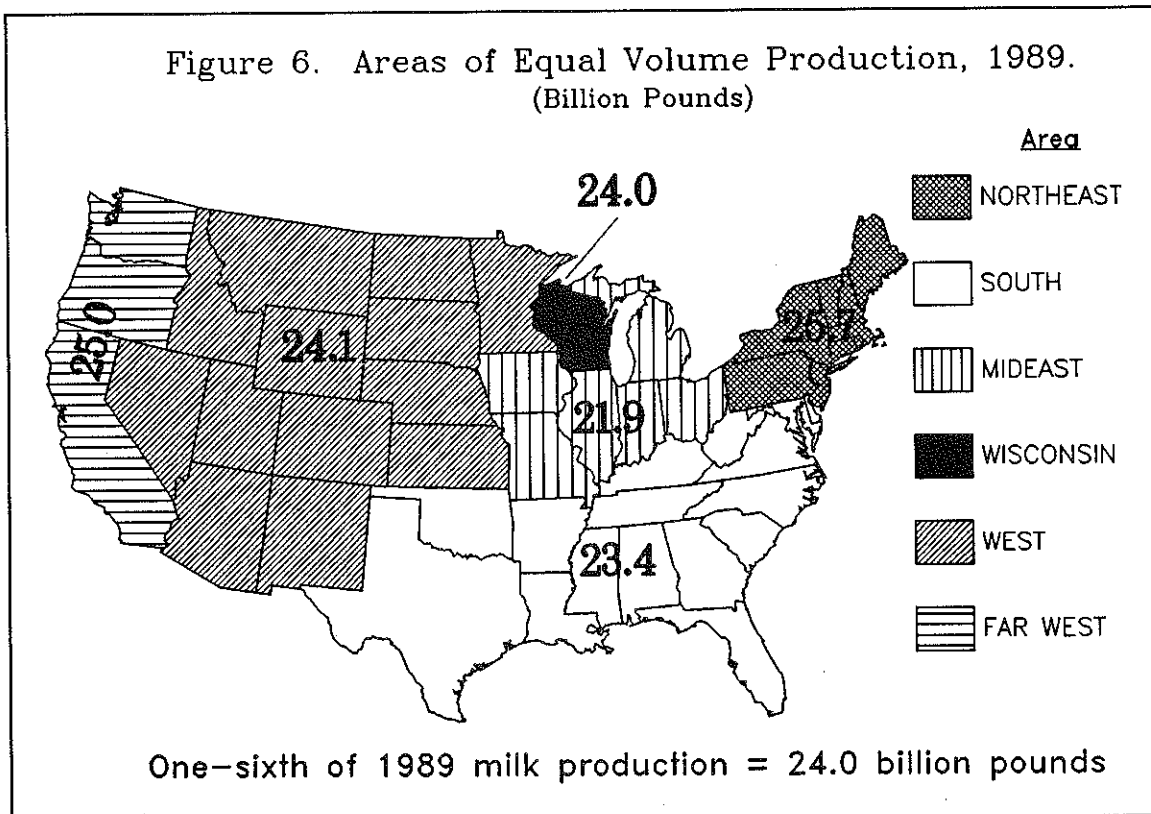


Figure 6. Areas of Equal Volume Production, 1989. (Billion Pounds)



Changes in the Far West region are particularly interesting. If a similar map were made using data from 1987, the region would have had to include Arizona and Nevada as well. Even with two more states in the group, the Far West's 1987 total, at 24.9 billion pounds of milk, was only slightly larger than Wisconsin at 24.8 billion pounds. In 1989 the three Pacific coast states alone produced a billion more pounds of milk than Wisconsin, mainly due to extremely large increases in California.

The Northeastern region is the largest of the six. Within the region, #3 New York, #5 Pennsylvania, and #15 Vermont totaled 23.5 billion pounds, representing 91% of the region's total and nearly as much as Wisconsin's.

The Midwest region consists of only six states and ended up the smallest of the regions. This despite the fact that three of the states are in the top ten, and the other three are in the second ten.

The Western region includes #4 Minnesota and #13 Idaho but requires 11 other states to match Wisconsin's production.

The Southern region includes #6 Texas, #14 Florida, and 14 other states, and it still falls just short of Wisconsin's production.

The purpose of this figure is not to imply anything qualitative about milk production in any state or are of the country. Rather it is simply to further highlight the commanding position that the largest dairy states hold and to provide a different perspective than the more usual regional groupings (such as the standard USDA regions used by ERS or NASS).

The Next Fifteen Years

Based on the annual growth rates in Table 3, milk production is extrapolated to 2005, as shown in Table 4. This extrapolation illustrates the impact of future growth at these recent rates; however it must be emphasized that it would be naive to blindly extrapolate simple regression trends for the purposes of forecasting. Likewise, any interpretation of this analysis should be tempered by noting that the period since 1975 has been one in which there have been widespread increases in milk production. If the statistical analysis were carried back to a time before milk production began its steady upward climb, the resulting equations would not have as large a positive trend coefficient.

The rapid growth in California, and very recently in Texas, is well known and much discussed. Based on production trends since 1975, California milk production will just pass Wisconsin's in 2018. Texas has moved up in the rankings considerably in recent years. However, with Pennsylvania production almost twice that of Texas, it will be some time before Texas breaks into the top five, if ever. The gap in production between sixth place Texas and seventh place Michigan could widen.

Since 1987, according to the revised data, Iowa and Washington have held down the ninth and tenth places, respectively, with production differences of less than 150 million pounds separating them in any one year. Washington is growing more slowly than California or Texas but its solid growth in the 1970s has put it firmly in the top ten. The projection in Table 4 shows Washington well ahead of Ohio and in eighth place by 2005.

Table 4. Milk Production of Top Ten Dairy States in 1989 and Projected to 2005 Based on Trends from 1975 to 1989.^a

<u>State</u>	<u>1989</u>		<u>2005</u>	
	<u>Rank</u>	<u>Amount</u>	<u>Rank</u>	<u>Amount</u>
		(million pounds)		(million pounds)
Wisconsin	1	24,000	1	31,607
California	2	19,353	2	28,633
New York	3	11,142	4	13,616
Minnesota	4	10,108	5	12,706
Pennsylvania	5	9,998	3	14,328
Texas	6	5,170	6	6,538
Michigan	7	5,152	7	6,482
Ohio	8	4,555	9	5,506
Iowa	9	4,202	10	4,136
Washington	10	4,097	8	6,202
U.S.		144,252		183,527

^a Production trends were calculated from annual production adjusted for leap years.

ANALYSIS OF CHANGES IN MILK PRODUCTION BY STATES

The Big Get Bigger

California and Wisconsin have led all states in volume growth. As they become even larger, it appears that the gap between them and states lower in the rankings will widen, as shown in Table 4. From the late 1800s through the 1960s, the top two dairy states accounted for about 20% of the nation's milk (cf. Table 2). In 1989, the top two states had just over 30% of the U.S. total. Based on growth patterns of the last fifteen years, Wisconsin and California will command just over one-third of U.S. production by 2005.

Of the next three highest states, Pennsylvania has generally (until 1989) maintained its share, while New York and Minnesota have declined. In 1989, 110 million pounds (1%) separated Pennsylvania and Minnesota. So far, 1990 has been a disappointing year for milk production in both states, but Pennsylvania in particular. Nevertheless, it should not be surprising if Pennsylvania overtakes Minnesota sometime soon as the fourth largest milk producing state. In fact, our naive trend extrapolation in Table 4 shows Pennsylvania capturing the third spot from New York in the early 21st century. Today over half of U.S. milk production comes from the top five states.

Prior to the 1960s the second five had a share of slightly over 20%. In 1989 their share is just over 16%. The jump from fifth to sixth is large. The production share of the second five totals less than Wisconsin's (16.6%), but it has been growing in the last two years, largely as a result of growth in Texas and, to a lesser extent, in Iowa and Washington.

With just over two-thirds of the U.S. milk supply coming from 10 states, one might well question how important it is to look at production in any one of the other states. Missouri is the only other state having more than a 2% share. Missouri and seven other states are the only other states to produce more than 2 billion pounds in 1989; altogether their total is about equal to California's. The average size of the "lower 40" is about 1.2 billion pounds, with an average share of less than 1%.

If nothing else, this should suggest that for some comparisons, percentage changes in milk production in a smaller state or region need to be balanced against actual production levels. The fact that percentage growth in New Mexico is very large is of some interest, but generally it is of small national consequence. Even in a major dairy state like Texas, comparisons with the largest states must be balanced by actual volume. For example, the amount of milk associated with a 4.6% increase in Texas is equivalent to a 1% increase in Wisconsin.

The differences implied by percentage growth versus actual growth is illustrated in Figures 7 and 8, which show changes in state milk production from 1960 to 1989. Figure 8 also illustrates the fact that 29 of the 48 states actually produced less milk in 1989 than they did 30 years ago, despite the fact that U.S. milk production is up more than 21 billion pounds (17%) from 1960.

Prospects for Growth and Competitiveness

Growth in milk production, in and of itself, is not necessarily good, and declines are not unequivocally bad. Although changes in milk production probably imply something about the vitality and competitiveness of a state's dairy industry, there are other measures that should be studied. One that we will look at here is production per cow.

Production growth has not occurred in all states; however all states have improved their record of milk production per cow. Until the 1980s, total production growth in most states and at the national level was achieved by steady increases in production per cow, not increases in cow numbers. Improvements in production per cow are only one of many possible measures, but we will use it as an indicator of current and future competitiveness and growth potential.

Table 5 and Figure 9 illustrate the very different rates at which the leading milk producing states improved their production per cow. As with our earlier trend analyses, these are straight-line trends. The time period of analysis is longer, but there are no significant ups and downs to contend with in the earlier years.

Figure 7. Percentage Change in Milk Production, 1960 - 1989.

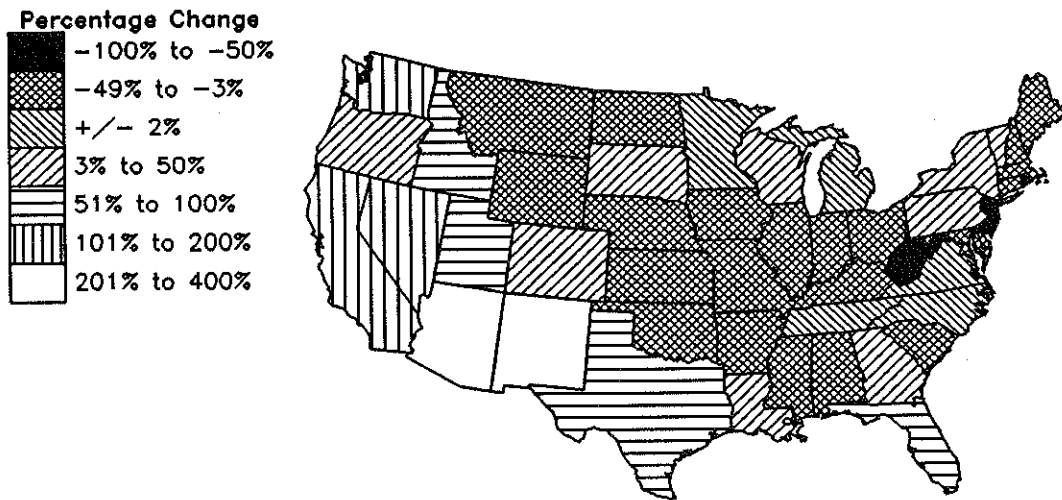


Figure 8. Actual Change in Milk Production, 1960 - 1989.

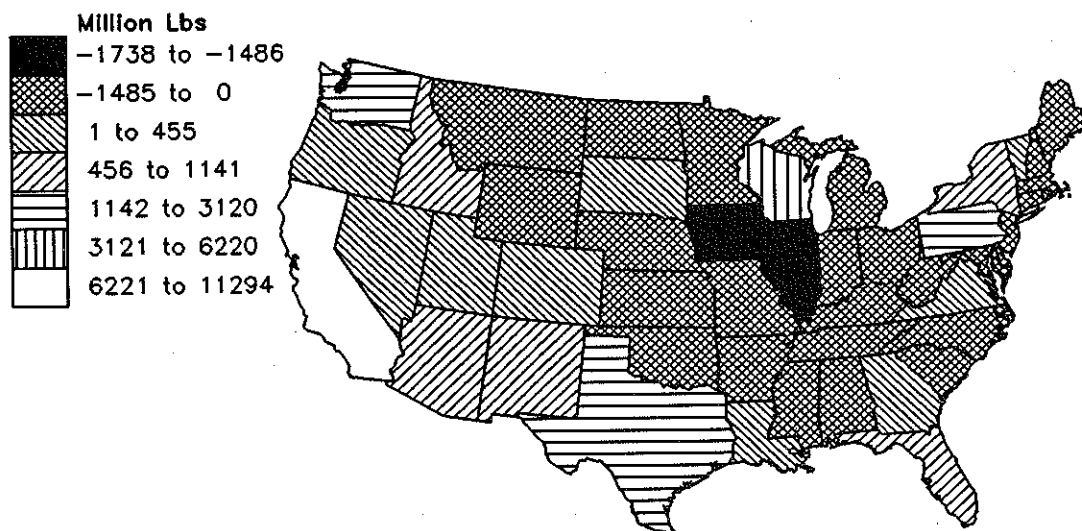


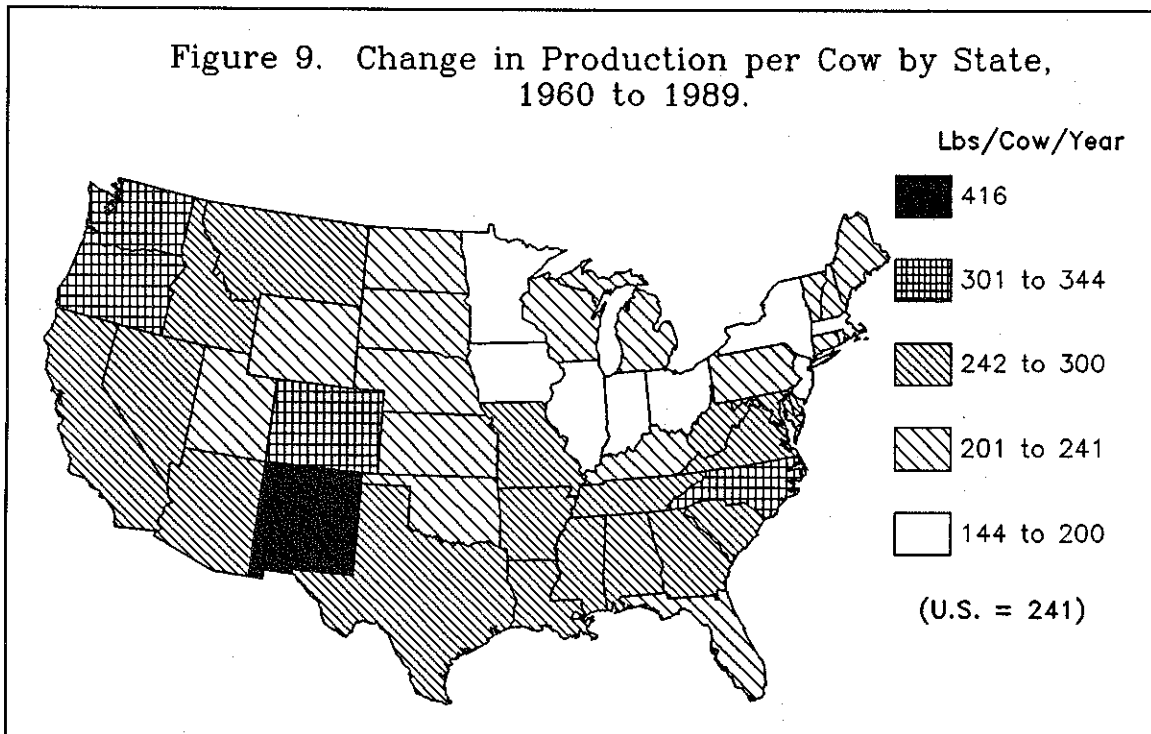
Table 5. Trends in Milk Production per Cow Among the Top Ten Dairy States, 1960 to 1989.^a

	Annual Trend ^b		1989		1960 ^c	
	Rank	Lbs/yr	Rank	Amount	Rank	Amount
Washington	2	346	2	18209	6	8380
Texas	11	275	31	13394	42	5100
California	14	260	3	17530	1	9780
U.S.	24	241	20	14244	26	7029
Michigan	28	231	10	14933	15	8070
Pennsylvania	30	223	18	14324	16	7780
Wisconsin	36	205	26	13801	8	8270
Ohio	42	191	35	13014	18	7460
New York	43	188	17	14358	11	8150
Iowa	44	185	29	13599	28	6980
Minnesota	49	169	28	13771	13	8120

^a Ranks are relative to the contiguous 48 states.

^b Data used to compute trends have been adjusted for leap years.

^c 1960 production data are unadjusted for leap year.



In 1989, Washington ranked second behind New Mexico both in annual rate of gain since 1960 and in actual production per cow. California is just behind Washington in actual production per cow. Its annual rate of gain is quite a bit lower than Washington's, although still respectably above the U.S. average. Texas is the only other leading state that ranks above the U.S. average rate of gain, although it ranks well below the U.S. average in actual production per cow.

Michigan and Pennsylvania rank slightly below the U.S. average rate of gain, but they are above the U.S. average production per cow. Of the remaining large states, except Wisconsin, five are among the bottom ten states according to annual rate of gain. All but New York also rank below the U.S. average production per cow. Wisconsin and Minnesota are within 500 pounds of the U.S. average. Ohio is more than 1000 pounds below the U.S. average production per cow.

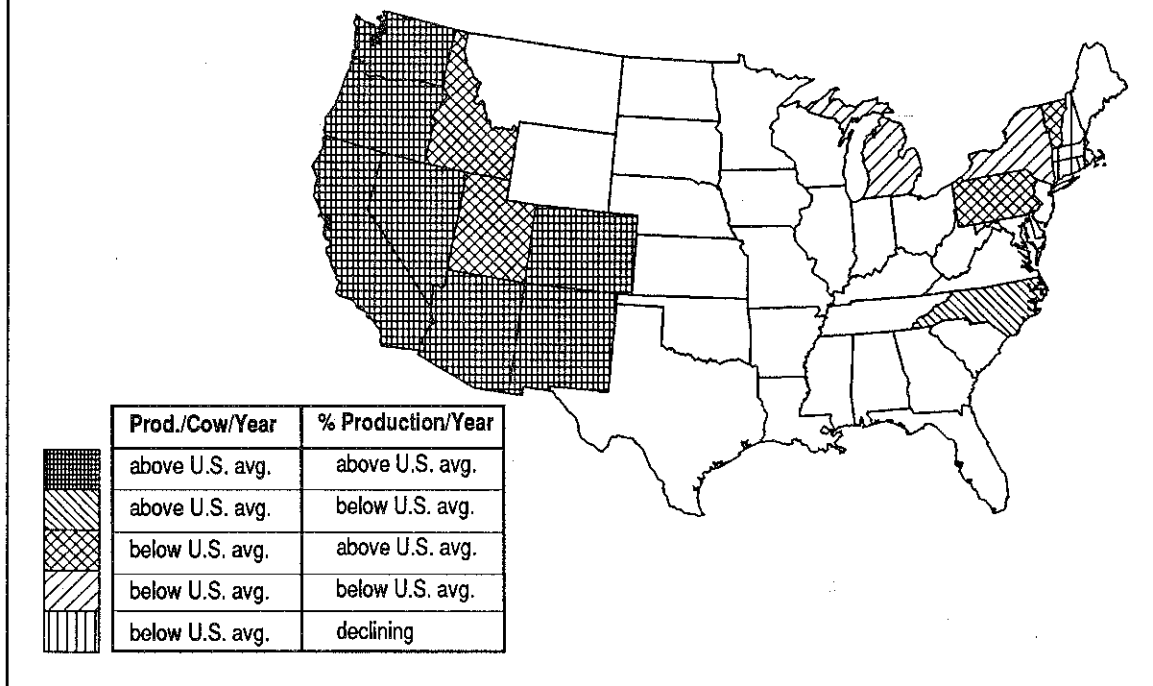
The state rankings for actual milk production per cow in 1960 and 1989 shown in Table 5 illustrate the cumulative effects of poor rates of gain. Among the top ten states in 1989, only Texas, Washington, and Michigan showed any improvement in ranking from 1960. California slipped to third, but it obviously occupies a strong position. Between 1960 and 1989, Pennsylvania essentially held its ground in the rankings. Wisconsin, Ohio, New York, Iowa, and Minnesota have suffered an appreciable deterioration in their respective ranking. Thirty years ago these states were among the leaders in production per cow as well as total production. Today they are among the bottom third tier of states, based on production per cow gains.

Past performance in production per cow is not the only indicator of likely future performance or current vitality, but those states showing better than average yield increases are probably more likely to have a growing and/or financially secure dairy farm sector.

The final comparison we will make involves looking at 1) current levels of productivity, 2) changes in production per cow, and 3) changes in total production. Our purpose is to differentiate such things as states that have similar growth rates in productivity but different changes in cow numbers and total production. To reduce the complexity of the maps, we do this in two figures. States having above average milk production per cow in 1989 are illustrated in Figure 10; the other states, whose production per cow is below the U.S. average, are shown in Figure 11. In both maps, states are further differentiated by their percentage growth in both production per cow and total milk production for the period 1960 to 1989.

In Figure 10, we see that the states having the higher than average production per cow in 1989 were in the West and East; Michigan being the only state that doesn't quite conform to that delineation. The only states that have 1) current production per cow, 2) productivity growth, and 3) production growth all in excess of the U.S. average are located in the West. Moreover, of these nine western states, the two that do not fall in this exclusive category come in just slightly below only because their productivity growth has been below the national average. Among the eastern states, Pennsylvania and Vermont are in the same category as Idaho and Utah. Virginia has productivity growth above the U.S. average but total production growth below the U.S. average. New York and Michigan have lower growth rates than the U.S. average in terms of both productivity and total production.

Figure 10. Growth Rates in States with Production per Cow Higher than the U.S. Average, 1989.



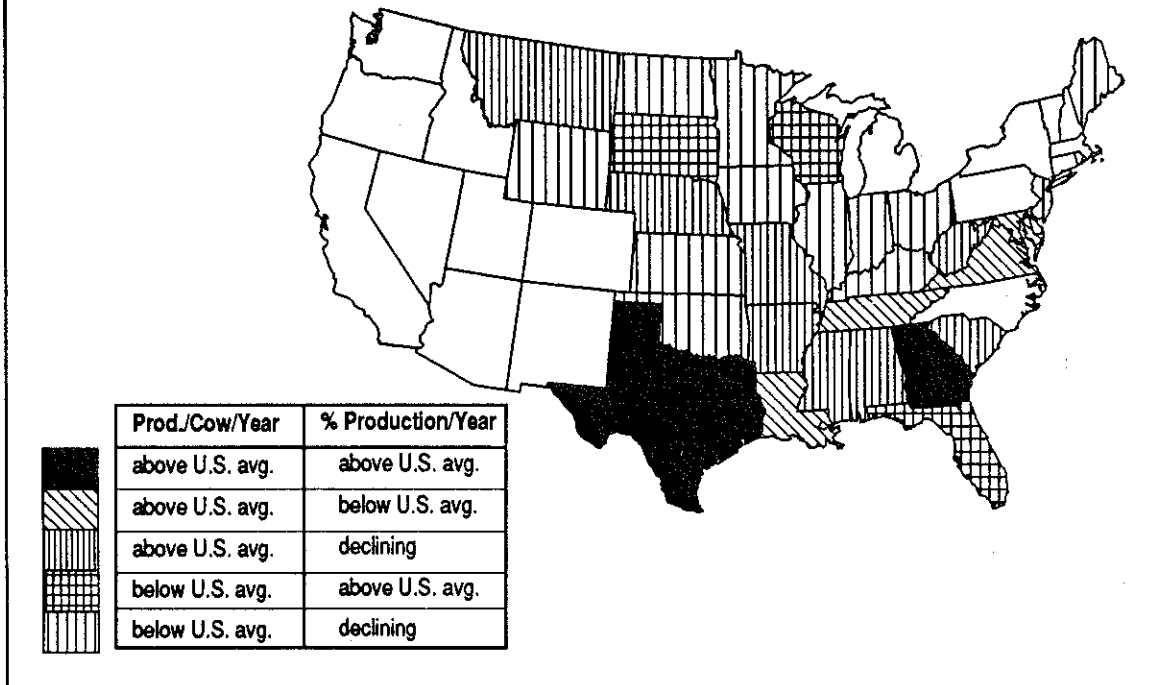
The southern New England states have lower than average productivity growth and are actually declining in milk production.

Figure 11 picks up the other states in which milk production per cow in 1989 was lower than the national average. Within this group there are states whose productivity growth (pounds/year) is better or worse than average and/or those whose total growth is better or worse than average.

Generally speaking, most states in the New England and Southeast regions have lower milk production totals today than in 1960. What differentiates these regions? The Southeast has made large percentage increases in per cow production since 1960, but actual production levels still lag well behind the U.S. average. These trends tend to be reversed in New England, where per cow production levels are higher than the national average (with Maine an exception) but annual average growth is lower - in fact it is declining in five of the six New England states.

Trends in milk production in the Midwestern and Plains states are remarkably uniform. With the notable exceptions of Wisconsin, Texas, and South Dakota, states in these regions have experienced negative growth in total milk production since 1960. In 1989, with the exception of Michigan, all states in the Midwestern and Plains regions reported per cow milk production levels below the national average.

Figure 11. Growth Rates in States with Production per Cow Lower than the U.S. Average, 1989.



CONCLUSIONS

Are there obvious regional patterns here? Yes and no. Growth in the West has obviously been the greatest, but it is not all downhill in the Midwest and Northeast. In fact, the intraregional differences are more intriguing than those across regions. As noted earlier, in the Midwest Minnesota has been in a weak position and Iowa may not be much better, but neighboring Wisconsin is holding its own. In the Northeast, Pennsylvania has been very healthy, but neighboring New York has a more lackluster record. Comparisons of neighboring farms in any one region would likely reveal as great or greater contrasts.

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