

Thomas, Arthur C.; Tauer, Loren W.

Working Paper

The Causes of Economic Inefficiencies in New York Dairy Farms

Staff Paper, No. SP 91-16

Provided in Cooperation with:

Charles H. Dyson School of Applied Economics and Management, Cornell University

Suggested Citation: Thomas, Arthur C.; Tauer, Loren W. (1991) : The Causes of Economic Inefficiencies in New York Dairy Farms, Staff Paper, No. SP 91-16, Cornell University, Charles H. Dyson School of Applied Economics and Management, Ithaca, NY, <https://doi.org/10.22004/ag.econ.121482>

This Version is available at:

<https://hdl.handle.net/10419/276847>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

CORNELL
AGRICULTURAL ECONOMICS
STAFF PAPER

THE CAUSES OF ECONOMIC INEFFICIENCIES IN
NEW YORK DAIRY FARMS

by

Arthur C. Thomas
Loren W. Tauer

June 1991

No. 91-16

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

THE CAUSES OF ECONOMIC INEFFICIENCIES IN NEW YORK DAIRY FARMS

Arthur C. Thomas

Loren W. Tauer*

Abstract

Technical and overall cost efficiencies are measured for 125 New York dairy farms. Explanatory models of efficiencies are estimated to determine how farms can increase their efficiencies. Changes in efficiencies are explained by changes in both assets and prices. Efficiency levels are explained by farm and operator characteristics.

*Thomas is a graduate student and Tauer is an associate professor, Department of Agricultural Economics, Cornell University. This research was partially funded under Cornell Experiment Station Hatch Project 121-438.

THE CAUSES OF ECONOMIC INEFFICIENCIES IN NEW YORK DAIRY FARMS

In a competitive environment the success and survival of an individual firm is dependent on economic efficiency in that firm's production process. Efficient use of resources in a production process also benefits society. Given this importance it is not surprising that extensive efforts have been made defining and measuring various types of firm efficiencies. More surprisingly, however, is that little effort has gone into determining why some firms are more efficient than others. This is essential to determine how firms may be made more efficient in their use of resources.

The purpose of this paper is to estimate the technical and overall cost efficiencies of 125 New York dairy farms annually from 1981 through 1987. The efficiencies of these farms are then explained by characteristics of the farms. Annual changes in efficiencies are partially explained by changes in investment and prices. The annual relative static measures of efficiency are partially explained by farm and operator characteristics.

Measuring Efficiencies of New York Dairy Farms

Färe's non-parametric technical efficiency measure allowing for variable returns to scale was used to determine the farms' technical efficiencies. (Färe and Grosskopf, p.597) This efficiency measure is the value of the objective function in the following linear program.

$$\begin{aligned} \text{Min } & \lambda \\ \text{s.t. } & zU \geq u_a \\ & zX \leq \lambda x_a \\ & \sum_{i=1}^s z_i = 1 \\ & z \in \mathcal{R}_+^s \end{aligned}$$

In the linear program, s is the number of firms, m is the number of outputs, n is the number of inputs, U is an $s \times m$ matrix of the firms' outputs, X is an $s \times n$ matrix of the firms' inputs, u_a is a $1 \times m$ vector of firm a 's outputs, and x_a is a $1 \times n$ vector of firm a 's inputs.

The 125 dairy farms comprising the data consistently participated in the New York Dairy Farm Business Summary Program for the seven years 1981 through 1987 (Smith, et al.). The quality of these data are considered quite high, but they are not necessarily representative of all New York dairy farms. In fact, they are perceived to be better than average farms. The efficiency measurement procedure used computes efficiency relative to the entire group of farms. Specifically, the linear programming approach determines if any farm or linear combination of farms is more efficient than the specific farm being tested. The efficiency of each farm was computed for each of the seven years. This requires running 125 linear programs for each year.

Milk is the principle output of the farms and was defined as the single output. Miscellaneous receipts were converted into milk equivalent units by dividing by the annual price received for milk on that farm.

Since the level of aggregation affects the resulting efficiencies (Thomas and Tauer), two technical efficiency measures were estimated, one using eight inputs and one using two inputs. The eight inputs include hired labor, family labor, livestock expense, crop expense, machinery expense, real estate expense, debt capital, and equity capital. These were linearly aggregated from more

detailed expense categories. The two inputs were simply variable and fixed expenses.

Summaries of the efficiency measures as well as an overall cost efficiency measure are presented in Tables 1-3. Overall cost efficiency was estimated using the common procedure of comparing actual costs to minimum costs. (Färe, Grosskopf, and Lovell, p. 75)

Technical efficiencies measured over the seven years using eight inputs had means near 96 percent with minimum observed efficiencies around 70 percent. Efficiencies measured using only two inputs had means near 80 percent with observed minimums in the range of 55 to 60 percent. The number of inefficient farms in the eight-input case ranged from 44 to 58 over the seven years, as opposed to 111 to 115 inefficient farms in the two-input case. Mean overall cost efficiencies ranged from 66 to 77 percent with observed minimums ranging from 40 to 50 percent. Since only one farm produced at the minimum cost per unit of output, 124 farms were found to be overall cost inefficient.

The explanatory models of efficiencies that follow rely on the variability of efficiencies between firms and over time. When eight inputs were used to measure firms' technical efficiencies, the resulting efficiencies were quite high. In fact, for most years nearly half of the firms were found to be 100 percent efficient. This low variability consequently weakens later analyses that use this eight-input efficiency measure. Much more variability is present, however, in the two-input technical efficiency and overall cost efficiency measures.

Table 1. Summary statistics of eight-input technical efficiencies.
for 125 New York DFBS farms, 1981-87

| Year | 1981 | 1982 | 1983 | |
|--------------------|--------|--------|--------|--------|
| Mean | 96.98 | 96.21 | 95.92 | |
| Min Efficiency | 73.77 | 71.05 | 74.80 | |
| Max Efficiency | 100.00 | 100.00 | 100.00 | |
| Number Inefficient | 44 | 49 | 55 | |
| | 1984 | 1985 | 1986 | 1987 |
| Mean | 95.92 | 96.13 | 96.28 | 96.29 |
| Min Efficiency | 70.78 | 66.98 | 67.59 | 75.55 |
| Max Efficiency | 100.00 | 100.00 | 100.00 | 100.00 |
| Number Inefficient | 46 | 58 | 54 | 49 |

Table 2. Summary statistics of two-input technical efficiencies for
125 New York DFBS farms, 1981-87

| Year | 1981 | 1982 | 1983 | |
|--------------------|--------|--------|--------|--------|
| Mean | 79.83 | 79.93 | 78.51 | |
| Min Efficiency | 59.76 | 56.73 | 56.91 | |
| Max Efficiency | 100.00 | 100.00 | 100.00 | |
| Number Inefficient | 114 | 111 | 115 | |
| | 1984 | 1985 | 1986 | 1987 |
| Mean | 83.30 | 81.02 | 80.90 | 78.45 |
| Min Efficiency | 55.60 | 54.29 | 58.90 | 55.89 |
| Max Efficiency | 100.00 | 100.00 | 100.00 | 100.00 |
| Number Inefficient | 112 | 113 | 112 | 115 |

Table 3. Summary statistics of overall cost efficiencies for 125 New York DFBS farms, 1981-87

| Year | 1981 | 1982 | 1983 |
|--------------------|--------|--------|--------|
| Mean | 71.77 | 70.88 | 66.06 |
| Min Efficiency | 47.96 | 43.08 | 41.93 |
| Max Efficiency | 100.00 | 100.00 | 100.00 |
| Number Inefficient | 124 | 124 | 124 |

| | 1984 | 1985 | 1986 | 1987 |
|--------------------|--------|--------|--------|--------|
| Mean | 77.27 | 75.95 | 73.92 | 71.56 |
| Min Efficiency | 49.77 | 40.70 | 44.81 | 44.78 |
| Max Efficiency | 100.00 | 100.00 | 100.00 | 100.00 |
| Number Inefficient | 124 | 124 | 124 | 124 |

Explaining Efficiencies of New York Dairy Farms

If technology is embodied in the assets of a farm, one would expect purchasing new assets to cause a farm's technical efficiency to decline the year the new assets are purchased, while the operator accustoms himself to using the new technology. In subsequent years, the farm's technical efficiency should be restored gradually as the farmer learns to use the new technology. Since Thomas and Tauer have shown that technical efficiencies measured from inputs that are linearly aggregated are actually combined technical and allocative efficiencies, one would expect factors causing changes in allocative efficiency to affect the three computed efficiency measures. Perhaps the most significant cause of a change in allocative efficiency is a change in price. A change in output or input prices may cause a farmer to be initially inefficient as he searches for the new optimal input mix. A dynamic first-difference model which explains the change in efficiency as a function of changes in assets and changes

in prices was estimated for the eight-input and two-input measures of technical efficiency and the overall cost efficiency.

Ideally, the change in efficiency should be modelled as a function of changes in specific farm input and output prices and the change in specific farm assets. Data limitations on individual input prices and specific assets restricted the models to include only the change in the price of milk for a farm squared (ΔMPSQ) and the change in total farm assets lagged one and two years ($\Delta\text{ASSET}(-1)$ and $\Delta\text{ASSET}(-2)$). Milk price is squared to allow either a price increase or decrease to decrease efficiency symmetrically. Percentage changes in assets rather than absolute changes are used to account for size. The model specification is linear in the variables.

Given that contemporaneous correlation exists in the errors between years and that a relatively large sample is used, seemingly unrelated regression (SUR) estimators should be more efficient than OLS estimators for each of the seven years. (Judge, et. al.) Therefore, SUR estimators were used.

The SUR models estimated for the change in overall cost efficiency are presented in Table 4. The OLS model for 1987 is included as well for illustrating differences between the estimation procedures. The model coefficients for the change in the two-input technical efficiency were similar. In the case of the eight-input technical efficiency, however, the models were substantially weaker, due to the large number of efficient farms. A limited dependent variable model might be appropriate for the eight-input data.

The overall explanatory power of the models is low. However, many of the parameters are statistically significant and signed consistently with expectations. Purchasing assets appears to result

Table 4. First-difference dynamic models of a change in the overall cost efficiency for 125 New York DFBS farms, 1983-87

| Year: Method: | 1983 SUR | 1984 SUR | 1985 SUR | 1986 SUR | 1987 SUR | 1987 OLS |
|--------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Variable | Parameter (t-ratio) | Parameter (t-ratio) | Parameter (t-ratio) | Parameter (t-ratio) | Parameter (t-ratio) | Parameter (t-ratio) |
| INTERCEPT | -4.8476 (-6.09) | 11.4952 (19.29) | -1.2538 (-2.01) | -1.8352 (-2.91) | -1.4860 (-2.53) | -1.1922 (-1.97) |
| Δ ASSET(-1) | -8.6144 (-0.74) | -16.0931 (-1.92) | -22.3608 (-2.93) | -19.2039 (-3.07) | -16.8192 (-2.23) | -19.1013 (-2.40) |
| Δ ASSET(-2) | -1.6847 (-0.28) | 1.1447 (0.28) | 9.8390 (2.09) | -4.9121 (-1.14) | 1.2747 (0.35) | 0.9561 (0.26) |
| Δ MPSQ | -0.2252 (-0.21) | -2.0703 (-0.69) | 0.9758 (1.81) | 1.3960 (1.70) | -1.5474 (-1.22) | -2.4784 (-1.83) |
| R-Squared | | | | | 0.1250 | 0.0742 |

* The R-squared reported under the SUR model in 1987 is the SUR system weighted R-squared for all years.

in decreased measured efficiency the year following the purchase. For example, in accordance with the linear specification a one percent increase in assets resulted in an 8.61 percent decrease in efficiency in 1983. However, the second year there appears to be no significant positive or negative effect, perhaps indicating that farmers re-establish their efficiency at different rates after an asset purchase. It was initially hypothesized that a change in the milk price, regardless of whether it is an increase or decrease, would decrease efficiency. However, the parameter estimates for ΔMPSQ and their lack of significance fail to confirm this.¹ The intercept is typically significant but varies in sign. It may reflect either a positive or negative trend in efficiency during the year, perhaps caused by changes in government policies or input prices.

Factors expected to influence a farm's general or static level of efficiency over the entire period are characteristics of the farm and operator that remain stable or slowly change, such as region within the state, age of the operator, education of the operator, type of milking system, type of barn, size of farm, type of dairy production records, type of business records, and type of business ownership. Moreover, price levels that are consistently different among farms may affect a farm's efficiency.

More specifically, the eight-input and two-input technical efficiencies and overall cost efficiencies are modelled as linear

1 The models were also estimated with the change in milk price rather than the change in milk price squared. The parameter estimates for the change in milk price were all negative and statistically significant. A plausible explanation is that an increase in the price of milk affords farmers the opportunity to become less efficient in the short run.

functions of the following variables. A dummy variable is included for farm participation in the Dairy Herd Improvement (DHI) association, which maintains dairy production records for farm decision use. Milking system types are incorporated through the dummy variables, pipeline (PIPE) and parlor (PARLOR). Because the type of milking system highly correlates with the type of barn, barn type was not included. Sole proprietorships (PROPR), as opposed to multiple ownership operations, are indicated through a dummy variable. Business record keeping systems, both accountbooks (ACCTBK) and computerized systems (COMP), are accounted for as dummy variables. The age (AGE) and education (EDUC) of the primary farm operator are included. Five dummy variables incorporate the regional location of the farm within New York state--southwestern (SW), northwestern (NW), central (CENT), northern (NORTH), and the Catskill region (CATSK). Different soil, climate, and infrastructure are available in these different regions. Average herd numbers (COWNO) are included as a proxy for farm size. Finally, the price of milk (PMILK) is included.

As was the case with the dynamic models, the estimation method used was Zellner's seemingly unrelated regression (SUR) method. Table 5 presents the annual static models. Also, OLS estimates for 1987 are again provided for the purpose of illustrating the differences that exist in the two estimation methods.

The explanatory power of the models is not particularly strong, as indicated by the low r-squared values. The models for the eight-input technical efficiencies again proved to be the weakest. Nonetheless, the explanatory power of the models is comparable to similar efficiency studies. (Tauer and Belbase, Kalirajan and Shand)

Table 5. Static models of the overall cost efficiencies for 125 New York DFBS farms, 1983-87

| Year: Method: | 1983 SUR | 1984 SUR | 1985 SUR |
|------------------|------------------------|------------------------|------------------------|
| Variable | Parameter (t-ratio) | Parameter (t-ratio) | Parameter (t-ratio) |
| INTERCEPT | 97.2246 (7.44) | 130.5895 (9.31) | 119.4357 (9.47) |
| DHI | 0.9242 (0.50) | 0.7901 (0.41) | 0.7276 (0.39) |
| PIPE | 4.2725 (2.11) | 3.9077 (1.80) | 2.0264 (0.87) |
| PARLOR | 5.7243 (2.43) | 5.5288 (2.22) | 2.4007 (0.92) |
| PROPR | -0.3414 (-0.24) | 0.9135 (0.61) | -1.1626 (-0.74) |
| ACCTBK | 1.3017 (0.74) | 1.9881 (1.14) | 1.1805 (0.63) |
| COMP | 0.6935 (0.40) | 2.3010 (1.34) | 2.0362 (1.08) |
| AGE | -0.1006 (-1.85) | -0.1288 (-2.12) | -0.2436 (-3.72) |
| EDUC | 0.5233 (2.38) | 0.6379 (2.39) | 0.2687 (0.95) |
| SW | 4.9719 (1.70) | 5.3147 (1.68) | 3.1755 (0.95) |
| NW | 7.1015 (2.53) | 7.3947 (2.40) | 5.6143 (1.72) |
| CENT | 2.8935 (1.09) | 3.4153 (1.18) | 2.8439 (0.93) |
| NORTH | 3.6344 (1.31) | 6.0305 (2.00) | 4.9779 (1.56) |
| CATSK | 1.4925 (0.65) | 1.8149 (0.72) | 0.1234 (0.05) |
| COWNO | 0.0317 (2.89) | 0.0319 (2.99) | 0.0404 (3.84) |
| PMILK | -3.3284 (-3.92) | -5.1805 (-5.54) | -3.5178 (-4.13) |

Table 5 (cont.). Static models of the overall cost efficiencies for 125 New York DFBS farms, 1983-87

| Year: Method: Variable | 1986 SUR Parameter (t-ratio) | 1987 SUR Parameter (t-ratio) | 1987 OLS Parameter (t-ratio) |
|------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| INTERCEPT | 132.2242 (10.49) | 115.7439 (10.09) | 121.1104 (7.54) |
| DHI | -0.0849 (-0.05) | 0.8172 (0.51) | 4.5745 (2.08) |
| PIPE | 2.7096 (1.19) | 4.8214 (2.22) | 3.6891 (1.33) |
| PARLOR | 4.4630 (1.73) | 6.4132 (2.61) | 6.4764 (2.13) |
| PROPR | -0.4898 (-0.33) | 1.6981 (1.25) | 1.9506 (1.16) |
| ACCTBK | 0.4821 (0.26) | -0.1347 (-0.07) | 0.1352 (0.05) |
| COMP | 2.2911 (1.25) | 1.5867 (0.91) | 1.8688 (0.75) |
| AGE | -0.1657 (-2.77) | -0.1190 (-2.13) | -0.1482 (-1.93) |
| EDUC | -0.0260 (-0.09) | 0.2257 (0.91) | 0.3472 (1.01) |
| SW | 1.4469 (0.46) | -0.6302 (-0.22) | -0.5535 (-0.19) |
| NW | 3.6245 (1.18) | 6.5270 (2.35) | 6.6551 (2.33) |
| CENT | -1.6358 (-0.56) | 0.7003 (0.27) | 1.2720 (0.47) |
| NORTH | 4.5344 (1.48) | 4.8464 (1.77) | 4.0726 (1.44) |
| CATSK | -0.7879 (-0.31) | 0.2816 (0.12) | 0.9278 (0.40) |
| COWNO | 0.0335 (3.85) | 0.0221 (3.27) | 0.0150 (2.09) |
| PMILK | -4.6472 (-5.28) | -4.1433 (-5.09) | -4.7751 (-4.14) |
| R-squared* | | 0.2892 | 0.4349 |

* The R-squared reported under the SUR model in 1987 is the SUR system weighted R-squared for all years.

Several sets of variables are generally statistically significant and consistently signed in the models. Operator age is shown to be negatively related to efficiency, perhaps contrary to researchers' typical beliefs that experience with age increases efficiency. About half of the regional dummy variables are statistically significant. The parameters indicate that farmers in northwestern and northern New York are more efficient than farmers in other regions of the state. As might be expected, the average herd size is positively related to efficiency. Finally, milk price is found to be negatively related to efficiency, as was the case in the dynamic explanatory models.

Summary and Conclusions

Efficiencies of 125 New York dairy farms were estimated annually from 1981 to 1987. These efficiencies were used in dynamic and static explanatory models of efficiency. Results found that a change in assets decreased efficiency in the following year. This lends credence to the dynamic adjustment cost models based upon asset changes (Howard and Shumway). Milk price changes were not found to symmetrically decrease efficiencies, but rather milk price changes were statistically significant and negatively related to the change in efficiency. The level of efficiency about which yearly fluctuations occur was explained primarily by the age of the operator, the regional location of the farm within New York state, the average herd size of the farm, and the price of milk.

References

- Fare, R. and S. Grosskopf. "A Nonparametric Cost Approach to Scale Efficiency." Scandinavian Journal of Economics, 87(1985):594-604.
- Fare, R., S. Grosskopf, and C. Lovell. The Measurement of Efficiency of Production, Boston: Kluwer-Nijhoff, 1985.
- Howard, W. and C. Shumway. "Dynamic Adjustment in the U.S. Dairy Industry." American Journal of Agricultural Economics, 70(1988):837-847.
- Judge, G., R. Hill, W. Griffiths, H. Lutkepohl, and T. Lee. Introduction to the Theory and Practice of Econometrics, Second Edition, New York: John Wiley and Sons, 1988.
- Kalirajan, K. and R. Shand. "A Generalized Measure of Technical Efficiency." Applied Economics, 21(1989):25-34.
- Smith, S., W. Knoblauch, and L. Putnam. New York Dairy Farm Business Summary, 1987, Department of Agricultural Economics, Cornell University, A.E. Res. 88-8, July 1988.
- Tauer, L. and K. Belbase. "Technical Efficiency of New York Dairy Farms." Northeastern Journal of Agricultural and Resource Economics, 16(1987):10-16.
- Thomas, A. and L. Tauer. "Input Aggregation and Firm Efficiency." paper presented at the American Agricultural Economics Association's annual meetings at Louisiana State University, August 1989.

Other Agricultural Economics Staff Papers

| | | |
|-----------|--|-------------------------------|
| No. 91-3 | How Not to Farm Together | Eddy L. LaDue |
| No. 91-4 | Honey Industry Survey: An Update | Lois Schertz Willett |
| No. 91-5 | Environmental Protection Through Local Land Use Controls | David J. Allee |
| No. 91-6 | Farm Structure: Concept and Definition | B. F. Stanton |
| No. 91-7 | Recognizing the Effects of Government Programs in Developing Cost and Returns Statements | B. F. Stanton |
| No. 91-8 | Price Formation and the Transmission of Prices Across Levels of Dairy Markets | Andrew M. Novakovic |
| No. 91-9 | Outlook for New York Farm Milk Prices With or Without an Emergency Order | Andrew M. Novakovic |
| No. 91-10 | The Impact of the Immigration Reform and Control Act of 1986--IRCA--on Farm Labor Contracting | Enrique E. Figueroa |
| No. 91-11 | Principles of Institutionalist Research Methodology | Mark Cohen |
| No. 91-12 | Bulgaria A Long and Winding Road to Democracy and a Market Economy - The Special Problems of Agriculture | Christo Petkov Dimo Dichev |
| No. 91-13 | The "Adirondack Dilemma" | Mark Cohen |
| No. 91-14 | Needed Reforms in the Harmonization of U.S. Patent Law | William Lesser |
| No. 91-15 | Time-of-Use Pricing for Electric Power: Implications for the New York Dairy Sector--A Preliminary Analysis | Mark C. Middegh |