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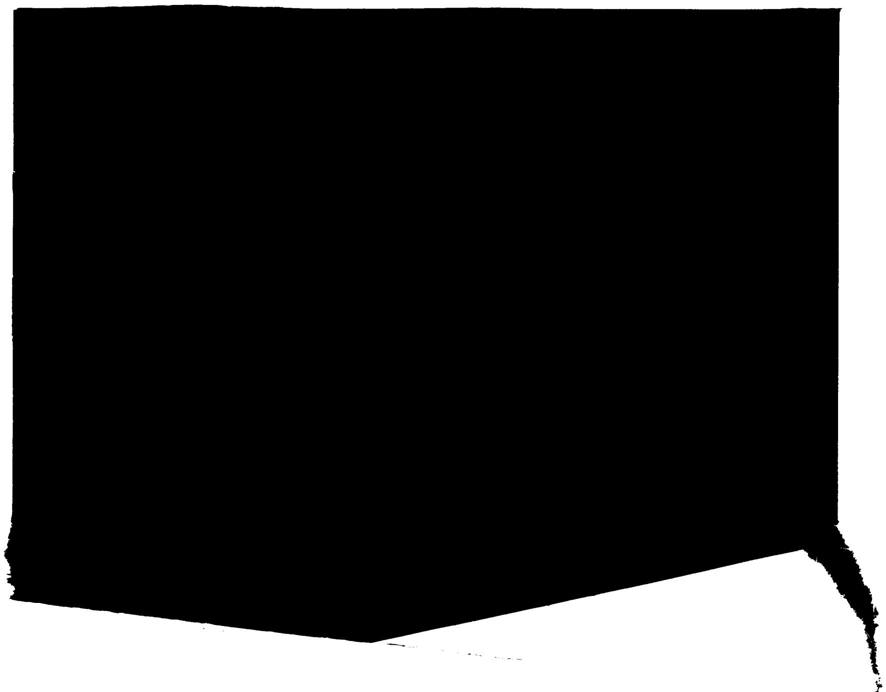

Evaluation of Potentials to Expand Profit Margins on Commercial Dairy Farms

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Introduction

Dairy analysts sometimes project profit margins that do not materialize. Trends toward technological advancement support greater efficiency, evidenced by lowering total costs per unit output, and hopefully enlarging profit margins even with lower average product prices. However, profits can fall short for many reasons, including the failure of some dairy farmers to utilize technology to reduce costs and falling average United States farm-level milk prices during the middle of the 1980's. During the 1950 and 1960 decades, measures to expand profit margins focused heavily on improving facilities and labor efficiency. But an area of unclaimed potential still lies in the interface between man, machine and cow.

This paper attempts 1) to analyze why some predicted profit margins did not materialize, and why improved technology was not always fully adopted, 2) to investigate the future potential for profit expansion through improved management of man-machine-cow interface, and 3) to study some of the special characteristics of dairy farmer-dairy farm entrepreneurial interaction.

Previous studies have shown dairy farms with 200-250 cows can be as cost efficient, as larger herds, and more cost efficient than smaller herds. These larger commercial dairy farms have been organized to produce replacement heifers as well as forage and concentrate feeds.

Dairy Industry Historical Trends

The American dairy industry has adopted many technological and economic advancements that increased overall resource productivity. This has resulted in decreased average real labor and management costs required per unit of farm output. For example, the United States total milk cow herd has declined from over 25 million head in 1945 to nearly 10 million head in 1991. Conversely, average milk per cow has increased from nearly 4,000 pounds per cow per year to almost 15,000 pounds per cow over the past 50 years (1), and total U.S. milk production is higher than ever before at 148 billion pounds in 1990.

Past industry-wide changes have resulted from rising average milk production per man-hour and man-year. In the U.S. dairy industry, an average of nearly 0.2 man-hours was used per cwt. of milk produced in 1990 according to USDA estimates. This reflects the sharp decline from an average 3.4 man-hours used nationally in 1935-39, and 0.9 man-hours used on the average in 1965-69 per cwt. of milk output (2). With over 148 billion pounds of milk produced in 1990, the total amount of labor and management time and dairy farm workers and managers used for current U.S. milk production has declined substantially from earlier levels (3).

Although continuing advances through time have been made in technology and efficiency, this was not because dairy farmers were primarily concerned with making the highest possible profits as efficiently as possible. Dairymen analyze their opportunity costs for the whole farm business unit. Many farmers express lifestyle satisfaction, citing such things as self-employment, outdoor work, work with other living things, land ownership, and life in a rural setting, as benefits for dairy farm employment.

Moreover, many traditional farmers are not as cost-benefit-analysis oriented as many younger dairy entrepreneurs are. Not only do many not analyze their costs fully, but some tend to look predominantly at their out-of-pocket expenses when making long-term farm decisions. This can cause them to underestimate their investments and fixed costs in certain areas. If one asks a dairy farmer what his greatest cash outlay feeding expense is, he will often say "concentrate" or "protein", if he raises his own forages. However, if the value of labor and machinery and fuel required to produce forage on-farm is accounted for, forage may prove to be the major feed expense. The discount of his/her labor cost may cause the farmer to avoid capital improvements. If the farmer enjoys the work, does not want to work off the farm, and is not interested in accumulating as much wealth as possible, he may decide to work on the farm all day long anyway, and not worry about time management.

Finally, because of the interest in lifestyle, "free" labor, and the difficulty in forecasting success in raising and selling crops and animal products, dairy farmers have a history of employing advancements that give immediate returns. For example, an increase in feeding a milk cow can increase milk production within days. Without cost-benefit analysis, long-term benefits would be hard to predict. The picture can become so complicated by uncontrollable variables like weather, war, world markets, and disease, that it can be difficult to track a planned improvement, or overriding variables can mask or eradicate effects. To illustrate, consider the difficulty in analyzing and evaluating the effect of BST on average milk production in a herd which then contracts Johne's Disease.

Technological advancements which have been adopted tend to be those which gave a quick return on initial investments (e.g., feeding improvements and automatic milkers). Improvements which have a slower turn around are slower to be adopted. Mastitis control, dry cow management, and replacement animal management are examples.

Labor and Management Cost Analysis

Current realized average dairy farm productivity figures still are lower than some economic and technical adjustment projections during the 1960's. More total profit per farm or per worker is often possible. For example, projections indicate that a typical worker on a combination crop-dairy farm could handle over 50 cows per worker in the 1990's vs. 30 both in the late 1960's and late 1980's. (4). A well bred, fed and managed milk cow herd produced over 29,000 pounds of milk annually per cow on 1990 Dairy Herd Improvement testing instead of nearly 17,000 pounds annually, with the application of current biological technology (5). These types and magnitudes of changes could result in higher productivity levels with over 1.2 million pounds of milk sold per worker annually on specialized crop-dairy farms (6). Further improvements in cow productivity and worker efficiency may more than double the annual production of farms that are able not only to stay at the cutting edge of technology, but which also make the fixed and variable capital investments required to remain (or become) competitive with other U.S. milk producers in terms of profit margins per cwt. of milk sold.

Labor and management costs per cwt of milk have generally averaged from 15 to 20 percent of the total production costs calculated per unit of output or per dollar of sales. The average blend price for milk in the U.S. ranged between $12.00 and $13.00 per cwt in the mid to late 1980's. The 20 per cent level gives labor and management costs of $2.40 to $2.60 per cwt, or $1.80 to $1.95 per cwt at 15 per cent. The national average of 0.2 hour per cwt of milk produced figured at $9.00 per hour wage and management would mean costs of $1.80 per cwt. In situations with higher wages or higher labor requirements, the $2.60 per cwt figure might be more appropriate. This level of labor and management expense is in line with 1990 cost levels in most major areas of California according to the CDFA in Sacramento.

Reasons for Diminished Profit Margins and Failure to Fully Employ Technology

Inflation may have protected farm profits during the 1970's, in spite of failure to stay current with technological advances. That is, rising prices may mask otherwise decreasing profit margins caused by higher costs per unit of milk output. To quote from Leibenstein cited by A. A. Cecen, "...there is a two-way causality between inflation and productivity; the retardation in the productivity growth of the American economy which has taken place in recent years is not only a contributor to inflation but to some degree is a consequence of it. This is due to the fact that an inflationary atmosphere can work as a shelter and contribute to the decrease of pressure within the firm, towards cost containment and decrease in productivity." (7)

The national U.S. milk market is mature, and only expands with population growth and not increased income levels. Average farm level milk prices are lower in 1991 than they were in the 1981-83 period. There has also been a decline in per capita consumption of milk products from 1945-75, in part due to dietary considerations involving fat and cholesterol. This phenomenon could prevent farmers in the aggregate from committing new capital to the adoption of initially expensive technology due to marginal cash flows, uncertain profit forecasts, or lack of sound economic analysis.

Within the wholesale raw milk market, premiums generally are paid for qualities such as fat and protein content and low somatic cell count. However, milk from many farm sources is blended into a common pool at the processing plant level. Opportunity for private brand related competition as is seen within the car industry, or even between poultry companies with branded products and parts, has been more limited in the dairy industry fluid markets.

There are many reasons why new technology was not adopted to a greater extent during 1970's and 1980's. Some farms failed to implement seemingly profitable and advantageous production and marketing technology. For example, farms in some of the largest milk producing states, (e.g., Wisconsin, New York, Minnesota, and Pennsylvania) have adopted some of the available technology to good gain, but not as readily as many of the Western and Southwestern states (e.g., California, Texas, Arizona, Washington). Many of the Western dairy farms have made large profits on their real estate when they sold out and shifted location to lower cost areas. Closer examination reveals that the Western-Southwestern market supports huge dairies which can most cost effectively install innovations due to geographic protection from lower priced milk sources (8) and a federal policy of low cost water that artificially lowers alfalfa costs in the South-West United States.

Where such market protection does not occur, farmers are likely to be unwilling to destroy aging facilities which are still serviceable but cannot be modified to be state-of-the-art, especially when the increased profit margin is slight. In some cases, dairy farmers are willing to make improvements, but their marginal cash flow cannot withstand temporary losses and still allow the farm to function, or some changes do not bring enough of an increase in profit margin to justify the energy and resources required to bring them about. Interest rates have remained fairly high in recent years, and the vagaries of farming continue, making future profits unpredictable and highly variable. Failures occur, even on expertly managed farms, if weather or markets deteriorate and there is a mortgage due with high debt-servicing payments.

In all cases, detailed technical and economic analyses are required to ensure that returns from proposed technological improvements exceed the costs and risks of their adoption. For example, observations on modern dairy farms (9) show that parlor innovations have sped cow preparation and milker attachment so that a single skilled person can operate a double 9 herringbone parlor (18 stalls) and have 5-6 minutes to spare per milking round. This is an amount of time that is easily wasted. The amount may seem trivial initially, but it amounts to 2 - 2.5 hours (for 200-250 cows, respectively) each day which is 14-17 wasted man hours per week, 61-70 hours per month, and 728-910 hours per year. There is a further cost liability because some milkers report that boredom is one of the worst aspects of the job, and causes people to leave employment. Conversely, this wasted time, converted to work activities which increased milk output, would increase profitability. Thus, unless time saved by further innovation and improved efficiency is converted to increased milk production, it is wasted time because it has little or no opportunity cost.

Sometimes lifestyle, tradition or nostalgia has blocked farm productivity advances. For example, some dairymen continue to keep lower producing cow breeds other than Holsteins. New efficiencies can also reduce intrinsic rewards and satisfactions of the job; increasing the efficiency and speed of milking decreases the farmer's direct contact with the cow, and a producer who enjoys spending time with the cows may count this as a loss.

Payoffs also can be non-monetary. A farmer may be willing to run a farm with less than maximum utilization of employees in order to let employees take more time off. Some farmers may farm to maintain a lifestyle for themselves and their families, knowing that when they are ready to retire they generally can sell to non-farming interests for greater capital gain than they could ever realize through farm improvement and increased net farm income. The fact that many dairymen and landowners could sell out tomorrow to land developers and become real estate millionaires may make otherwise rational farm technological improvements moot.

Future Technological Development of Robotic Milkers

The past dairy technologies adopted were largely concerned with biotechnology and facilities efficiency, or, the management of the cow as a milk factory, and the conservation of time and labor through the design of the work plant and equipment. Some dairy farmers may be approaching the limits of the potential for these areas to yield further profit margin. An area which is presently underexploited, is the management of behavior - the interaction between living things, or between living things and the plant facilities, in this case, the interface between cow, man and machine (and facility). Problems that exist in this realm may be solved with minimum cost and often with already existing technology.

Moving cows through and within the milking parlor is such an example. Despite available technological advances, the average American farmer milks about 33 cows per hour (10), although Hoard's Dairyman reports that a single person working a D-10 (20 stalls) can milk 93 cows per hour (11), if he uses the latest technology, including feeding and crowding gates, pre- and post- milking sprays, automatically detaching milking machines, a work height parlor, and low vacuum milk lines.

One avenue of advancement that is being pursued deals with equipment behavior directed toward the cow. Robotic milkers have been made and are being tested in the Netherlands and in Maryland. A system is being tested which identifies the cow as she enters the area, checks her health and milk records, sorts her into the parlor or the veterinary treatment area, measures her, adapts to her size, and connects the milking machine, and milks the cow without any human intervention. One system currently being tested is milking 75 cows per day, on demand. (12) However, cow and udder size and teat placement are variable, and while the task of attaching the milker to the cow's udder is simple for a human, it is very complex for a machine, especially when the cow's ability to move around is taken into account. Development of such a system is expensive, unlike many endeavors in behavior management, and is still experimental. Nonetheless, it is an exciting possibility, and if successful, may further revolutionize the dairy industry (13). Other examples of machines interacting directly with cows include computerized feeding stations, where cows can be fed an individualized mix, on demand, according to a programmed schedule. The computer can monitor the cows intake and notify the farmer if the cow is not eating as desired. Work is in progress to use computer/cow interaction for estrus detection.

An ironic problem encountered in many milking parlors concerns the human aspect of the triad (man/machine/cow). The irony: this problem is due to the adoption of technology. Automation has reduced the milker attachment time per cow but the milk-out time per cow has actually increased due to greater production per cow. This causes some parlors to be wasteful of employee time. Where formerly the human milker would work smoothly from cow to cow at high efficiency, he can now find himself waiting with nothing to do while the machines milk away. As mentioned previously, this causes boredom. The best solution to this problem would consolidate this time so that it could be usefully applied to other productive activities, or institute short activities that could be accomplished in five minute bits while the machines were monitored. For example, the time could be invested in informal employee training sessions using quizzes, flashcards or vignettes. Thus the time would be productively employed until further technological advances allowed consolidation of all these five minute intervals in a pool which could be applied to other productive labor. On a 200-250 cow farm which uses a double nine herringbone milking parlor, the five minute intervals add up to 2-2.5 hours per day.

If humans do not appreciate the boredom of milking (9), it may not be too surprising that cows may not be eager to face it either. Bringing the cows into the parlor from the dry-lot or the pasture is a source of aggravation for man and cow alike, apparently. On large farms, this chore often requires a second man. Even if most of the cows will come in voluntarily, the farmer must check the field for stragglers and ill or injured stock. Though this task might only account for 10-25 minutes per milking on a 250 cow farm (14), it accrues to the committed time of the milker waiting on cows to milk out. Two-2.5 hours per day expands to 2.5-3 hours per day, or 17.5-21 hours per week. Thus, the alleviation of this chore (through training the animals or automating the task) would result in a tangible increase in time available for other labor. It might also improve the workers' job perception and therefore his performance. Training the cows (versus automating the task) has the advantage that there is the opportunity, through the use of rewards, to change the cow's perception of the event, on the way to changing her performance. Mental outlook and perception can effect the hormonal environment of the body which can effect milk letdown and perhaps milk quality, as well as the cow's willingness to cooperate in the collection of milk. An example of how this problem might be approached follows:

Computerized feeding stations may be used to solve this problem. Computers are presently used to regulate, deliver, and monitor cow feed intake, on an individual basis. With minor changes of existing equipment and software, the cows could be taught a call (15), at the computerized feeding station, which could then be used to call them into the parlor. This could be done through the computer with no extra labor except that used rigging and programming the computer. Cows could be taught two calls, a herd call and an individual call. A sequence of relay stations could beckon the cows to the parlor by either.

A computer station at the parlor entrance could monitor the cows and display a list of any missing. The farmer would only check the fields as needed. Once the cows learned to respond to the calls, the calls could be used to lead the cows to other places such as loading chutes and veterinary treatment areas. Since the cow's compliance is voluntary, it is likely they would sometimes fail to respond, for a variety of reasons. However, if the system worked 50 percent of the time on the laggard cows, it could result in a savings of 15 minutes per milking (9) or 182.5 hours per year or 1,277 dollars per year, if a hired man worked for seven dollars per hour.

Chickens have been trained for an analogous system (personal experience at Animal Behavior Enterprises) and function very reliably. Cows readily learn to come to a call or a signal if they are motivated (15). Some other cow training has been done with varying effectiveness (17), and personal experience at the University of Maryland). But while chickens are generally very responsive to the availability of food (16), cows are noted to be less so (17). But if cows were called to feed rather than allowed completely random access to food, they might prove to be more cooperative than imagined, and new sophistication in the management of reinforcers will open opportunities in this direction.

Solutions based on training or managing an animal's behavior can be exceptionally cost efficient, because the equipment required to do the job is already developed and tested: it is the successfully evolved animal. Non-verbal communication systems and new understanding of how to motivate organisms increase our access to research and development funded by Mother Nature (instead of Uncle Sam). Because the regulation of behavior is complex, it tends to be variable in ways that have caused it to be regarded as unpredictable. In an absolute sense, it is, but in a general sense it is not. Predicting behavior is analogous to trying to predict the behavior of an electron, which is the domain of our most "absolute" science, physics. Within the infinite range of the atom's electron, there is a highly probable range. This fact allows us to make empirical projections about the atom that are useful but could never be absolute.

The behavior of people and animals is similar. We understand enough about how behavior is instigated to make the management of behavior very useful, if not one hundred percent reliable. Throughout the history of man's association with animals, we have cultivated cooperative working relationships with animals, whether it was for hunting or herding other animals, or, more recently, to feed the physically handicapped (monkeys (18)) or identify electromagnetic fields (honeybees (19)).

Summary and Conclusions

Profit margins may be expanded in the future, through development of behavior management technology and applications. These advancements can apply to cows, men or machines. Machine advancements have the advantage of reducing wage costs per unit of output and increasing labor capacities. Advancements based on the behavior of living organisms have the advantage of greatly reduced research and development costs and risks.

Past development has been largely in biotechnology and facilities efficiency, and further profit increases can still be reaped, as those opportunities that are already available are not universally exploited. Since 1975, changes in biological capital (cow) efficiencies have been a major source of on-farm labor productivity improvement found on U.S. commercial dairy farms. High interest rates and input costs, limited milk markets, tighter credit and higher interest rates and other types of economic uncertainties have restricted the full-scale modernization of many commercial dairy farms, and thus, the realization of potential profit margins.

The trend toward more milk output per cow will necessitate a further decline in the national milk cow herd during the 1990's if supply is to be balanced with commercial demand at reasonable prices to both producers and consumers. the number of commercial dairy farms is expected to decline again during the decade of the 1990's.

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Abstract

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The trend toward more milk output per cow will necessitate a further decline in the national milk cow herd during the 1990's if supply is to be balanced with commercial demand at reasonable prices to both producers and consumers. The number of commercial dairy farms is expected to decline again during the decade of the 1990's.