

Dairy Split Sessions

Moderators: Jennifer Trout, Luke Miller

U.S. Dairy Replacement Strategy: Macroeconomics, Microeconomics or Biology?

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Abstract

Key Summary Points

The replacement heifer market is strong, and still profitable.

The heifer replacement market is stronger than it has been in recent memory. Moreover, current heifer prices are not out of line with what it costs to raise a heifer and still return a profit over an animal's typical productive lifetime.

The replacement heifer market is driven by many factors.

While the price of heifers is in many ways a reflection of the long-term milk price and the animal's long-term production and salvage value, the heifer market is an open market and is influenced by many dynamic market forces and industry trends. No one factor is solely responsible for changing market prices.

A historically weak replacement market has supported high culling and inefficient replacement management.

From 1985 through 1999 there was a plentiful heifer supply and a decreasing cow population (*USDA-NASS Statistical Report*). Historically, replacement heifer market prices have been below total rearing costs to first calving. These market conditions encourage high culling rates and allow depressed birth rates and high calf and heifer losses to be economically feasible. However, these market conditions are not sustainable, as demand will eventually outpace supply, a point the industry is apparently reaching. Achieving this point was expedited by a slight increase in the U.S. dairy cow population in 2000, the first time this has occurred in nearly 20 years. Years 1999 through 2002 were unusual because in none of these years was there a decrease in the U.S. dairy cow population (*USDA-NASS Statistical Report*). The impact of this trend has been to increase de-

mand for replacement heifers. The first noticeable resumption in the decline of dairy cow numbers did not occur until the second quarter of 2003.

Past performance is not a good indicator of the future.

When supply exceeds demand, on-farm reproductive management and culling does not have to be intense and reproductive and replacement program efficiency can slip with little financial penalty. Thus, trends apparent for culling, birth rate, and morbidity and mortality are not necessarily related to or caused by other commonly cited trends (e.g. increasing herd size, increasing production, or adoption of new technology and management practices) for the change in supply and demand.

The replacement heifer market is likely to remain stronger than historically accepted as normal because of increased sensitivity of long-term milk price to cow numbers.

Despite a currently volatile and weak milk price, heifer prices are not likely to fall to the same degree. In the longer term, it appears that supply and demand for heifers will be tighter than it has been in the past, leading to stronger replacement prices. Likewise, the sensitivity of milk price to changing cow numbers over a relatively tight range will tend to hold heifer prices closer to their true marginal value than has been historically common.

Introduction

Replacement issues have become a major topic of discussion over the last several years. Much of this has been driven by questions about optimal removal rates and the volatile cost of replacement animals. As veterinarians and dairy professionals have searched to answer these questions and lead these discussions, they have typically turned to their historical strengths in the

realms of biology for answers. While questions of cow longevity and reproductive performance have led to great learning, one void in these discussions has been a firm understanding of how economic forces impact replacement.

The objectives of this paper are to provide a fundamental understanding of how changing demographics of the dairy industry, evolving national dairy policy, and the basic economic forces of supply and demand impact management decisions and work to alter the way in which the replacement market functions.

It is no surprise to anyone that the U.S. dairy industry is undergoing consolidation. This is a trend that began in the post-World War II era, as industrialization began to make great expansions and the population accelerated its long shift from a rural base to an urban base. In more recent years, however, cow numbers have essentially flattened, and the milk market has become increasingly sensitive to relatively small changes in cow numbers. This effect has been exacerbated by the recent slowing of the rate of demand for milk and milk products.

Analysis of recent USDA and American Farm Bureau data on the national dairy herd suggests that between 1994 and the present time, annual replacement

numbers should have declined. As total cow numbers make a net decline from year to year, the dairy industry as a whole removes more cows than it replaces. Since there is a three-year lag from the time a cow is bred until her replacement ultimately enters the milking herd, a consolidating market should always have slightly more replacements available (supply) than there is need for them (demand). While excess supply cannot be maintained in the long run, in the short term it has provided the industry with a great deal of flexibility with regards to replacement practices. This puts downward pressure on price, driving it back to a point where the market price of heifers would provide a less-than-market rate of return to growers. This is consistent with the near or below cash-cost price of heifers that was paid throughout much of the 1990s.

Most recently, however, we have seen a volatile, but generally higher price being paid for replacements.

There are several likely causes of the current changes in market dynamics:

1. Supply and demand effects, including volatility and sourcing issues;
2. Market forces, including market location, expansion impacts, grower specialization and governmental policy; and
3. Population dynamics and on-farm management trends.

Supply & Demand

Is there a shortage? Although the perception in the industry is that the supply of heifers is low, it has not been well documented. However, in a supply and demand driven market, just a widely held perception of a shortage can affect price. So we will proceed, examining possible reasons for the stronger replacement heifer market.

Cow number volatility from 1999 through 2002 has been unique in the past 18 years: During this period, the number of U.S. dairy cattle numbers rose instead of declined. This has occurred only once in the last 60 years, the early 1980s, (USDA-ERS), which is also the last time heifers were difficult to find and prices were high. Cow numbers are increasing, despite decreasing numbers of dairy farms and high culling rates. This indicates that many surviving farms are expanding, keeping their heifers from the market and using them to expand at home.

Are heifer prices too high, or simply higher by comparison to customary market prices? Since the mid 1980s the supply of heifers has been so plentiful that prices commanded by springing heifers (\$1,000 to \$1,200) seldom covered the full cost to raise them to calving (\$1,200 to \$1,500) (Cady & Smith; Hoffman; Tozier; Willet,

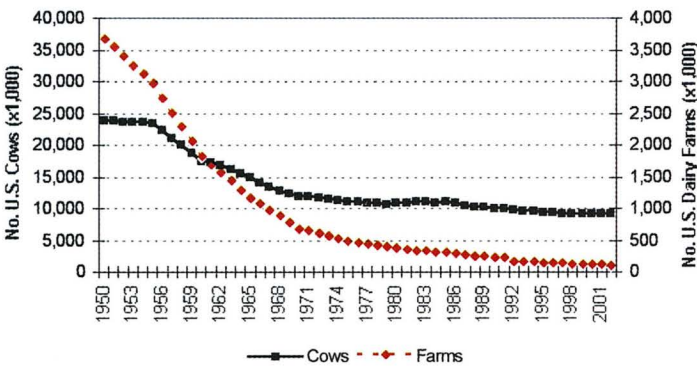


Figure 1. Number of U.S. dairy cows and dairy farms (1950-2002). Source: USDA-NASS and American Farm Bureau as published in Hoard's Dairyman.

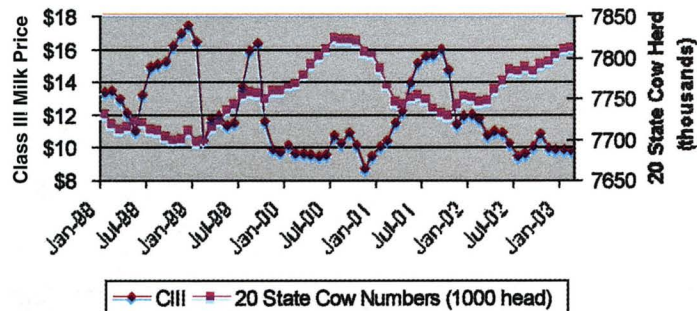


Figure 2. Class III milk price and cow population (1998 to Feb 2003).

Moore, Stephens, Wurth, Frazier and Torbett). Low replacement costs encourage high culling rates, and all-low depressed birth rates and high calf and heifer losses to be economically feasible. In essence, it may be economically easier to replace cows than increase management when replacement costs are low. The current market has allowed heifer growers and those selling heifers to raise prices and generate a profit instead of simply covering the variable costs of rearing.

Fewer farms - fewer sources: Farm numbers have been declining steadily for decades. In the past 11 years, dairy farm numbers have declined 44% (1992 – 131,535; 2002 – 74,012, Olson, AFBF). Smaller farms have been a traditional source of heifers. While there are still certainly farms from which to obtain heifers, when farms that used to supply heifers go out of business, this creates an impression that heifers are scarce. As supply and demand move toward equilibrium, small fluctuations in supply (or demand) can cause noticeable price changes.

Producers bringing heifer-growing programs home: As heifers become more difficult to find and more expensive to purchase on the open market, producers who used to sell their calves and buy heifers have found it more economical to keep and raise their own heifers or have them raised contractually by a heifer grower. This removes heifers from the market, although fewer buyers in the market may offset this impact. However, the net effect on the market may not be balanced.

Currently it appears that national heifer supply and demand is near equilibrium. As such, we move to a new point on the demand curve where demand is more inelastic (*i.e.* the ratio of demand to supply approaches or exceeds 1.0) and upward price pressure exists. The market price could potentially continue to rise until the marginal cost of an additional heifer is equal to the marginal revenue of that heifer discounted over her productive life. It is interesting to note that if one calculates that potential price of an additional heifer using the current national average milk production level, average herd reproductive performance, and a milk price of \$12/cwt, the breakeven point is reached at a heifer price of around \$1900, which is near the current market price.

While changes in calving interval may contribute slightly to the current situation in the heifer market, analysis leads one to conclude that calving interval changes on the order of magnitude observed in recent years (about three days per year) are relatively insignificant, not impacting heifer supply by more than 25,000 head on demand of 3.2 to 3.5 million head per year. With milk price volatility on the order of 50-plus %, the market, through changes in removals and other

Table 1. Breakeven milk price to add cows.

Heifer Price	Milk shipped per year (lb)									
	14000	16000	18000	20000	22000	24000	26000	28000	30000	
\$1,100	\$12.02	\$10.98	\$10.17	\$ 9.52	\$ 8.99	\$ 8.55	\$ 8.17	\$ 7.85	\$ 7.58	
\$1,300	\$12.71	\$11.58	\$10.71	\$10.00	\$ 9.43	\$ 8.95	\$ 8.55	\$ 8.20	\$ 7.90	
\$1,500	\$13.40	\$12.19	\$11.24	\$10.49	\$ 9.87	\$ 9.36	\$ 8.92	\$ 8.55	\$ 8.22	
\$1,700	\$14.09	\$12.79	\$11.78	\$10.97	\$10.31	\$ 9.76	\$ 9.29	\$ 8.89	\$ 8.54	
\$1,900	\$14.79	\$13.40	\$12.32	\$11.46	\$10.75	\$10.16	\$ 9.66	\$ 9.24	\$ 8.87	
\$2,100	\$15.48	\$14.01	\$12.86	\$11.94	\$11.19	\$10.57	\$10.04	\$ 9.58	\$ 9.19	
\$2,300	\$16.17	\$14.61	\$13.40	\$12.43	\$11.63	\$10.97	\$10.41	\$ 9.93	\$ 9.51	
\$2,500	\$16.86	\$15.22	\$13.94	\$12.91	\$12.07	\$11.37	\$10.78	\$10.28	\$ 9.84	

**adapted from Excel spreadsheet 'AddingCows' by John Fetrow, DVM, MBA

management practices, can respond to supply and demand needs for cattle much faster than the potential three-year lag time (conception to first calving) that biology would force on the market.

Another large concern relative to the heifer supply issue involves changes in replacement practices. In many instances, it appears that the increase in heifer prices is being blamed on changes in replacement practices. In reality, however, it is likely only that the increase in heifer prices has brought dairy managers and consultants to look more closely at their replacement practices as an opportunity to reduce replacement costs. In general, well-managed herds with excellent reproductive performance and successful heifer raising programs will have large numbers of heifers, often near 40% or more of their current milking herd, to bring into their herds in a given year. This means that they must either sell heifers, expand, or replace existing lower producing animals. If expansion is not a viable option, replacement is most often the option of choice. In these herds, a large percentage of cows leaving the herd are leaving later in lactation. In other herds with less tightly managed programs, cows are often leaving soon after calving – a very undesirable situation which quickly exposes these herds to the economic pressures of the cash replacement market.

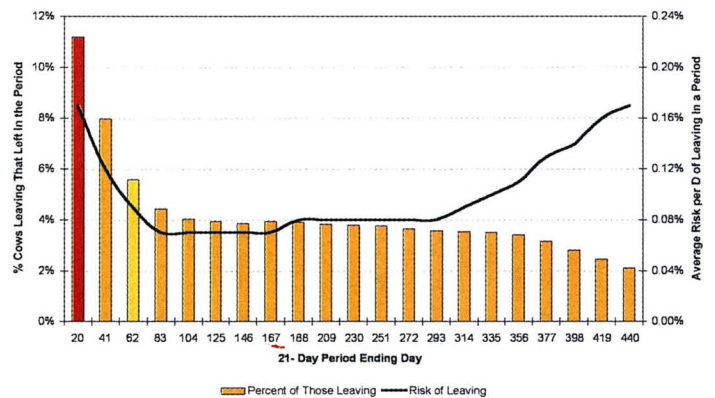


Figure 3. When cows leave and the risk of leaving a herd during a 5-year period in MN DHIA. Source: 2002, S. Stewart, Univ. of Minnesota. 624,614 cows leaving from 2,800 herds.

When heifer supply exceeds demand by a substantial margin, as it has for much of the 1980s and 1990s, the cash market price of heifers is relatively low, making replacement a less critical decision. As cow numbers have stabilized and created greater balance between replacement supply and demand, the relative price of replacement animals has risen in kind. It is interesting to note that, as an industry, we endure 10% stillbirths and seven of every 44 live heifer calves never make it into the lactating herd (NAHMS, 1996). Obviously, if we could do a better job of reducing birth to pre-calving morbidity and mortality, our replacement supply might look differently.

Certainly as the size of the national dairy herd continues to decline, the number of available replacement animals declines in concert. Once the cow market reaches stability in numbers, when conditions are supportive of expanding the national dairy herd, even with relatively small numbers, there are generally not adequate heifers available to meet that short-term demand. This causes significant upward price pressure in the heifer market.

Market Forces

How much can someone afford to pay for a heifer?

Economic analysis using a spreadsheet created by Dr. John Fetrow, VMD, MBA, University of Minnesota, indicates that even at today's mailbox milk prices (over \$12/cwt.) in herds at average production (18,000 lb/yr; 8,182 kg), producers can profit over an animal's productive lifetime when purchased at a price as high as \$2,200. Even with \$10/cwt milk, and average annual production at 24,000 lb (10,909 kg), a heifer purchased at \$2,300 should turn a profit over her productive lifetime.

The heifer market is no longer a local market: Industry consolidation and farm expansion has changed the heifer market from a local market into a regional, and even national market. This results in increased price pressure because the pool of buyers is larger, increasing the likelihood of identifying a buyer willing to pay a price nearer the heifer's true marginal value. Increased demand increases price.

Expanding and new startup operations put demand pressure on the market for two years: In a start-up or expansion operation, 1.7 heifers will be required for each new stall over the first two years. Cull rates in startup operations average between 35% and 40% (Faust). Expansion stalls stocked with heifers do not have replacements waiting in the on-farm heifer pipeline to replace culled cows for at least two years. Therefore, replacements for startup and expansion facilities must also come from the open market until the on-farm replacement pipeline can take over. Between 1999 and 2000,

there were at least 35,000 new stalls added to the industry through expansion and new startups (USDA).

Governmental Policy: Governmental policies have changed over time, forcing the dairy industry to move closer to operating as a free, supply/demand driven market. These policy changes, in and of themselves, would force a move towards balancing heifer supply and demand. Currently it appears that national supply and demand of heifers is near equilibrium. As such, we move to a new point on the demand curve where demand is less elastic and upward price pressure exists. The market price should continue to rise until the marginal cost of an additional heifer is equal to the marginal revenue of that heifer, discounted over her productive life.

Increasing specialization increases value: Increased specialization is occurring in the dairy industry. Instead of one producer taking responsibility for all enterprises (jack-of-all-trades), managers are increasingly operating single-function, specialized operations, such as forage growers, heifer growers and milk producers. The advent of the heifer grower industry, which has increased dramatically over the past eight years, has brought a new awareness to the true value of a heifer and likely added value to the heifer market.

Population Dynamics & On-farm Management Trends

Culling rate: Conflicting information exists regarding cull rate trends. According to USDA, culling rates have increased from a national average of 35% in 1990 to 40% in 1998 (Ferris). The trend has occurred within all production levels and herd sizes (DRMS). Information reported in 2003 at the American Dairy Science Association (ADSA) meeting by Young indicates this trend may be due to increased death rates, although data from the western U.S. (Smith, DHI-Provo) has demonstrated that while death rates have increased, overall cow removal has been relatively steady. That would confirm reports by Hoard's Dairyman Magazine (Apr. 2002), which show that slaughter rates of dairy cows have not changed over the past five years. While awareness of the increase in death rates initially pointed at management deficits, the issue really needs further study. This increase may well be the result of improved awareness of food safety issues by both producers and professionals, leading to better handling of downer cow issues and increased use of humane euthanasia with these cattle. It may also be attributable to improved understanding and compliance relative to residue avoidance issues, thus ensuring consumers of a safer food supply. Regardless, increased cow removal increases the demand for replacement animals.

Birth rate: Records from nearly 18,000 herds in *DHI-Provo* and *DRMS Raleigh* processing centers indicate that birth rate (percent of population giving birth in a year) has declined over the past 10 years by approximately 5%, from 89% to 84%. The trend has occurred at all production levels and herd sizes. Proposed reasons for this trend are many and varied. Accounting for sex ratio, but not calf and heifer losses, there are currently only sufficient heifer calves born to replace 42% of the milking population two years from now. As with culling rate, when replacements are plentiful and relatively cheap, birth rates can decline with little impact on profitability. However, this is not a sustainable situation because a drop in birth rate decreases supply.

Heifer mortality rate: There has been little change documented in heifer mortality rates since publication of the *USDA-APHIS-NAHMS* study in 1992. That study indicated that 10% of calves died within the first eight weeks of birth (including stillborns). Another 5% to 10% never make it into the milking cow string. This is a loss of at least 15% of heifer calves born, reducing the number of available heifers for replacements to, at most, 36 per 100 cows. In other words, the heifer supply can only support a 36% culling rate. A loss rate of 15% to 20% from birth to calving is unnecessarily high, and intolerable in other food animal industries. These kinds of losses can be endured in a period of replacement oversupply, at least from a population perspective. However, a population cannot be sustained indefinitely if the removal rate is greater than the replacement rate. An unnecessarily high mortality rate obviously has affected the balance of supply and demand by decreasing supply.

Trends started in 1985: Population stability is achieved when the number of animals entering the population (births and immigration) equals the number leaving the population (death and emigration). There are basically three biological factors impacting the balance of supply and demand for replacements: removal of milking cows (demand), birth rate (supply), and heifer mortality (supply). Age at first calving (length of the pipeline from heifer pool to cow population) affects the size of the heifer population, but does not affect the rate at which heifers are available to the cattle population. Current trends in removal rate and birth rate started in 1985 (*DRMS*), right after the last heifer shortage occurred and prior to many production and marketing practices introduced since 1985. An oversupply of heifers has provided a pool of replacements that has masked the impact of population shifts on the heifer market and kept prices depressed until the surplus was depleted.

Longer terminal lactations: Ferris found in his study of USDA data that terminal lactations have in-

creased by two months over the past decade, from 226 days in milk (DIM) to 288 DIM. This means that cows that are not going to produce a replacement are occupying an increasing number of stalls. This could be a contributing factor to the reduced birth rate.

Factors with No Apparent Impact

Increasing herd size: Speculation abounds that as herd size increases, culling rates increase as well. A survey of 14,000 dairy herds (17% of the total U.S. herds, 43% of cows on DHIA) enrolled in the *DRMS-Raleigh* processing center indicates that average culling rates have been increasing at similar rates in herds of all sizes over the past five years, with the exception of the very largest herds. Culling rates in the largest herds (1000+) have decreased slightly. Furthermore, it is a widely held belief that larger herds have more challenges with reproductive management. Information from the same *DRMS* survey indicates that calving intervals (an indicator of birth rate) are increasing in all sizes of herds. Furthermore, calving intervals for the largest herds are no higher than for smaller herds. This information indicates that blaming larger herd sizes for increased culling rates and decreased birth rates is not supported. Any relationship between the industry trend for increasing herd size and increasing calving interval and culling rates appears to be coincidental. That being said, if the market price of heifers stays up, this will be yet another force accelerating industry consolidation and dairy expansion. Better-than-average producers will continue to have an opportunity to generate better than market average returns while purchasing heifers at these prices, while producers with less than average milk production will be forced to become more competitive or consider their alternatives. Economies of size and scale are increasingly important.

Increasing production: Speculation abounds that as production level increases, culling rates increase as well. A survey of 14,000 dairy herds (17% of the total U.S. herds, 43% of cows on DHIA) enrolled in the *DRMS-Raleigh* processing center indicates that average culling rates have been increasing in herds of all production levels over the past five years, with the exception of the very highest producing herds. Culling rates in the highest producing herds (26,000+ lb; 11,818 kg) have decreased. Furthermore, there is still a widely held belief that higher producing herds have more challenges with reproductive management. Information from the same *DRMS* survey indicates that calving intervals (an indicator of birth rate) are increasing in herds of all production levels. Furthermore, calving interval in the *lowest* producing herds is among the longest of all. With the exception of the highest producing herds, calving inter-

val appears to be inversely related to production level in the DRMS survey, e.g. calving interval tends to be shorter in higher producing herds. Godden recently reported from a University of Minnesota study on culling that higher producing animals are actually at less risk within a herd for culling than their lowering producing herdmates. Blaming higher production for increased culling rates and decreased birth rates is not supported by this information. Other factors must be at work.

Commercial use of bST: Current trends for increasing production, fewer cow and farm numbers, culling, replacement heifer management and reproduction started in the mid '80s or earlier, well before the commercial availability of bST in 1994. The introduction of bST appears to have had no noticeable impact on the direction or rate of any of these trends. Furthermore, the *Northwest DHIA Summary* clearly shows that while calving interval (an indicator of birth rate) is increasing, it is increasing in herds that have *never* used bST in a manner similar to herds that have used bST regularly. No difference between calving intervals in the two groups and similar trends indicate that there is some other reason than bST for calving interval to be increasing. Additionally, the Northwest DHI summary shows that since bST was made available there has been no change over time and no difference for culling rates in herds that have used bST, compared to similar herds that have *never* used bST. Godden's report using MN DHIA data has shown that cows in herds using bST are at no higher risk for culling than cows in herds that have never used bST. Furthermore, in the same study and based on reproductive parameters measured, there is no evidence to support a detectable difference in the

birth rate for herds using bST, versus herds that have never used bST.

Prognosis for the Future

Most information would suggest that a strong heifer market is here for at least the near term. Market forces supporting open market economics in the dairy industry are here to stay, despite gasping efforts to the contrary. Industry consolidation and expansion will continue to keep replacement demand high. Heifers available for today's replacements were born two years ago, so short of importation there is no way to overcome this biological lag period and dramatically increase supply soon. Importation is not likely to have an impact either. Prior to the current embargo on importation of Canadian animals, Canadian imports totaled approximately 40,000 to 60,000 animals per year, less than 2% of annual heifer replacements. It will take two to three years to notice a change in the supply, even if dramatic, market-wide changes are made today. It will take one year to notice a change in the birth rate, even if more aggressive reproduction programs are implemented immediately.

The market may soften as cow population numbers begin to decline again, which has already started. If the rate of producers exiting the industry increases, cow and heifer supply may be increased. Removal rates can probably be reduced, but they, too are affected by a multitude of issues. These factors will moderate forces pushing for stronger heifer prices. On balance, the replacement heifer market is likely to remain strong for the foreseeable future.