



Economic Considerations of Low-Profile Cross-Ventilated Freestall Barns

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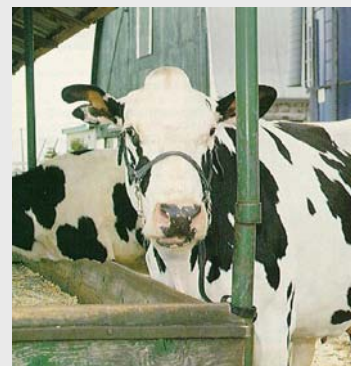
Kansas State University, Manhattan, KS



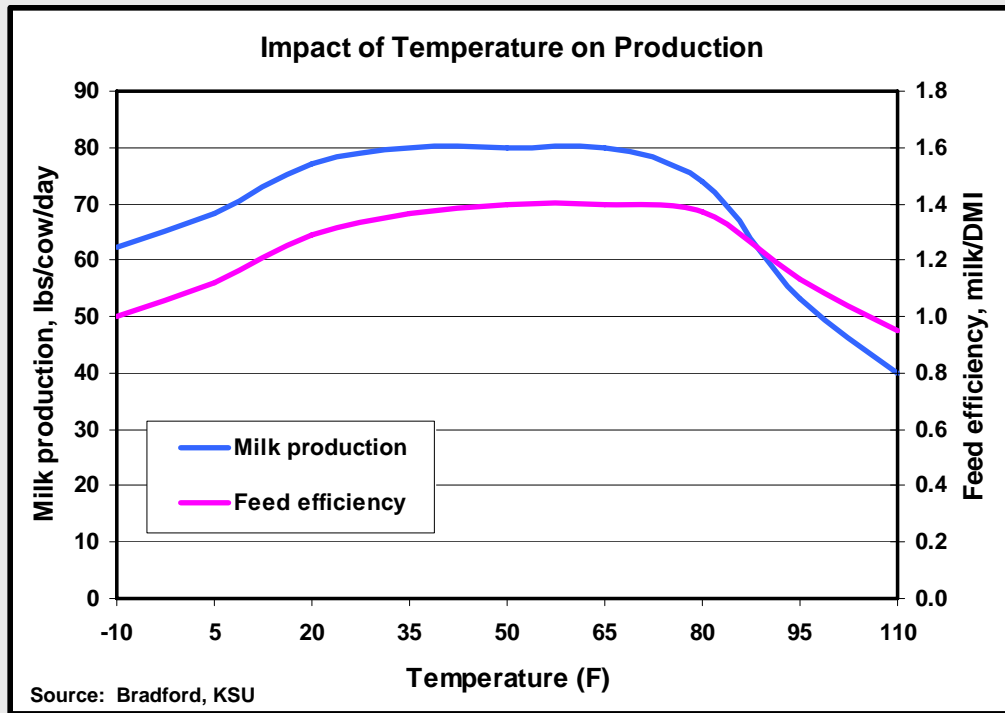
Outline



- Impact of temperature on production
- Temperature differences
- Budget assumptions
- Economic results / sensitivity analyses
- Conclusions



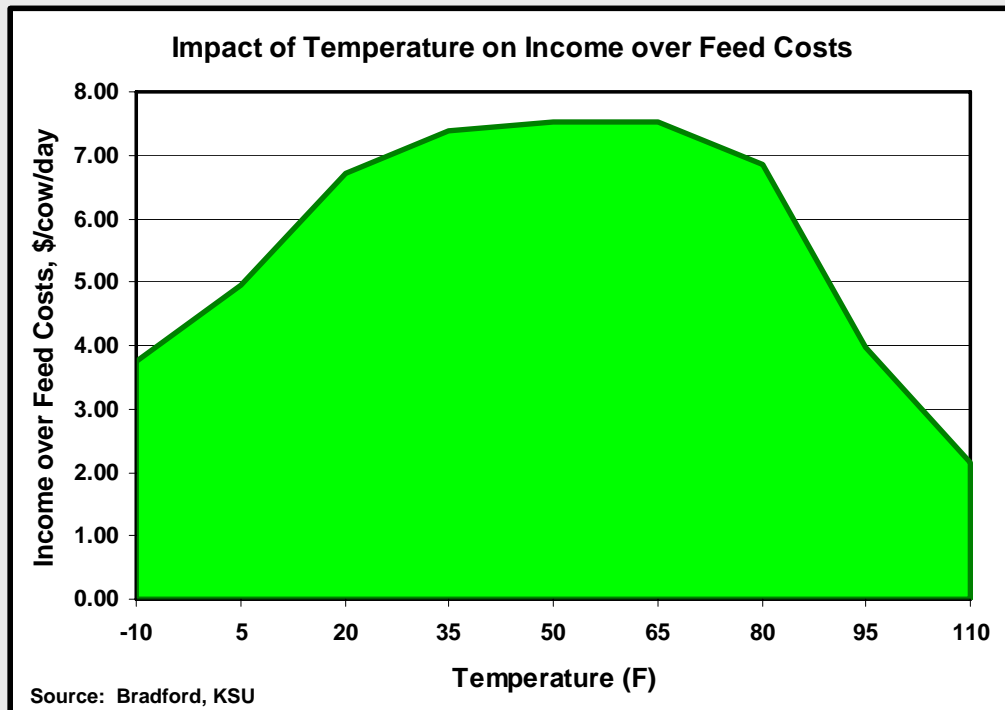
Milk production and feed efficiency...



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Sioux Falls, SD

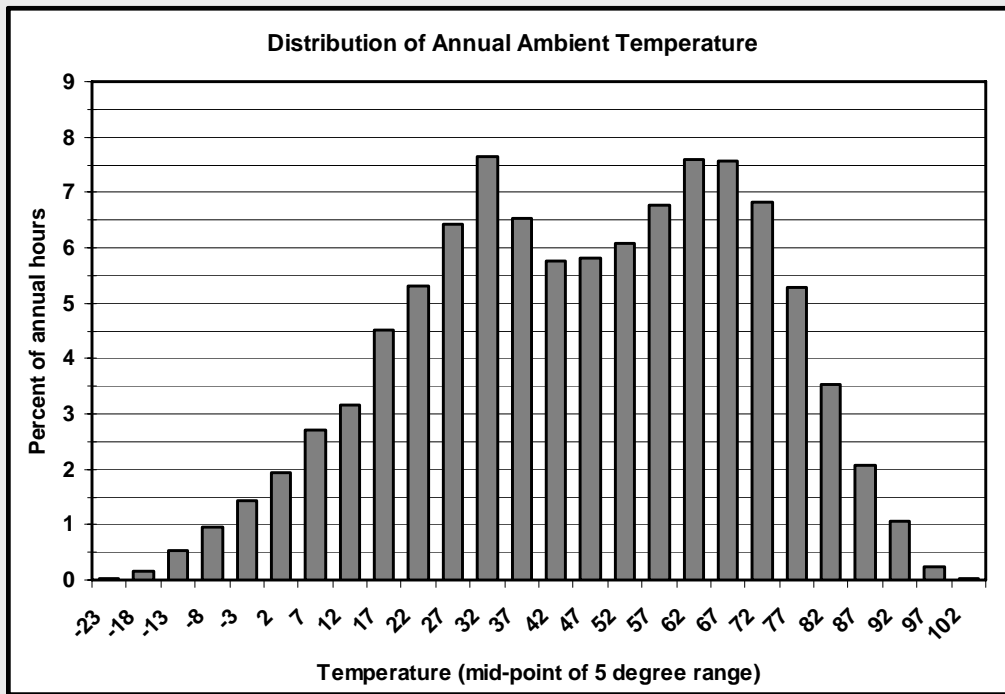
Returns over feed costs (\$18/cwt milk, \$0.12/lb feed)



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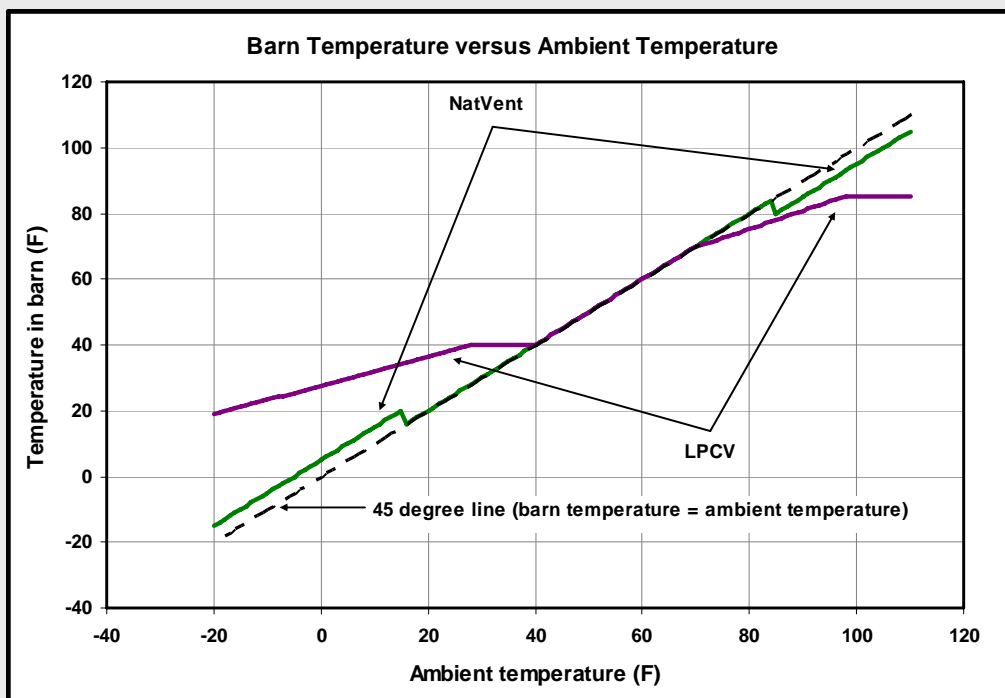
Temperature variability in Sioux Falls, SD



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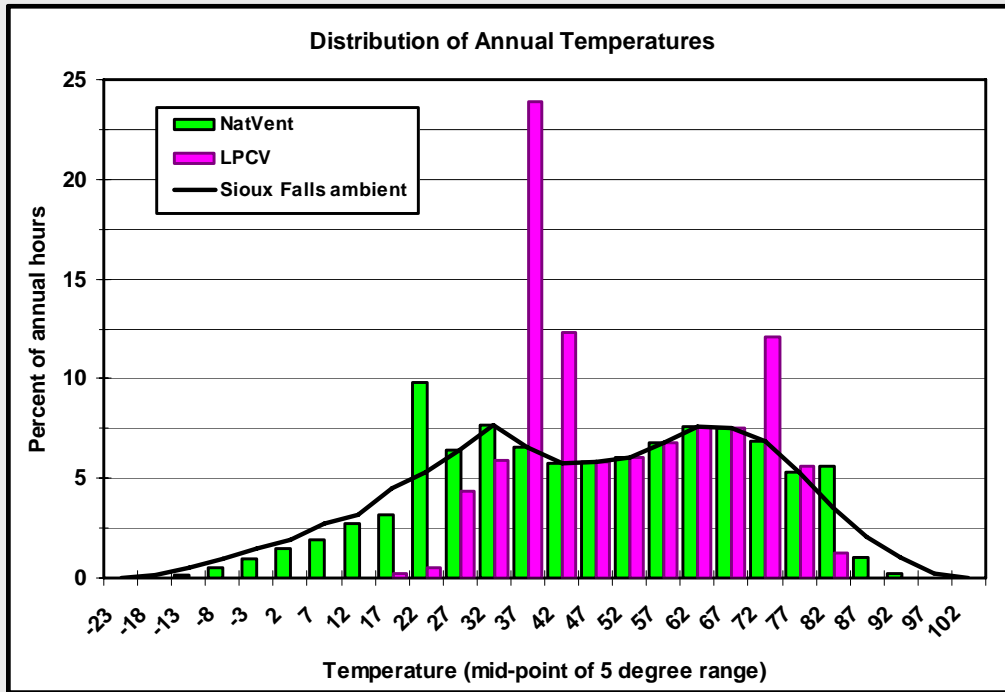
Estimated relationship between barn and ambient temperatures...



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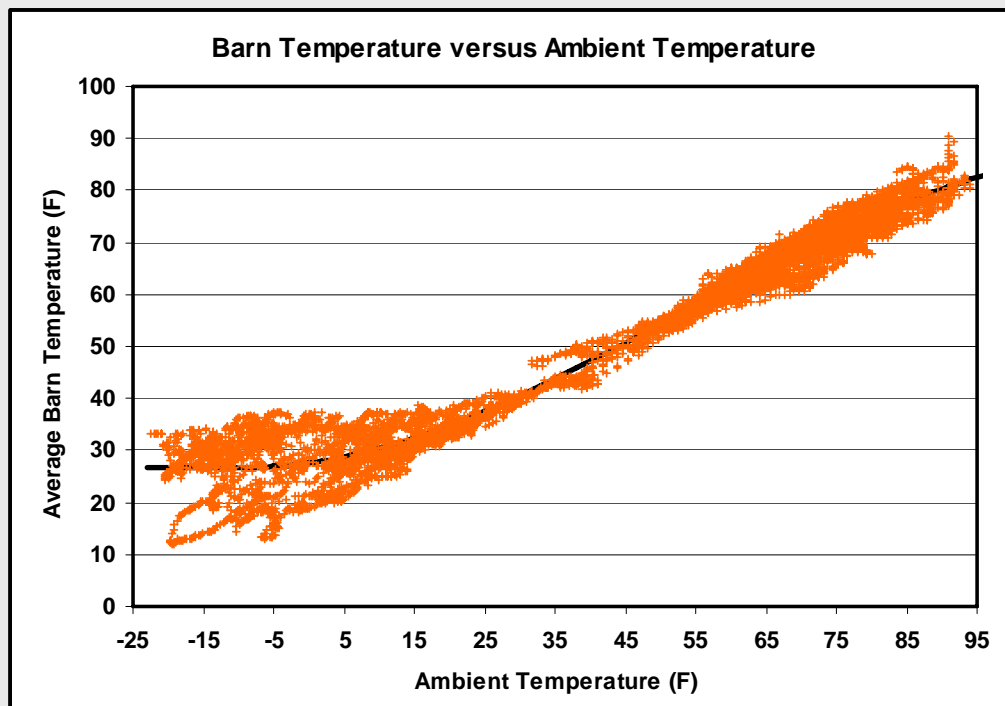
Temperature variability is decreased...



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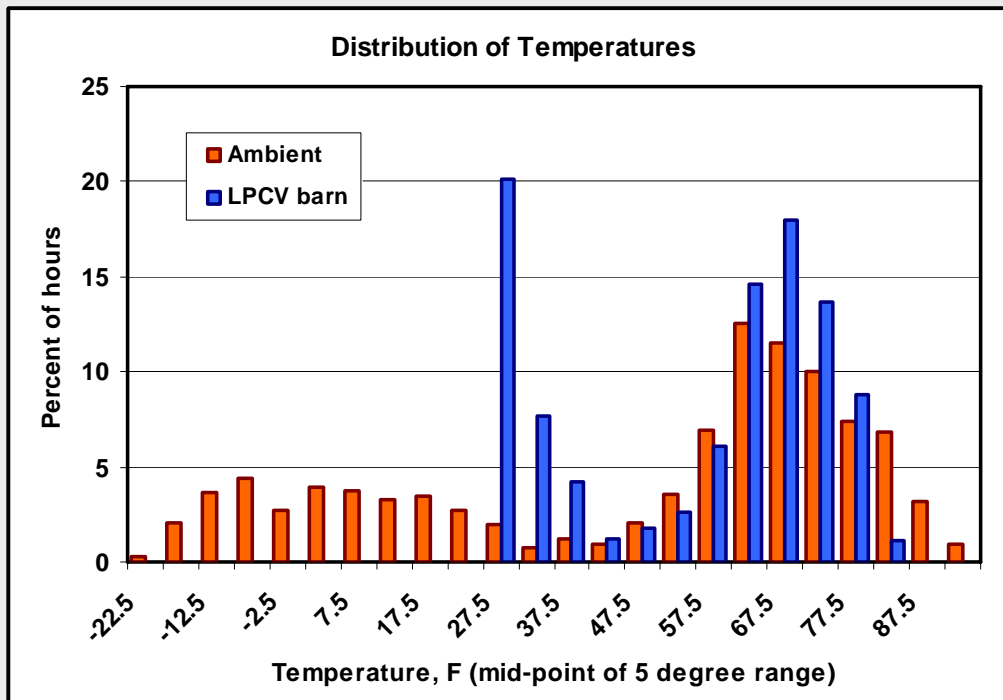
Relationship between barn and ambient temperatures in a MN LPCV barn...



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Distribution of ambient and MN LPCV barn temperatures...



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Format follows K-State budgets...



Farm Management Guide **MF-2442**

Dairy Enterprise – 2,400 Lactating Cows (Freestall)

Department of Agricultural Economics — www.agmanager.info

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

| | | | |
|--|--|--|---|
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|--|--|--|---|

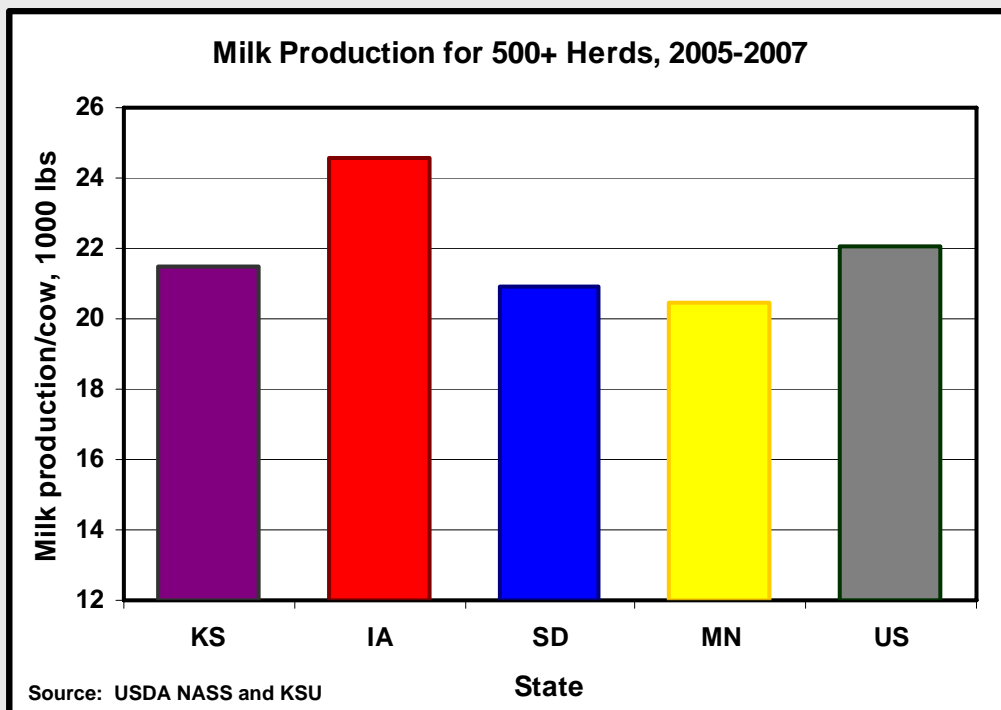
Available at <http://www.agmanager.info/farmmgmt/fmg/livestock/default.asp>

- All costs are included (economic profit vs. cash flow returns)
- Production levels
- Investment assumptions
- Feed and other cost differences

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Milk production in the midwest...



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Milk production assumptions...



- 23,000 pounds for naturally ventilated barn
- Given temperature differences and relationship between milk production and temperature (Bradford), the equivalent value for LPCV barn was 23,477 pounds
- Included an additional 523 lbs for LPCV barn to account for lower DIM, improved health, long-day lighting, etc.
- Initial comparison: 23,000 (73.0) vs. 24,000 (76.2) (sensitivity analysis around production)

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Investment assumptions...

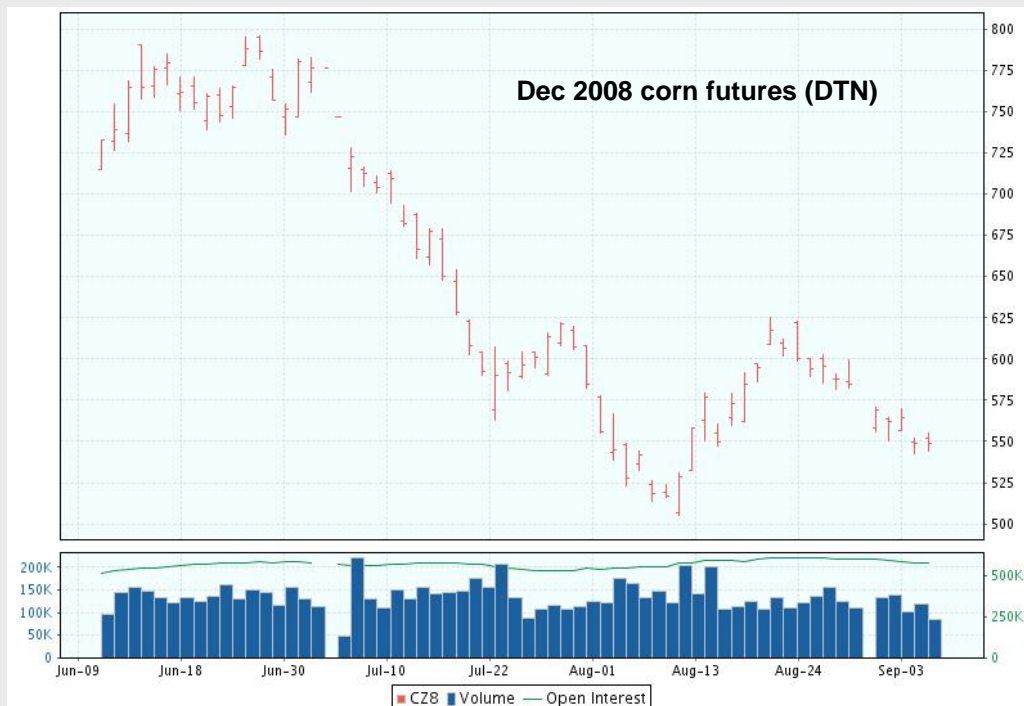


- \$4,650 per cow for both facility types
- Land at \$5,500/acre
 - 50 acres for NatVent = \$97/cow
 - 40 acres for LPCV = \$78/cow
- Buildings have 20-year life with 10% salvage value
- Rolling equipment has 7-year life with 20% salvage value
- Interest rate of 8%
- Annual repairs = 2.5% of investment

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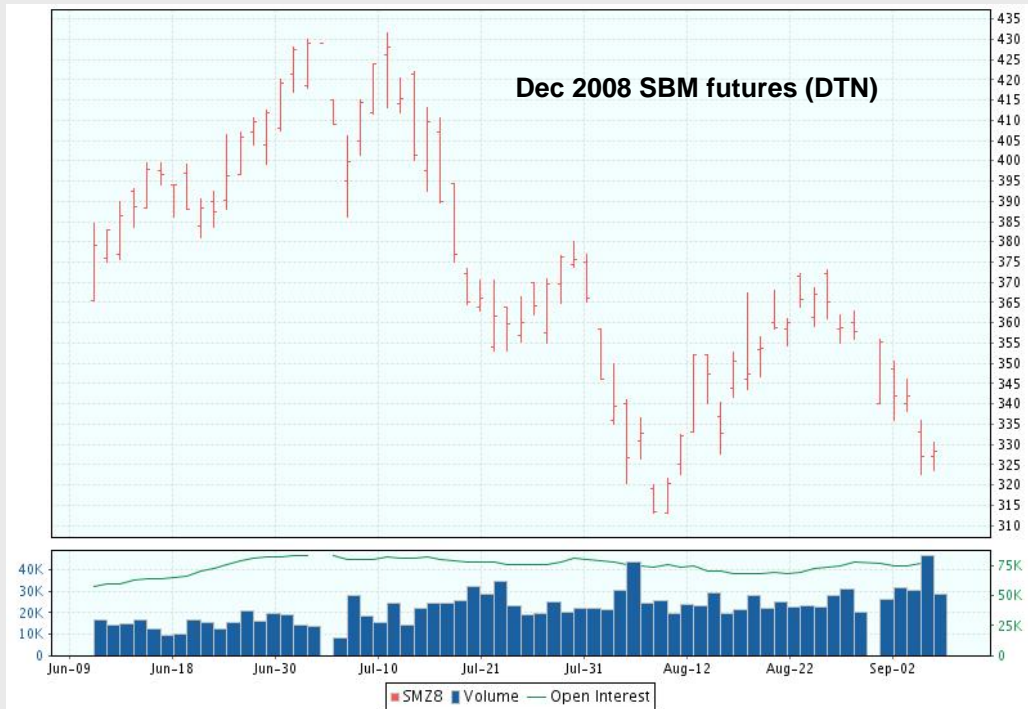
Corn prices have been falling...



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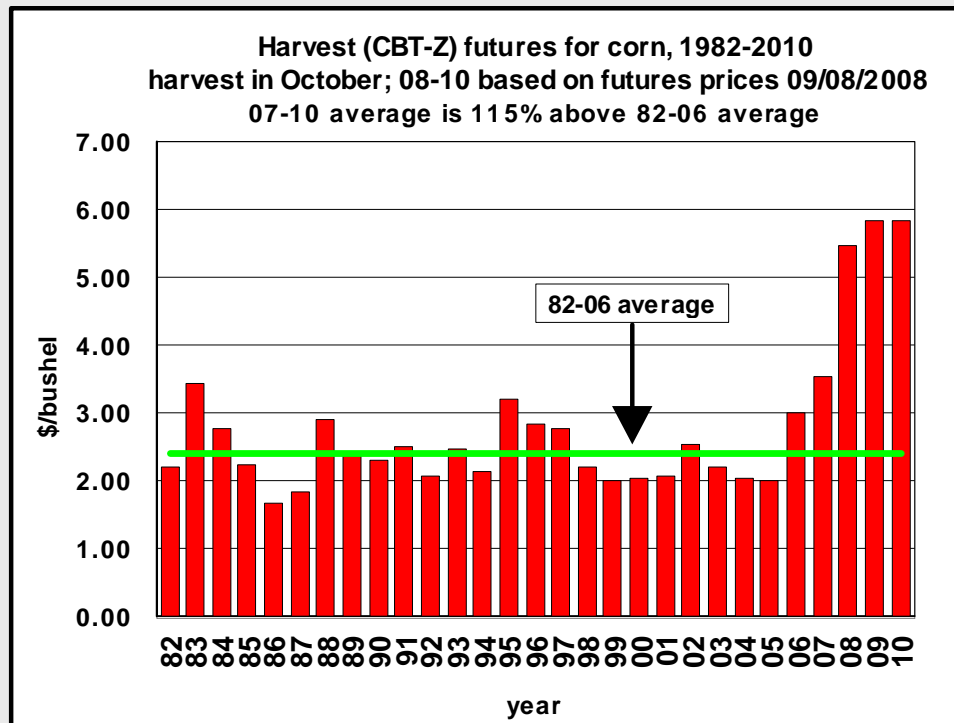
SBM prices have also been falling...



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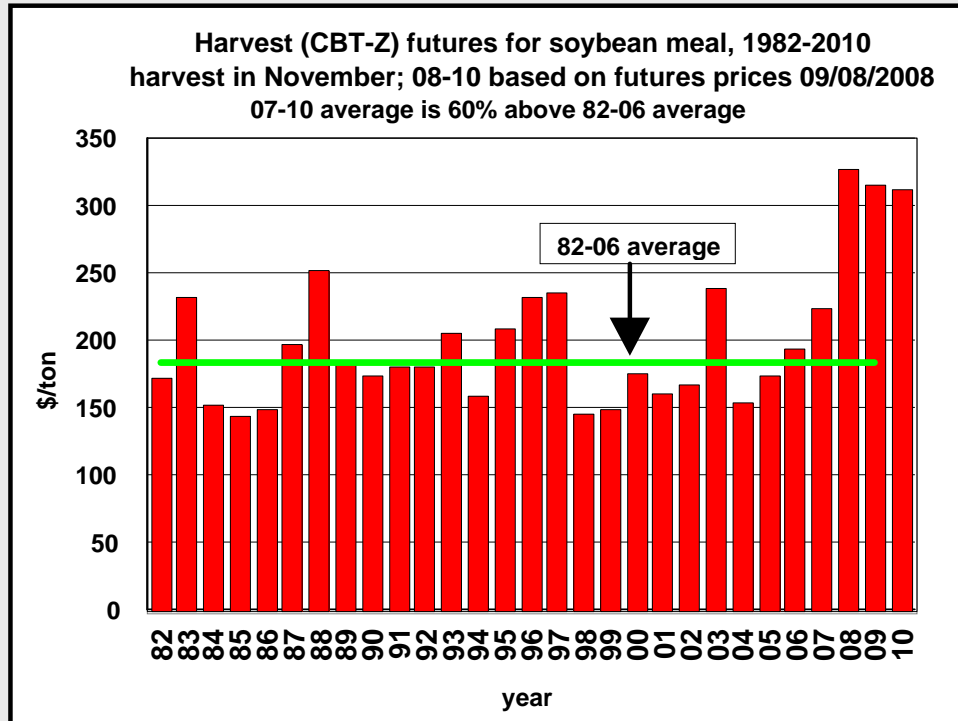
But, corn prices are still quite high...



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As are SBM prices...



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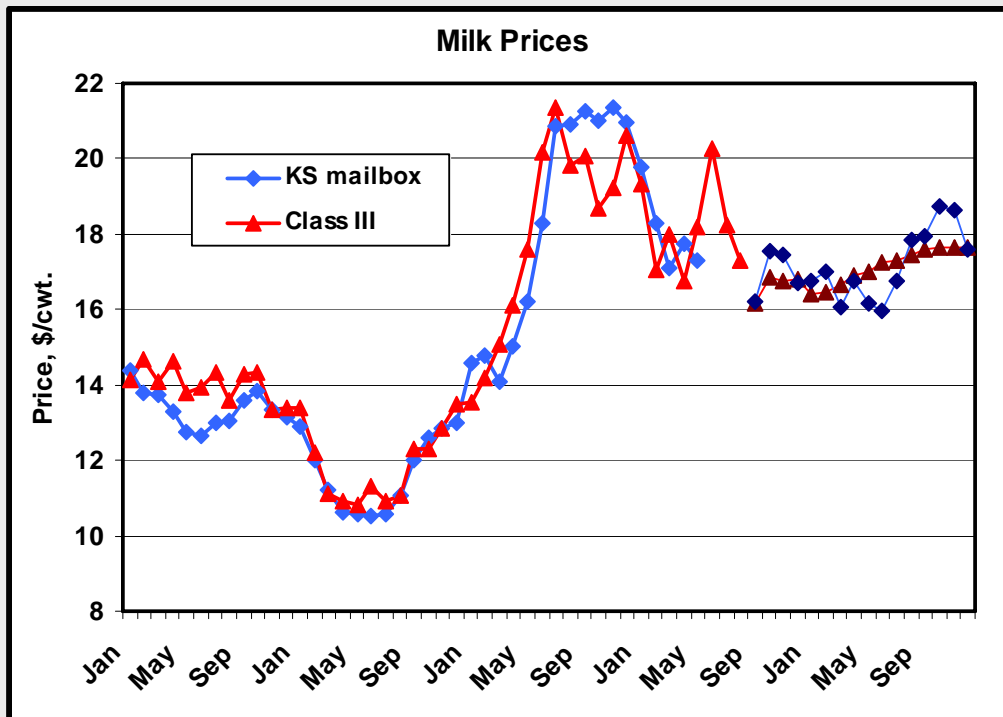
Milk prices have been falling quite rapidly...



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But, they are also above long-term averages...



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Other budget assumptions...



- Lactating cow feed = \$13.56/cwt
 - NatVent feed efficiency = 1.30
 - LPCV feed efficiency = 1.34
- Dry cow feed = \$7.57/cwt
- Utilities – electricity = \$0.06/kWh
 - NatVent = 730 kWh/cow/year (2.0 kWh/cow/day)
 - LPCV = 1,095 kWh/cow/year (3.0 kWh/cow/day)
- Other costs assumed to be the same per cow
- Milk price = \$18.50/cwt (less \$1.00 for hauling and promotion)

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Baseline projected budget...



| Cost-Return Projection --- 2,400 Lactating Cow Freestall Dairy ¹ | | | | | |
|---|----------------------------------|----------------|-------------------|----------------|-------------------------|
| | Natural ventilation ² | | Cross ventilation | | Difference ³ |
| | per cow | per cwt | per cow | per cwt | |
| PRODUCTION LEVEL, lbs milk sold | 23,000 | 230 | 24,000 | 240 | 1,000 |
| Gross Returns | \$4,749.90 | \$20.65 | \$4,934.86 | \$20.56 | \$184.96 |
| COSTS: | | | | | |
| Feed | \$2,555.34 | \$11.11 | \$2,592.13 | \$10.80 | \$36.80 |
| Labor | 335.45 | 1.46 | 335.45 | 1.40 | 0.00 |
| Utilities and water | 125.47 | 0.55 | 147.37 | 0.61 | 21.90 |
| Supplies, fuel, and other | 376.08 | 1.64 | 378.42 | 1.58 | 2.34 |
| Repairs | 116.25 | 0.51 | 116.25 | 0.48 | 0.00 |
| Milk hauling and promotion | 230.00 | 1.00 | 240.00 | 1.00 | 10.00 |
| Capital replacement | 912.50 | 3.97 | 912.50 | 3.80 | 0.00 |
| Building, equipment, and land | 518.14 | 2.25 | 517.05 | 2.15 | -1.09 |
| TOTAL COSTS | \$5,169.22 | \$22.47 | \$5,239.17 | \$21.83 | \$69.95 |
| Returns over Total Costs | -\$419.32 | -\$1.82 | -\$304.31 | -\$1.27 | \$115.01 |
| Breakeven Milk Price, \$/cwt | | \$20.32 | | \$19.77 | \$0.56 |
| Net Return on Assets ⁴ | | 1.36% | | 3.10% | 1.73% |

¹ Replacements purchased

² Includes costs and investment associated with heat abatement

³ Per cow value for cross ventilated facility minus per cow value for natural ventilation facility.

⁴ Assets equal total value of breeding herd and land, buildings, and equipment.

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Projected budget Doubling the cost of electricity (6¢ to 12¢ per kWh)



| Cost-Return Projection --- 2,400 Lactating Cow Freestall Dairy ¹ | | | | | |
|---|----------------------------------|----------------|-------------------|----------------|-------------------------|
| | Natural ventilation ² | | Cross ventilation | | Difference ³ |
| | per cow | per cwt | per cow | per cwt | |
| PRODUCTION LEVEL, lbs milk sold | 23,000 | 230 | 24,000 | 240 | 1,000 |
| Gross Returns | \$4,749.90 | \$20.65 | \$4,934.86 | \$20.56 | \$184.96 |
| COSTS: | | | | | |
| Feed | \$2,555.34 | \$11.11 | \$2,592.13 | \$10.80 | \$36.80 |
| Labor | 335.45 | 1.46 | 335.45 | 1.40 | 0.00 |
| Utilities and water | 169.27 | 0.74 | 213.07 | 0.89 | 43.80 |
| Supplies, fuel, and other | 377.83 | 1.64 | 381.05 | 1.59 | 3.22 |
| Repairs | 116.25 | 0.51 | 116.25 | 0.48 | 0.00 |
| Milk hauling and promotion | 230.00 | 1.00 | 240.00 | 1.00 | 10.00 |
| Capital replacement | 912.50 | 3.97 | 912.50 | 3.80 | 0.00 |
| Building, equipment, and land | 518.14 | 2.25 | 517.05 | 2.15 | -1.09 |
| TOTAL COSTS | \$5,214.77 | \$22.67 | \$5,307.50 | \$22.11 | \$92.73 |
| Returns over Total Costs | -\$464.87 | -\$2.02 | -\$372.64 | -\$1.55 | \$92.23 |
| Breakeven Milk Price, \$/cwt | | \$20.52 | | \$20.05 | \$0.47 |
| Net Return on Assets ⁴ | | 0.72% | | 2.12% | 1.41% |

¹ Replacements purchased

² Includes costs and investment associated with heat abatement

³ Per cow value for cross ventilated facility minus per cow value for natural ventilation facility.

⁴ Assets equal total value of breeding herd and land, buildings, and equipment.

**Advantage per cow
decreases ~\$23.**

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Sensitivity analysis (investment vs. production)...



| Sensitivity of Return on Assets versus Investment and Milk Production ¹ | | | | | |
|--|-----------------------------|---------|---------|---------|---------|
| Milk Production | Facility Investment, \$/cow | | | | |
| | \$4,150 | \$4,400 | \$4,650 | \$4,900 | \$5,150 |
| Naturally Ventilated Freestall Barn | | | | | |
| 22,500 | 1.48% | 1.07% | 0.69% | 0.34% | 0.02% |
| 22,750 | 1.84% | 1.42% | 1.03% | 0.67% | 0.33% |
| 23,000 | 2.20% | 1.77% | 1.36% | 0.99% | 0.64% |
| 23,250 | 2.56% | 2.12% | 1.70% | 1.31% | 0.95% |
| 23,500 | 2.93% | 2.46% | 2.04% | 1.64% | 1.27% |
| 23,750 | 3.29% | 2.81% | 2.37% | 1.96% | 1.58% |
| 24,000 | 3.65% | 3.16% | 2.71% | 2.29% | 1.89% |
| 24,250 | 4.02% | 3.51% | 3.04% | 2.61% | 2.21% |
| 24,500 | 4.38% | 3.86% | 3.38% | 2.93% | 2.52% |
| LPCV Freestall Barn | | | | | |
| 22,500 | 1.73% | 1.38% | 1.05% | 0.74% | 0.44% |
| 22,750 | 2.09% | 1.73% | 1.39% | 1.07% | 0.77% |
| 23,000 | 2.46% | 2.08% | 1.73% | 1.40% | 1.09% |
| 23,250 | 2.82% | 2.44% | 2.07% | 1.73% | 1.41% |
| 23,500 | 3.19% | 2.79% | 2.41% | 2.06% | 1.73% |
| 23,750 | 3.55% | 3.14% | 2.76% | 2.39% | 2.05% |
| 24,000 | 3.92% | 3.49% | 3.10% | 2.73% | 2.38% |
| 24,250 | 4.28% | 3.85% | 3.44% | 3.06% | 2.70% |
| 24,500 | 4.65% | 4.20% | 3.78% | 3.39% | 3.02% |

At the same levels of production, LPCV barn has advantage due to improved feed efficiency.

¹ All costs are held constant except feed and hauling and promotion, which vary with production.

Sensitivity analysis (investment vs. production)...



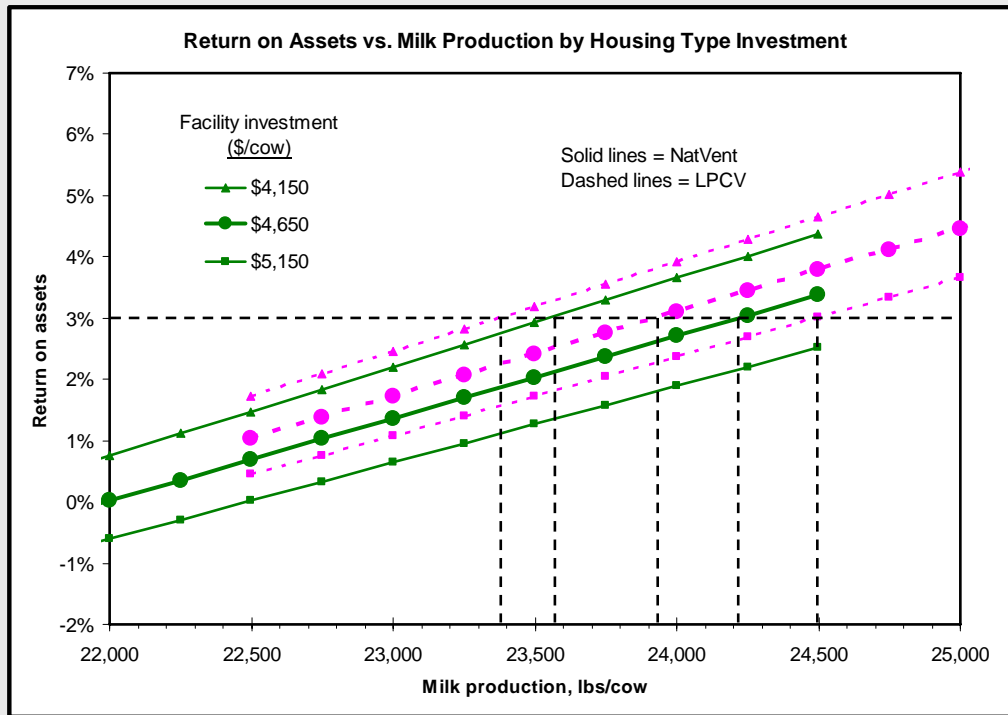
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|--|-----------------------------|---------|---------|---------|---------|
| Milk Production | Facility Investment, \$/cow | | | | |
| | \$4,150 | \$4,400 | \$4,650 | \$4,900 | \$5,150 |
| Naturally Ventilated Freestall Barn | | | | | |
| 22,500 | 1.48% | 1.07% | 0.69% | 0.34% | 0.02% |
| 22,750 | 1.84% | 1.42% | 1.03% | 0.67% | 0.33% |
| 23,000 | 2.20% | 1.77% | 1.36% | 0.99% | 0.64% |
| 23,250 | 2.56% | 2.12% | 1.70% | 1.31% | 0.95% |
| 23,500 | 2.93% | 2.46% | 2.04% | 1.64% | 1.27% |
| 23,750 | 3.29% | 2.81% | 2.37% | 1.96% | 1.58% |
| 24,000 | 3.65% | 3.16% | 2.71% | 2.29% | 1.89% |
| 24,250 | 4.02% | 3.51% | 3.04% | 2.61% | 2.21% |
| 24,500 | 4.38% | 3.86% | 3.38% | 2.93% | 2.52% |
| LPCV Freestall Barn | | | | | |
| 22,500 | 1.73% | 1.38% | 1.05% | 0.74% | 0.44% |
| 22,750 | 2.09% | 1.73% | 1.39% | 1.07% | 0.77% |
| 23,000 | 2.46% | 2.08% | 1.73% | 1.40% | 1.09% |
| 23,250 | 2.82% | 2.44% | 2.07% | 1.73% | 1.41% |
| 23,500 | 3.19% | 2.79% | 2.41% | 2.06% | 1.73% |
| 23,750 | 3.55% | 3.14% | 2.76% | 2.39% | 2.05% |
| 24,000 | 3.92% | 3.49% | 3.10% | 2.73% | 2.38% |
| 24,250 | 4.28% | 3.85% | 3.44% | 3.06% | 2.70% |
| 24,500 | 4.65% | 4.20% | 3.78% | 3.39% | 3.02% |

At a \$500 difference in investment (LPCV higher), it takes a 250 lb increase in production to have comparable returns (at low production).

The production advantage needed increases as production level increases.

¹ All costs are held constant except feed and hauling and promotion, which vary with production.

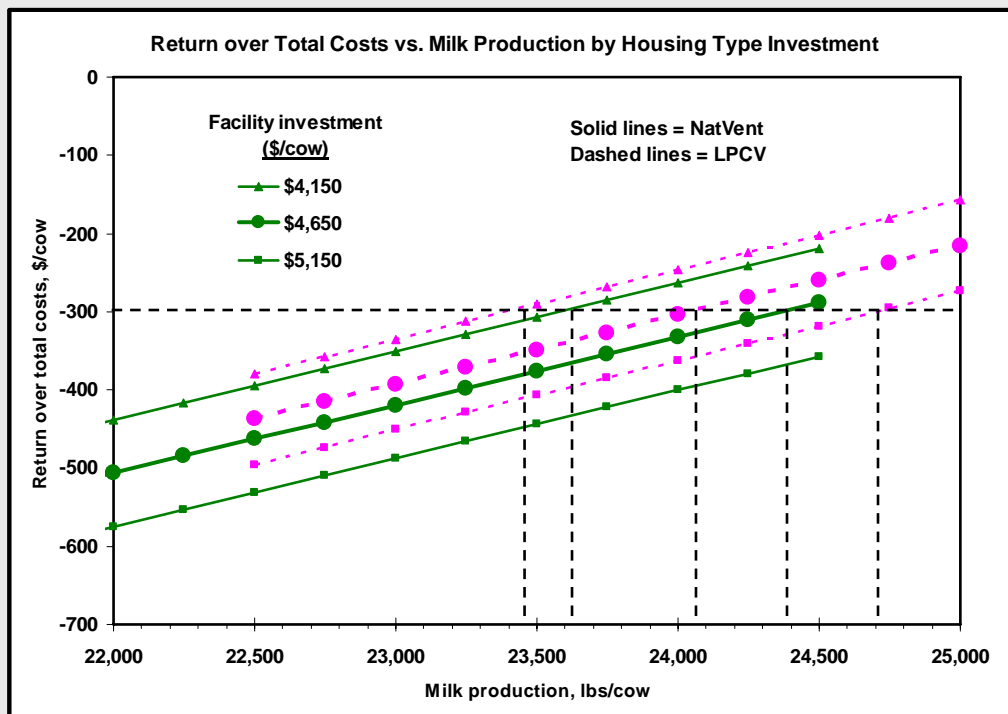
Sensitivity analysis (investment vs. production)...



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Sensitivity analysis (investment vs. production)...



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Projected budget

\$17/cwt milk (\$16 net) \$12/cwt feed costs



Cost-Return Projection --- 2,400 Lactating Cow Freestall Dairy¹

| | Natural ventilation ² | | Cross ventilation | | Difference ³ |
|-----------------------------------|----------------------------------|----------------|-------------------|----------------|-------------------------|
| | per cow | per cwt | per cow | per cwt | |
| PRODUCTION LEVEL, lbs milk sold | 23,000 | 230 | 24,000 | 240 | 1,000 |
| Gross Returns | \$4,404.90 | \$19.15 | \$4,574.86 | \$19.06 | \$169.97 |
| COSTS: | | | | | |
| Feed | \$2,276.71 | \$9.90 | \$2,309.28 | \$9.62 | \$32.57 |
| Labor | 335.45 | 1.46 | 335.45 | 1.40 | 0.00 |
| Utilities and water | 125.47 | 0.55 | 147.37 | 0.61 | 21.90 |
| Supplies, fuel, and other | 364.94 | 1.59 | 367.11 | 1.53 | 2.17 |
| Repairs | 116.25 | 0.51 | 116.25 | 0.48 | 0.00 |
| Milk hauling and promotion | 230.00 | 1.00 | 240.00 | 1.00 | 10.00 |
| Capital replacement | 912.50 | 3.97 | 912.50 | 3.80 | 0.00 |
| Building, equipment, and land | 518.14 | 2.25 | 517.05 | 2.15 | -1.09 |
| TOTAL COSTS | \$4,879.45 | \$21.21 | \$4,945.00 | \$20.60 | \$65.55 |
| Returns over Total Costs | -\$474.55 | -\$2.06 | -\$370.14 | -\$1.54 | \$104.41 |
| Breakeven Milk Price, \$/cwt | | \$19.06 | | \$18.54 | \$0.52 |
| Net Return on Assets ⁴ | | 0.38% | | 1.95% | 1.57% |

¹ Replacements purchased

² Includes costs and investment associated with heat abatement

³ Per cow value for cross ventilated facility minus per cow value for natural ventilation facility.

⁴ Assets equal total value of breeding herd and land, buildings, and equipment.

Similar advantage for
LPCV as feed and
milk prices decline

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Sensitivity analysis (feed costs vs. milk prices)...



Sensitivity of Return on Assets versus Investment and Milk Production¹

| Milk Price | Feed cost, \$/cwt | | | | |
|--|-------------------|---------|---------|---------|---------|
| | \$12.06 | \$12.56 | \$13.06 | \$13.56 | \$14.06 |
| Naturally Ventilated Freestall Barn (production = 23,000 lbs) | | | | | |
| \$15.50 | -4.75% | -6.12% | -7.49% | -8.86% | -10.23% |
| \$16.50 | -1.34% | -2.71% | -4.08% | -5.45% | -6.82% |
| \$17.50 | 2.07% | 0.70% | -0.67% | -2.04% | -3.41% |
| \$18.50 | 5.47% | 4.10% | 2.73% | 1.36% | -0.01% |
| \$19.50 | 8.88% | 7.51% | 6.14% | 4.77% | 3.40% |
| LPCV Freestall Barn (production = 24,000 lbs) | | | | | |
| \$15.50 | -3.42% | -4.82% | -6.21% | -7.60% | -9.00% |
| \$16.50 | 0.15% | -1.25% | -2.64% | -4.04% | -5.43% |
| \$17.50 | 3.71% | 2.32% | 0.93% | -0.47% | -1.86% |
| \$18.50 | 7.28% | 5.89% | 4.49% | 3.10% | 1.70% |
| \$19.50 | 10.85% | 9.45% | 8.06% | 6.67% | 5.27% |
| Difference (LPCV - NatVent) | | | | | |
| \$15.50 | 1.33% | 1.31% | 1.28% | 1.26% | 1.23% |
| \$16.50 | 1.49% | 1.47% | 1.44% | 1.42% | 1.39% |
| \$17.50 | 1.65% | 1.62% | 1.60% | 1.58% | 1.55% |
| \$18.50 | 1.81% | 1.78% | 1.76% | 1.73% | 1.71% |
| \$19.50 | 1.96% | 1.94% | 1.92% | 1.89% | 1.87% |

¹ All other costs are held constant at initial baseline assumptions.

LPCV is more
profitable at all
combinations
of milk price
and feed cost.

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Projected budget 15-year life and 3.5% for repairs on LPCV



Cost-Return Projection --- 2,400 Lactating Cow Freestall Dairy¹

| | Natural ventilation ² | | Cross ventilation | | Difference ³ per cow |
|-----------------------------------|----------------------------------|----------------|-------------------|----------------|------------------------------------|
| | per cow | per cwt | per cow | per cwt | |
| PRODUCTION LEVEL, lbs milk sold | 23,000 | 230 | 24,000 | 240 | 1,000 |
| Gross Returns | \$4,749.90 | \$20.65 | \$4,934.86 | \$20.56 | \$184.96 |
| COSTS: | | | | | |
| Feed | \$2,555.34 | \$11.11 | \$2,592.13 | \$10.80 | \$36.80 |
| Labor | 335.45 | 1.46 | 335.45 | 1.40 | 0.00 |
| Utilities and water | 125.47 | 0.55 | 147.37 | 0.61 | 21.90 |
| Supplies, fuel, and other | 376.08 | 1.64 | 380.28 | 1.58 | 4.20 |
| Repairs | 116.25 | 0.51 | 162.75 | 0.68 | 46.50 |
| Milk hauling and promotion | 230.00 | 1.00 | 240.00 | 1.00 | 10.00 |
| Capital replacement | 912.50 | 3.97 | 912.50 | 3.80 | 0.00 |
| Building, equipment, and land | 518.14 | 2.25 | 582.30 | 2.43 | 64.16 |
| TOTAL COSTS | \$5,169.22 | \$22.47 | \$5,352.78 | \$22.30 | \$183.56 |
| Returns over Total Costs | -\$419.32 | -\$1.82 | -\$417.92 | -\$1.74 | \$1.40 |
| Breakeven Milk Price, \$/cwt | | \$20.32 | | \$20.24 | \$0.08 |
| Net Return on Assets ⁴ | | 1.36% | | 1.44% | 0.07% |

¹ Replacements purchased

² Includes costs and investment associated with heat abatement

³ Per cow value for cross ventilated facility minus per cow value for natural ventilation facility.

⁴ Assets equal total value of breeding herd and land, buildings, and equipment.

**Advantage for
LPCV disappears**

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Summary...



- Low profile cross ventilated (LPCV) barns have potential to increase economic returns relative to naturally ventilated barns.
- An important driver of improved returns is increased milk production and improved feed efficiency due to reduced weather variability (also health & reproduction).
- Relative investment required of the two facilities will impact returns, but is not a major issue when allocated over expected life of facility.
- Benefits of LPCV outweigh higher electricity costs.
- Ability to manage a “different” type of facility?

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- [KSU-Landbuy.xls and Landbuy.xls](#)
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- [Debate Conference](#)
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