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Dairy Farm Revenue Insurance:

Is the Application Viable?

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Dairy Farm Revenue Insurance: Is the Application Viable?

Lowering the dairy price support throughout the 1980's led to a market milk price that has been largely determined by market forces since the early 1990's. Consequently the base farm market milk price has varied much more than it had in the decades where the price support routinely interfered (Figure 1). Recent World Trade Organization developments threaten to further erode formal US dairy policies which support and insulate farm milk prices. In reaction to this, USDA has championed farm-level risk management tools such as a milk price options pilot program.

In 2000 the Federal Crop Insurance Corporation (FCIC) authorized the Agricultural Risk Protection Act of 2000 to facilitate the provision of insurance on livestock, expanding insurance possibilities on farms to the livestock enterprise. This led to the development of Livestock Revenue Protection (LRP) and the Livestock Gross Margin (LGM) by private sector entities under 508h provisions. These products are currently in pilot testing on a limited basis for cattle and pigs. The LRP is an option contract based on an average of cash markets and is available for more months than Chicago Mercantile Exchange (CME) option contracts. The LGM is an option contract on gross margin which is based upon the CME for livestock futures prices and the Chicago Board of Trade (CBOT) for corn and soybean meal futures prices.

Prior to the LRP and LGM, Adjusted Gross Revenue (AGR) insurance was initiated on a pilot basis in 1999 and expanded subsequently to several locations. AGR is an insurance contract using expected accrual gross revenue for the farm as a basis for determining the insurance guarantee. The application was restricted to livestock as a minor contributor to farm revenues. Subsequently, a private sector 508h contract called

AGR-Lite was initiated which permitted livestock as the principal enterprise in a farm business. Variations of AGR-Lite have been proposed that capture some of the gross margin themes that underlie the LGM contract. This paper focuses on whether the current structure of AGR-Lite and variants that have been proposed meet the conditions for insurability as outlined by FCIC standards when applied to dairy operations.

The analysis is based upon Michigan dairy farm cross-sectional panel data from 1990 through 2004. Dairy revenue component for each farm is calculated as a sum of milk revenue, dairy livestock revenue, patronage, and government payments pertaining to the dairy enterprise adjusted for inventory adjustments to make adjusted gross revenue. In addition, crop revenue and other revenue (determined as a residual value) are used in the analysis to determine the variability in gross cash farm income for dairy farms. Milk price and milk yield per cow variability also are evaluated since the dairy enterprise is the primary source of revenue.

The paper proceeds as follows: the next section briefly describes the mechanics of AGR, the data are described in the third section including a revenue variance decomposition, insurance feasibility criterion are discussed in the fourth section and evidence from the Michigan farm data are examined vis-à-vis these criteria, finally conclusions and implications for further work are discussed.

AGR Revenue Insurance Contract

Current livestock revenue insurance tools include AGR and AGR-Lite. AGR insures the revenue of the entire farm by guaranteeing a percentage of average gross farm revenue, including a small amount of livestock revenue (USDA-RMA, 2003). The plan uses information from a producer's 5-year historical farm average revenue as reported on

Schedule F tax forms, and the current year's expected farm revenue, to calculate the policy revenue guarantee (USDA-RMA, 2003). AGR-Lite is similar to AGR. Insurance is provided against revenue loss due to any unavoidable occurrence (USDA-RMA, 2006).

AGR protection is calculated by multiplying the expected[1] adjusted gross revenue by the coverage level and the payment rate (co-pay) selected by the producer (USDA-RMA, 2003). The coverage level determines where indemnity payments begin; indemnities are given by:

Indemnity = (coverage expected AGR – realized AGR,0)*Payment rate.*

Payment rates determine how much the producer is paid for each dollar lost under the coverage level. Coverage levels are 65, 75 and 80 percent while payment rates are 75 or 90 percent. Some restrictions apply to the number of commodities that must be produced for eligibility of higher coverage levels.

Current AGR policies are based upon accrual farm revenue, rather than revenue per cow. This raises difficult underwriting questions which are explored below, using the panel data, including how the expected farm revenue would be measured and the consequences of yield shortfalls. One of the alternative measures of farm revenue that has been proposed as an insurance contract is milk revenue less feed purchases which better captures the impact of crop yield shortfalls on the farm on net farm income.

Insurance Feasibility

Assessing the feasibility of an insurance instrument requires understanding the peril and available instruments. Three questions must be addressed.

[1] USDA/RMA uses the term expected in a layperson parlance, not in a formal probabilistic manner.

What is the peril of concern?

The perils covered in revenue insurance include any unavoidable natural occurrence (e.g., adverse weather, disease, fire). Bad debts are treated as a form of negligence, not natural occurrences. Dairy farms might be especially interested in perils that are related to milk and forage production (quantity and quality) as these do not have obvious other available risk management instruments.

What are the risk characteristics of the peril?

This question is aimed at understanding the probability distribution of insured losses. Sufficient data must be available to estimate the distributions in question and identify any characteristics which may aid in categorizing producers by degree of risk. This is the primary purpose of this paper.

What risk mitigation or transfer mechanisms currently exist?

Current risk mitigation mechanisms available to dairy operations include futures and options contracts to handle feed and milk price risk. Additionally, forward contracts are available through many cooperatives and processors to help control for milk price risk. In addition, current milk marketing order provisions blend prices across classes and the dairy price support program provides a floor price for manufactured uses of milk. Finally, cooperatives perform most of the raw milk marketing in the U.S. and as part of this marketing use contracts and other instruments to manage price risk.

Insurability conditions

Past research indicates a number of conditions that must be present to consider a peril insurable (Rejda, 2001; Shaik et al, 2006). We consider each condition relative to dairy farm revenue.

Determinable and measurable loss

The contracts in question utilize Schedule F information which all producers must file as part of their income taxes. Revenue, or revenue less feed purchases, can be measured from this information.

Accidental and unintentional loss

This condition is meant to get at the potential for hidden action and monitoring moral hazard problems. Deductibles, co-payments and audits are ways to deal with these problems. Fraud on income taxes is subject to stiff penalties and audits are already performed by the IRS. Thus, we might reasonably assume that reporting problems would be minimal. The incentive to shirk managerial responsibility can be taken care of by the deductible.

Sufficient information to conduct risk classification

Adverse selection, the possibility that only farms likely to have revenue failures will purchase insurance is another potential problem. Which characteristics might aid in classifying farms, for example herd size, is one of the objectives of this research.

Sufficient data to establish accurate premium rates

Data is required to set premium rates based on expected losses. Insurers typically set premium rates inversely with the amount of data available.

Losses sufficiently uncorrelated to allow for pooling

This factor is related to premium level, therefore, the more systemic the risk, the less that pooling across farms reduces the variability in annual losses for the overall insurer portfolio. This relates to the level of reinsurance that will likely be required of RMA to transfer the systemic risk to the federal government.

Economically feasible premium

The final question is whether the premium will be at a level that farmers will be willing to pay. This relates to the required premium, subsidies from the government, diversification and other risk management strategies available to the farmer.

Dairy Farm Data and Summary Statistics

The data utilized are from Michigan State University Department of Agricultural Economics Farm Business Analysis Summary reports. Individual farm records are available from 1990 through 2004. To assess specific AGR policy implications requires at least 5 years of data available to establish a producer's historical farm average. There were 141 operations with at least 5 years of data available for a total of 1167 farm-year observations, with average years of data available for the farms around 8 years.

Cross-section summary statistics including mean, median, and standard deviation of size, production, price and revenue variables are presented in Table 1, which provide a description of the nature of the farms in the data set. All data were detrended and prices deflated to 2004 values. Within this cross-sectional data set the average herd size was 196 cows which is larger than the typical average herd size in Michigan which is closer to 120 cows in the time period considered. The median herd size was 137 cows indicating a positively skewed distribution.

Milk price averaged $14.19/cwt and milk per cow averaged 20,020 pounds. Adjusted gross revenue, calculated as gross revenue with accrual adjustments for change in inventories, averaged $618,645 with a large standard deviation and a large positive skewness. Dairy revenue included milk sold as well as cull and dairy animal sales, coop

dividends, and government payments related to the dairy enterprise. Other revenue is all other farm sales (excluding dairy sources of revenue).

Dairy Farm Revenue Variability

The objective of AGR is to partially mitigate the financial effects of significant revenue shortfalls. Examining the major components of milk revenue assists in locating the drivers of variation. To determine the cause of variation in dairy revenue factors we look at the variation in AGR, milk price, and milk per cow.

The first measure explored is the relative variation of AGR and AGR less feed purchases. The relative variation is calculated as the dollar value of AGR (AGR less feed purchases) divided by the predicted value of AGR (AGR less feed purchases). The predicted value is based on the regression of AGR against time. The estimate of relative variation was calculated for AGR and AGR less feed purchases for all farms as well as 3 different herd sizes: 24-99 cows, 100-249 cows, and 250 or greater cows. The results are presented in Charts 1-8. The estimates are smaller than the out of sample results would be because they are constructed as if the true but unknown mean was known as well as overcompensation in trend short time-series.

Reviewing Chart 1 and 2 for all farms it was determined that 5% of the cases were less than 79% coverage for AGR and 6% were less than 79% coverage for AGR less feed purchases. These frequencies are much lower than for crop revenue insurance contracts, even after adjustments for in versus out of sample properties and comparable aggregations were taken into account.

The second measure looks at milk revenue variation through the coefficient of variation for milk price. The average coefficient of variation for annual milk price without deflation across all farms and over years was 11 percent with a standard deviation of two percent. However, with the milk price deflated to 2004 dollars, the coefficient of variation averaged 20.8 percent with a standard deviation of three percent. A kernel density was also calculated for the deflated milk price shown in Figure 2. The crops for which revenue insurance contracts are facilitated by FCIC have coefficients of variation in the 18 to 22 percent range. Thus, the dairy farms in this set exhibit sufficient milk price variation to be feasible insurance candidates. It is important to note that options and futures contracts are currently available to handle this type of milk price risk.

The third measure, milk yield per cow, is much less variable than for crop farms with revenue insurance contracts, ranging from five to nine percent; that compares to 25 to 40 percent for dryland crops. Kernel densities of de-trended milk per cow (milk yield) indicate that 92% of all farms were within 3,000 pounds/cow of trend yield (and 84% were within 2,000 pounds) (Figure 3). Size categories were examined for both the milk price and milk per cow kernel densities, but were not shown to be important in classifying farms for dairy revenue purposes.

Revenue Variance Decomposition

Variance decomposition was used to identify the source of variation in adjusted gross revenue and adjusted gross revenue less feed purchases. Revenue was divided into two sources: dairy and other. The farms examined derive the majority of their revenue from

the dairy enterprise. On average these farms derived 90 percent of farm revenues from dairy related activities (and 82 percent of farm revenue was from milk sales).

Variance was decomposed using the general relationship Var(X+Y) = Var(X) + Var(Y) + 2Cov(X,Y). Table 2 presents the results of the revenue decomposition. When divided into dairy and other revenue sources, dairy revenues contributed the largest source of variation. The negative covariance between these two sources, dairy revenue and other revenue indicates that diversification contributes to less revenue variability. Similarly, when the insured revenue is defined as being net of feed purchases, the largest contributor to variation is dairy revenue and covariances between dairy revenue and other revenue is negative while the covariance between dairy revenue and feed purchases is positive, as well as the covariance between other revenue and feed purchases is positive. The relationship between the covariances is what was expected.

The resultant variability in milk revenue per cow is less than that of crops, even irrigated crops. One principal criterion for insurability is whether there is sufficient variation in the measure being insured to warrant a need for risk transfer, particular when the deductible structure required guarding against hidden action is taken into account. Revenue shortfalls would very seldom trigger an indemnity under the deductible structures used in insurance policies of these types.

Policy interference: The MILC program

The 2002 Farm Bill introduced deficiency payments on milk production for the first time. The Milk Income Loss Contract Program paid dairy farmers 45 percent of the difference between the Class I mover and $13.69/cwt from December 2001 through September 2005 on milk production up to 2.4 million pounds annually (e.g., 120 cows producing 20,000

pounds each). This program was very important in 2002 and 2003 with payments reaching $1.80/cwt in some months.

To account for MILC effects on farm revenue variation, we assumed that a producer would collect the average MILC payment on all eligible milk production (e.g., the greater of all milk production or 2.4 million pounds) but capped the amount at the reported level of farm government payments. MILC payments made up an average of 3.5 percent of gross farm revenue and 4.0 percent of dairy related revenue across farms from 2002 through 2004.

Without MILC payments, revenue variation was larger. The variance decomposition in Table 2 indicates that the MILC program off-sets dairy revenue variance under either insurance contract. The MILC program was recently renewed for two years at a reduced 34 percent payment rate. However, the presence of this or other similar programs clearly would affect the demand for revenue insurance.

Conclusions

One principal criterion for insurability is whether there is sufficient variation in the measure being insured to warrant a need for risk transfer, in particular when the deductible structure required guarding against hidden action is taken into account. Revenue shortfalls would trigger an indemnity under the deductible structures used in insurance policies of these types at a much lower frequency than for crops with revenue insurance and other AGR policies.

Currently, AGR for dairy enterprises is available on a very limited basis. The premium rate for the dairy enterprise in AGR was developed at a point in time when the

focus was on crops with the proviso that a limited component of farm revenues could come from livestock and poultry. The purpose was to not preclude farms from participating that had livestock as a minor enterprise. One of the underwriting issues was how one would separate out the impacts of a crop yield shortfall of a crop grown for both feed and sale; in the event of a crop yield shortfall, sales could go to zero as limited production would be diverted to use for feed. Given that context and substantial uncertainties about implementation including issues of underwriting, treatment of price cycles for some classes of livestock and poultry, and very limited experience with a new federal dairy policy, premium rates were set with a substantial safety factor.

The premium rate on the dairy enterprise was set at 9% of liability for 75% coverage. A re-examination of this rate is appropriate given the consideration of farms under AGR-Lite where dairy can make up the major component of farm gross revenues and a larger consideration has been given to dealing with underwriting issues.

The next step, if a decision were made to go forward with an insurance contract program, is to assess other insurability conditions criteria including acceptable consequences of hidden information and hidden action, and acceptable transactions costs including monitoring. Additionally, since this research was completed using an unbalanced panel, further insight will be needed on the consequences of an unbalanced panel when determining an insurance contract.

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Figure 1. Price variation in the Class III base price since 1988 across farms

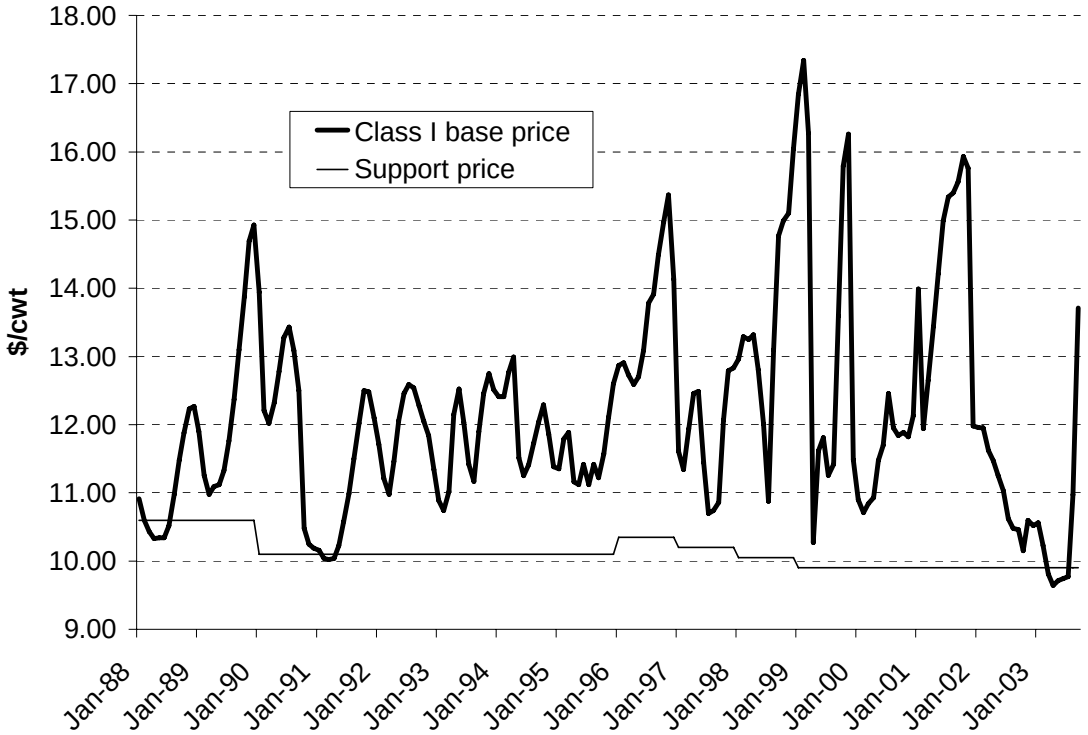


Table 1. Summary Statistics

	Herd Size	Milk Sold	Milk Price	Milk/cow	Adjusted Gross Revenue	Dairy Revenue	Other Revenue	Feed Purchases
	(cows)	(cwt)	($/cwt)*	(lb/cow)	($)*	($)*	($)*	($)*
Mean	196	41,363	14.19	20,020	618,645	528,524	90,056	128,425
Median	137	27,392	14.06	20,079	396,109	349,353	32,138	73,682
St.Dev.	242	52,930	1.75	4,296	1,056,592	679,494	717,870	200,143

*All values in 2004 dollars

Table 2. Farm Revenue Variance Decomposition[2]

	Variance Dairy Revenue	Variance Other Revenue	Variance Feed purchases	Covariance (Dairy revenue, Other revenue)	Covariance (Dairy revenue, feed purchases)	Covariance (Other revenue, feed purchases)
Adjusted Gross Revenue	80	60	---	-20	---	---
Adjusted Gross Revenue – Feed Purchases	99	62	21	-14.5	22.5	4.5

[2] Variance Decomposition equation: Var(dr+or-fp)=dr+or+fp+2Cov(dr,or)-2Cov(dr,fp)-2Cov(or,fp) , where: dr=dairy revenue, or=other revenue, fp=feed purchases

Chart 1: Relative Variation: Adjusted Gross Revenue: All Farms

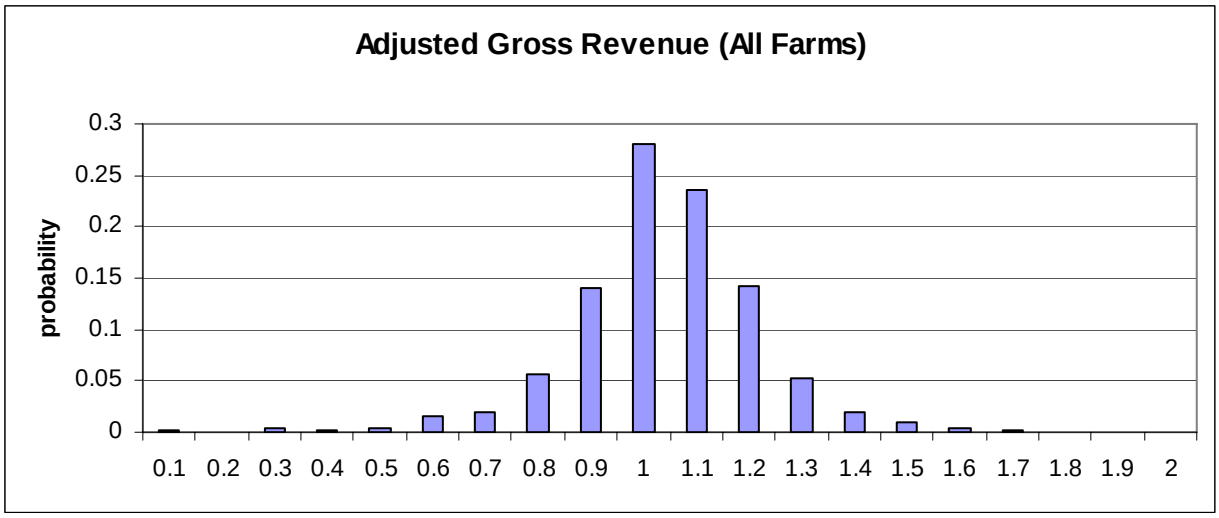


Chart 2: Relative Variation: Adjusted Gross Revenue less feed purchases: All Farms

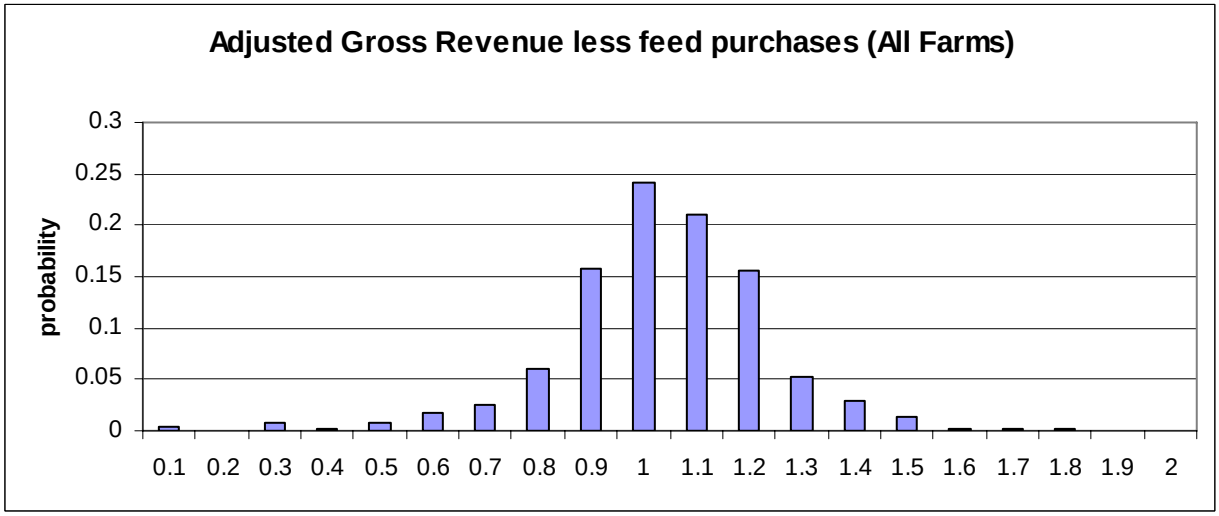


Chart 3: Relative Variation: Adjusted Gross Revenue: 24-99 cows

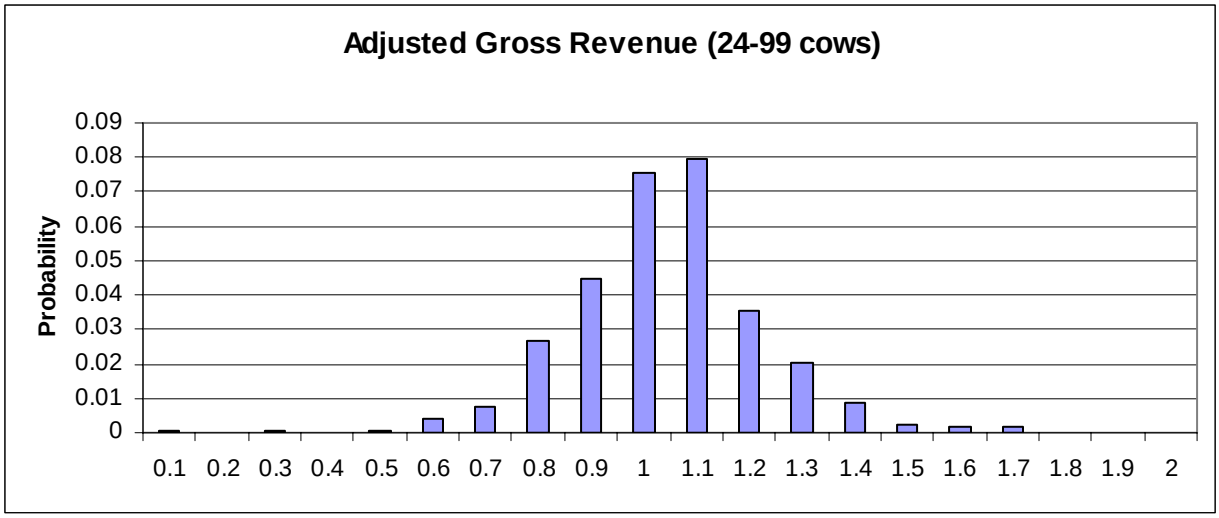


Chart 4: Relative Variation: Adjusted Gross Revenue less feed purchases: 24-99 cows

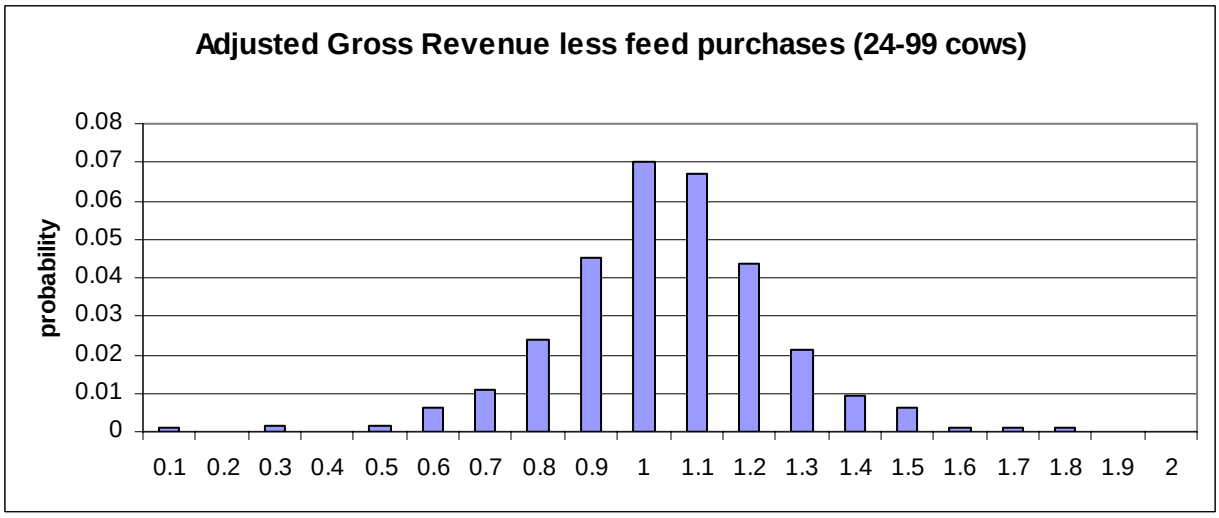


Chart 5: Relative Variation: Adjusted Gross Revenue: 100-249 cows

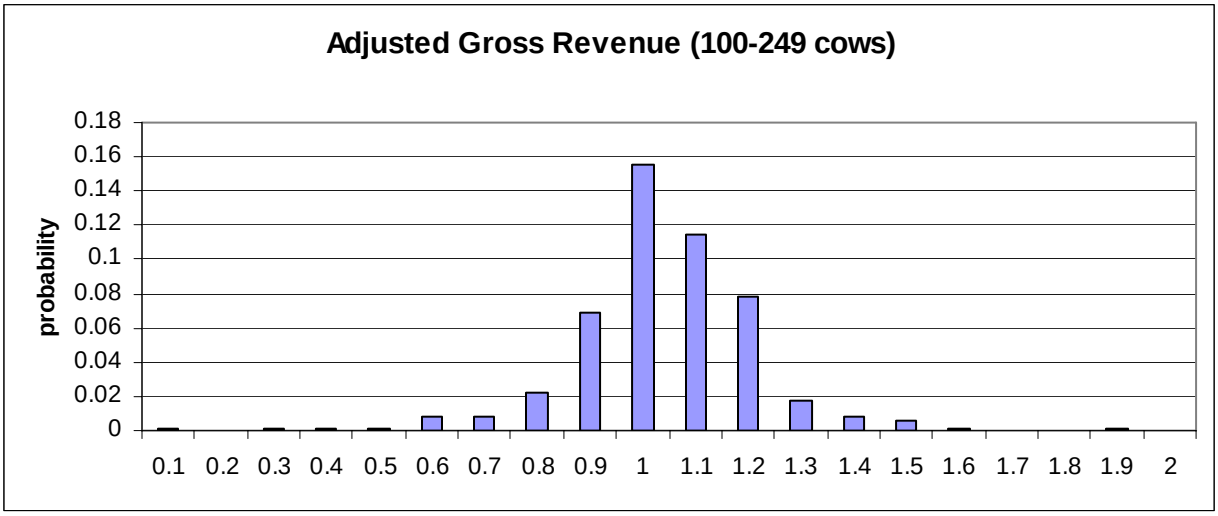


Chart 6: Relative Variation: Adjusted Gross Revenue less feed purchases: 100-249 cows

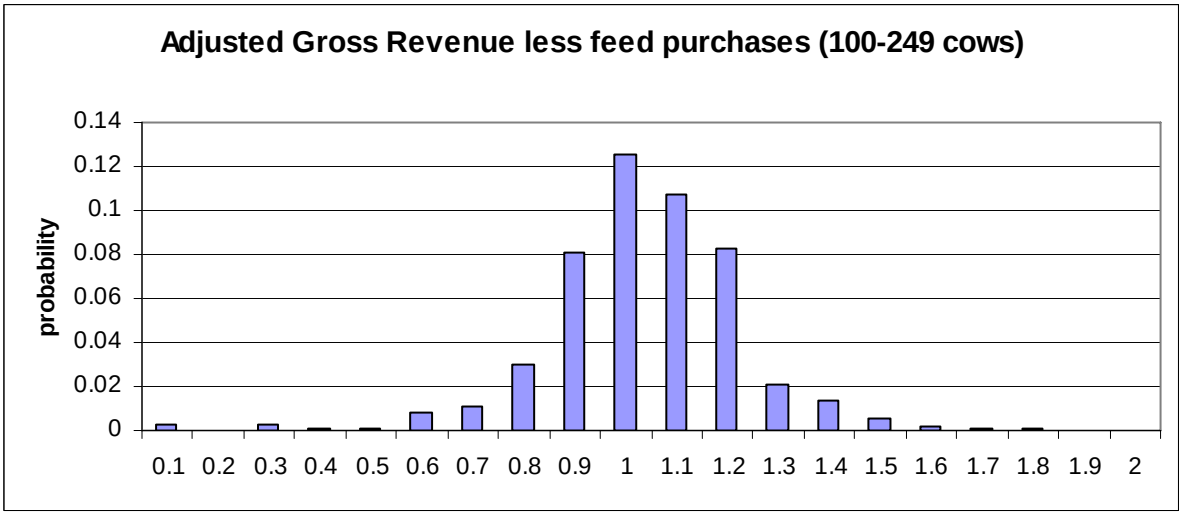


Chart 7: Relative Variation: Adjusted Gross Revenue: 250+ cows

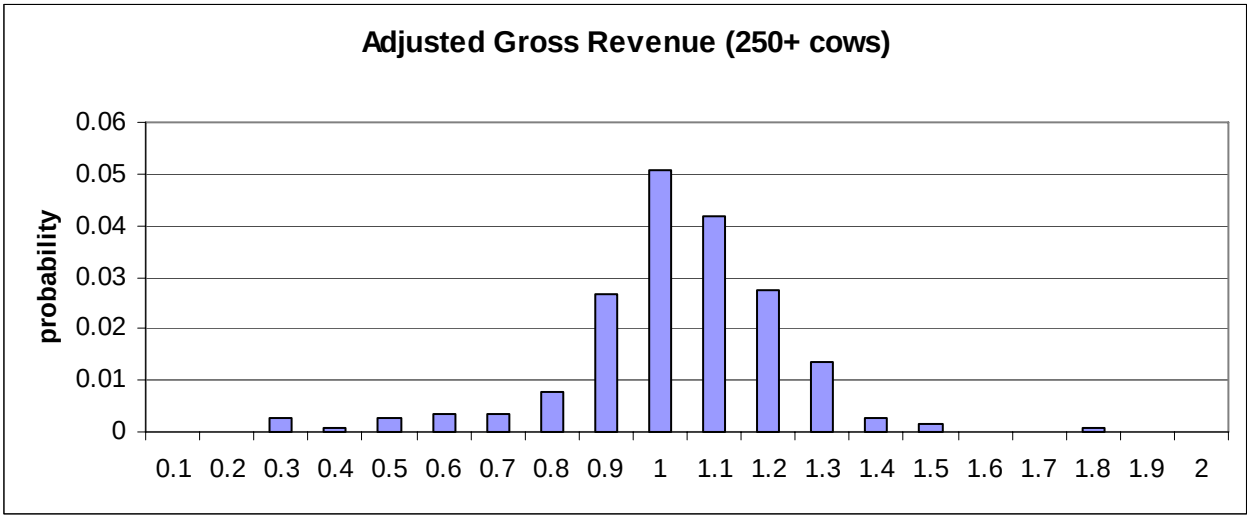
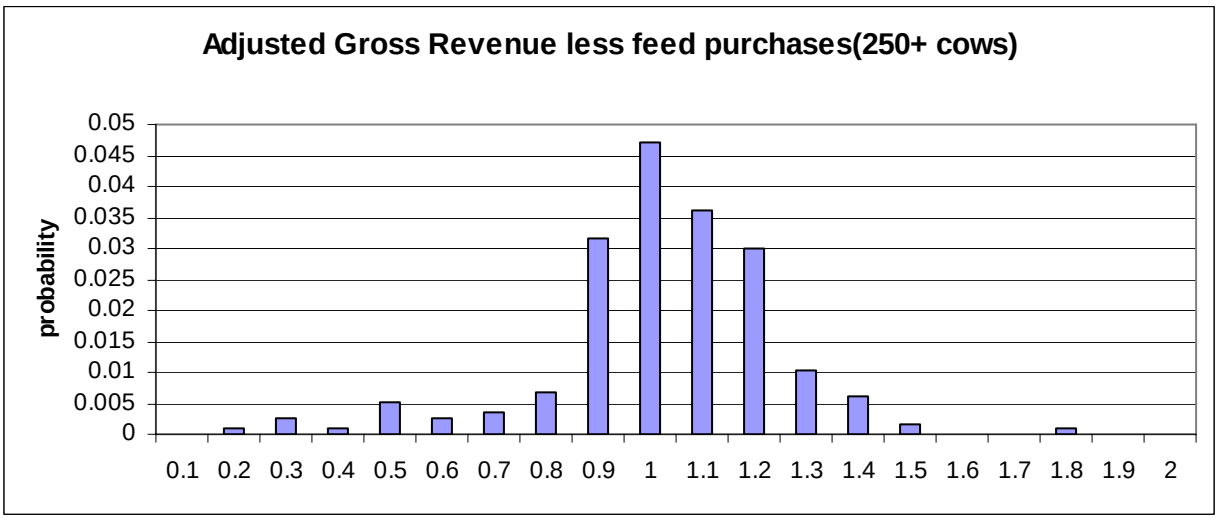


Chart 8: Relative Variation: Adjusted Gross Revenue less feed purchases: 250 + cows



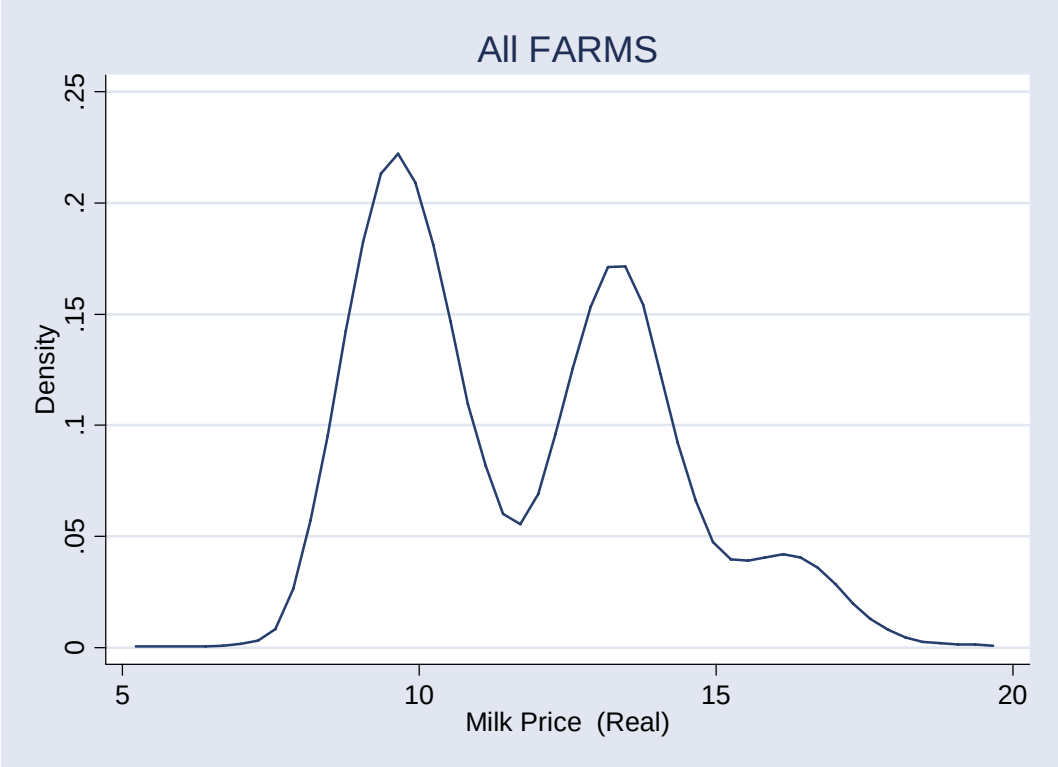


Figure 2: Kernel density of deflated Milk Price

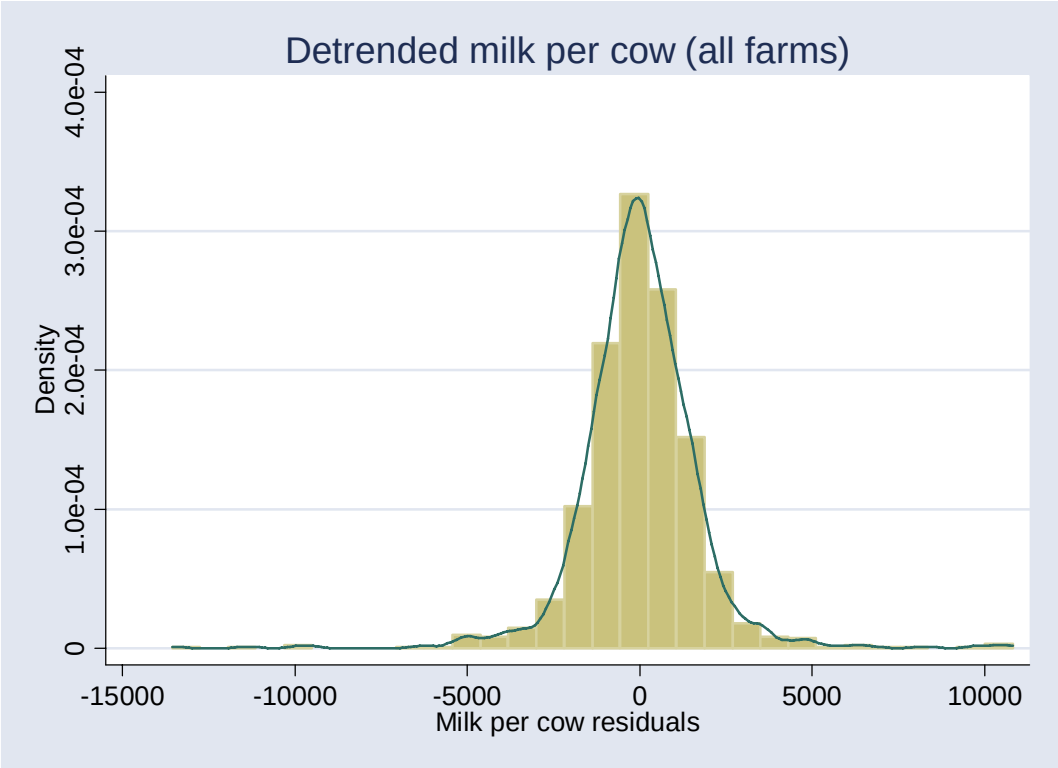


Figure 3: Kernel density of detrended milk per cow