Risk and Returns to Policy-Created Assets in a Portfolio Context: California Dairy Quota

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The capitalization of farm program benefits and the effects of policy on the rate of return to investments in farm assets have long been important to agricultural policy analysis. The issues often arise in the context of the influence of policy on prices of farmland and other physical assets, but also apply directly to policy-created assets such as farm program quota. Several years ago, D. Gale Johnson assessed the literature as follows, "Roughly speaking, the discount rate used to value future earnings from [farm-program created] quotas is approximately 25 percent. Thus individuals who have recently purchased a quota do receive a net return from owning the quota, but the net return can be reasonably said to be return to risk" (p. 202). Johnson's assessment was based on studies across a number of countries and commodity programs. (See for example, Arcus, Barichello (1981), Seagraves, Sumner and Alston, Warley, among others in the early literature.)

In this article we exploit particular characteristics of the California dairy quota program and an unusually rich data set to study the capitalization of program benefits and risks associated with farm policy. The design of the California dairy quota program helps make flow returns to quota ownership and the capitalized value of the policy benefits more transparent compared to most other agricultural programs. This transparency allowed us to assemble a more complete data set on the flow of policy benefits and capital values than has been available for most other government programs. In addition, the long policy history and the existence of monthly flow return and asset price data are unusual for such markets. We are therefore able to measure the contribution of quota ownership to variability of total returns in alternative portfolios.

Economists have used the term policy risk in two senses to discuss the rate at which expected revenue streams attributed to farm policy are capitalized into asset values. The first sense, "portfolio risk," is the standard notion from the investment/finance literature. The portfolio risk associated with an investment and hence the risk premium demanded is measured by the contribution of that investment to the future variability of returns of the investor's whole portfolio of assets. The second sense, "default risk," is related to the likelihood of a negative shock in the future that reduces the expected value of an investment. This is analogous to the way the term risk is used in the risk assessment literature and in informal discussions as, for example, when someone says that rock climbing is a risky hobby. In the context of policy analysis, default risk is related to the likelihood that a policy change that lowers the value of policy-related assets will occur in the future.

These two senses of policy risk lead to two hypotheses about why the measured historical rates of return to investments in farm-policy-created assets have been relatively high. The first hypothesis is that, since the benefits of farm programs (such as returns to production quotas or marketing quotas) are typically tied to production of a commodity, the benefits attributable to the government program co-vary positively with returns to farming itself. Given typical farm program rules, variability of returns to farm policy are not fully diversifiable. Therefore the rates of return demanded for investments in such policy-created assets are relatively high in part because these investments add to the risk of the portfolio held by farmers. The second hypothesis is that farmers expect that there is a significant likelihood that the historical returns associated with farm programs will fall in the future. Therefore, the expected value of the future revenue stream is less than that reflected by historical returns to investments in policy-created assets. This means that the measured historical rate of return on investments in these policy created assets will be high relative to investments for which the chance of default is lower or negligible.

This article provides clear evidence concerning the first of these hypotheses and thus contributes to interpretation of farm policy benefits. Using our unique data, we find that the historical rate of return to investments in California dairy quota has been about 27 percent per year—quite similar to that for other farm-policy-created quotas. However, we show clearly that this is not a result of portfolio risk. We establish for an important case, that the relatively high historical rate of return to a farm-policy created asset do not derive from rules that limit the ability of quota to be held by those with diversified. Of course, this does not mean that policy risk plays an unimportant role. Indeed, we expect that the reason historical rates of return to farm-policy-created assets have been "high" is that farmers see a non-trivial probability of a significant and (from their point of view) negative change in the underlying policy. That is, quota owners build substantial default risk into their estimate of the expected future return.

Measurement of Returns to Agricultural Quota

Previous researchers have attempted to compare the rates of return to investments in farm quotas to the rates of return earned by investments in other assets. The modern literature began with Seagraves, who calculated the rate of return for flue-cured tobacco allotment in North Carolina from estimated flow returns to quota ownership and variations in land prices. Seagraves estimated a high and declining rate of return over time and argued this decline was the result of subsiding producer concerns about the future of tobacco production and the quota program (see also Shuffett and Hoskins). Fifteen years later, Sumner and Alston noted that in 1982 the price of flue-cured tobacco quotas was three to five times the lease rate of the time, suggesting a rate of return of 0.20 to 0.33.

There are several estimates in the literature that deal with dairy marketing quota. Moschini and Meilke calculated the rates of return for the dairy quota in Ontario from 1980 to 1986 to be in the range of 0.01 to 0.34, depending on the specific type of quota and year. Barichello (1996) and Chen and Meilke found rates of return for Ontario dairy quota in the range of 0.26 to 0.36. Colman, *et al*. reported annual quota prices, lease rates, and linked these to the history of the dairy policy in the United Kingdom. In their data, the average ratio of the lease rate to quota price, for the period 1986 through 1998, was 0.18, with a small increase at the end of the period. (See also Arcus on the value of milk quota in British Columbia and Hubbard on the returns to milk quota in the United Kingdom.)

In general, the measured rates of return for quotas have been higher than the rates of return to investments in typical equity market indexes such as the S&P500. However, the cited studies have relied on relatively limited data on both the asset values and the flow returns to the quota asset to make these calculations.

Using the capital asset pricing model (CAPM), Lermer and Stanbury argued that the risk associated with Canadian agricultural marketing quotas was separable into diversifiable and non-diversifiable risk. Lermer and Stanbury pointed out that that most Canadian producers who produced under a quota program had a high proportion of their wealth attached to the commodity under quota. Furthermore, because Canadian programs established marketing or production quotas, the asset value of the quota was tied directly to the profit in the industry. Finally, restrictions on the transfer of quota limited producers from transferring quotas to others who had more diversified portfolios relative to the farmer-quota owners. The limited ability to diversify returns from the quota meant that producers incorporated an additional risk premium from the risk that was not diversified through a broad portfolio. Lermer and Stanbury noted that this limited ability to diversify "will be reflected in [the producer's] unwillingness to bargain up the price for quota rights" (p. 194). Lermer and Stanbury attributed the relatively high rates of returns to quota ownership to an inability to diversify quota risk. However, they did not test their hypotheses empirically. This article provides such a test of this diversification hypothesis for the important case of California dairy quota.

Sumner, Alston, and Barichello (1996) represented policy risk primarily in terms of a probability factor representing the likelihood of program elimination (or other reduction of in policy benefits) that lowers the asset price by lowering the expected present value of the future returns to the quota. Barichello (1996) stated, "This risk is manifested in a possible fall in the expected value of the asset rather than an increase in the variance of its future returns, the risk normally incorporated via a risk premium in the discount rate" (p. 294). However, Alston noted that in the case of the risk-averse producer, a risk premium exists in addition to the effect on the probability of program elimination on the expected value of future program benefits. And, Sumner observed that, in the case of the tobacco production quota, the restriction "that buyers of quota must be active tobacco producers also means that returns on investment in quota will be highly correlated with the returns to the farming activity" (p. 130).

Overall, the literature has established that the measured rate of return to owning farm-policy-created quota is relatively high. Some authors have explained that the measured rate of return reflects both the expected value of the future stream of benefits associated with the quota and the contribution of the quota to the risk of the quota owner's full portfolio. The present article is the first to measure explicitly the degree to which portfolio risk accounts for the high historical rate of return to quota.

The Basic Operation of the California Dairy Quota Program

Before discussing characteristics of the market for California dairy quota, it is important to appreciate how the program operates and how the returns to quota are generated. The dairy quota program in California began in July 1969. Quota was initially allocated to producers in proportion to their sales of milk for beverage consumption. However, milk revenue for the industry is not affected by the existence or distribution of quota. As in the U.S. federal milk marketing order system, dairy revenue in California is generated through price discrimination by end-use and then pooled before being dispersed to producers. The California quota program has no direct role in setting milk prices by end-use (price discrimination) or in allocating milk among uses. The quota program affects only the dispersal of pool revenue among producers. Quota ownership varies across farms, and the revenue of an individual farm depends on the amount of quota that the farm owns, as well as that farms milk production and the minimum class prices.

Prior to 1994, monthly returns for quota were calculated as the difference between the weighted average of the prices of the higher-priced end-use classes of milk and the weighted average of the prices of the lower-priced end-use classes of milk. For a typical month, the flow return to quota ownership was the difference between the quota milk price, P_q, and the overbase (non-quota) milk price, P_n (Sumner and Wolf, 1996). Milk prices P_q and P_n each varied widely because the underlying class prices varied and the shares used created the weighted averages varied. Thus, the per-unit flow of returns to quota varied over time because of variation in (1) milk sales by end use, (2) amount of aggregate quota relative to total milk sales, and (3) end-use class prices. Since 1994, the payment per unit of quota has been fixed. Under this system, the first step in dispersing pool revenue is simply to allocate daily $0.195 per pound of solids-not-fat (snf) for each pound of quota owned. For the aggregate quota quantity, Q, (in snf terms), the total daily revenue assigned to quota is \$0.195Q. Quota revenue for an individual is \$0.195Q_i, where Q_i varies from zero (for about 20% of producers) up to total milk of that farm's output (for a few producers in any month). The rest of the pool revenue, R_n, is dispersed to individual producers according to milk production. The non-quota pool price per unit of snf is therefore $P_n=R_n/M$, where M is total milk output in the program. The quota milk price (P_q) is defined in snf terms as $P_q=\$0.195 + P_n$ and total revenue for producer i (R_i) is simply $R_i= M_iP_n+0.195Q_i$.

The quota asset market is regulated by the state of California. Key rules are as follows: (1) Quota may be bought and sold, but only farmers who maintain a valid market milk permit and produce market milk in California from at least five cows may own quota. (2) Minimum holding periods limit short term speculative trading. (a) After a purchase of quota, a producer may sell no quota for two years, except for cases of hardship; (b) a producer who sells quota may not buy quota for two years; (c) newly allocated quota and quota purchased from cases of hardship may not be sold for five years. New quota was allocated to current owners and new producers intermittently, but no new quota has been allocated since 1992 (State of California).

Measurement of the Returns to Quota Ownership

We consider the return in period t to owning a pound of California dairy quota (in pounds of snf per day) for a month (*Quota Return*) into three components:

First, *Flow Return$_t$* = $[(P_{qt} - P_{nt})D_t]/8.7$, represents the monthly revenue flow from quota in pounds of snf equivalent, where the prices are per hundredweight of milk so must be divided by 8.7 to convert to pounds of snf. The total is multiplied by the number of days in the month (D_t) to convert daily revenue to monthly revenue. Second, *Capital Gain$_t$* = $V_t - V_{t-1}$, represents the capital gain in month as the average price paid for quota purchased during month t, V_t, minus the average price paid in the previous month, V_{t-1}. Third, *New Quota Return* = $(N_tV_t)/12Z_t$, represents the monthly value contribution of any annual disbursements of new quota as simply the number of units of new quota distributed to existing producers, N_t, times the unit price of quota, divided by the total quota already owned, Z_t and divided by 12 to turn annual value into a month flow equivalent[1]. Summing the components together yields the total monthly return to quota: $Quota\ return_t = Flow\ Return_t + Capital\ Gain_t + New\ Quota\ Return_t$.

Based on administrative records kept by the California Department of Food and Agriculture we assembled observations on each variable for each month since the inception of the program in July 1969. The first few months after the quota program began saw a rapid jump in the value of quota, extreme variability in the quota price and were clearly not representative of the next 29 years. Therefore, our sample period for empirical analysis begins in January 1970. Additional data used for the empirical analysis includes the per unit milk return divided by the unit cost for dairy production in California and the monthly rate of return to investments of a market index of equities in the United States. See the appendix for detailed data definitions.

Applying a Capital Asset Pricing Model to Quota Market Data

In order to measure the role of variability in returns to quota in determining the price of quota and the role of portfolio risk in the high rate of return to investments in quota, we must specify a model for pricing these capital assets. Researchers in the finance literature have spent considerable effort investigating the pricing of investments in a portfolio context. In the most commonly used approach, the degree to which an investment adds to the risk of the full portfolio, typically denoted as the beta, is measured as the covariance between the rate of return to a specific investment and that of the overall market portfolio divided by the variance of the rate of return to the market portfolio. (Classic contributions are Sharpe 1964, Lintner 1965, Black 1972, Fama and Miller 1972, and Ross 1977). Using this definition, $beta_j$ is simply the coefficient of the simple regression of the rate of return of the investment j on the rate of return of the market portfolio.

Virtues of this framework are its simplicity, robustness and long track record. As a descriptor of asset prices, the model assumes competition and the potential for portfolio diversification. California dairy quota is available for trade each month among hundreds of potential buyers and sellers. Furthermore, whereas holding-time rules limit short run speculation, owners typically hold quota well beyond the required two-year (and even the five-year) holding period. So these basic conditions seem to be approximately satisfied. Further, after reviewing several different asset-pricing models (the consumption beta, Arrow-Debreu securities, and the pure arbitrage version of the Arrow-Debreu securities models, as well as CAPM), Varian concludes, "…in most asset pricing, the value of an asset ends up depending on how it co-varies with other assets. What is surprising is how generally this insight emerges in models that are seemingly very different." (p. 370). Here we proceed with the simple CAPM framework to determine the impact of portfolio risk on the value of the California dairy quota.

Returns and Risk of Investment in Dairy Quota

Table 1 provides the mean, standard deviation, and coefficient of variation for each component of quota returns and the total returns to quota. Several facts stand out in the first four rows of Table 1. First, in contrast to investments in stock market indexes, almost 90 percent of *Total Quota Return* came from the monthly *Flow Return to Quota*—less than 10 percent of the quota return was from *Capital Gain*. In a typical stock index most return in from capital gain not dividends. (*New Quota Return*, which is analogous to a stock-split, provided only a very small share of the benefit of owning quota.) Second, capital gains were the dominant contributor to the monthly variation in returns. The coefficient of variation for the monthly *Total Quota Return* (3.60) was dominated by positive or negative changes in the monthly price of quota. Notice, also, that the coefficient of variation for the *Flow Return,* defined as P_q - P_n, was larger than the coefficient of variation for the *Overbase Milk Price*, P_n, which means that the *Quota Milk Price*, P_q, contributed variability to the *Flow Return* and that the two milk prices did not always move together.

Table 1 also shows summary statistics on the *Overbase Milk Price*, *Unit Cost of production* , and *Per Unit Milk Return* (defined as the *Overbase Milk Price* less *Unit Costs). Per Unit Milk Return* had a higher coefficient of variation than its components indicating the less than perfect correlation between the *Unit Cost* and *Overbase Milk Price*.

Finally, Table 1 summarizes the information in rate of return form and allows comparison of return to quota to returns to other assets. Measured over 348 months, the *Flow Rate of Return* (the *Flow Return* divided by the *Quota Price)* was 1.7 percent per month and the *Total Quota Rate of Return* was 2.2 percent per month. Based on this monthly rate, the annual rate of return was 27 percent for total return to quota ownership. Note that, over this 29 year period, the historical rate of return to investments in quota was double the historical rate of return to investments in a diversified portfolio of stocks as shown by the *Market Index Rate of Return*— 2.2 percent per month compared to 1.1 percent per month. This finding confirms that the historical rate of return to investments in California dairy quota is similar to that of other policy-created farm quotas and well above the rate of return to an index of stocks.

We next turn to measuring how California dairy quota performs in the context of a portfolio of a diversified stock index. Column 1 of Table 2 provides the betas from the regressions of the *Flow Rate of Return* and the *Total Quota Rate of Return* on the *Market Index*.

Analogous betas are commonly found in the finance literature for individual stocks and other investments. Using a market portfolio as the base portfolio, common stock betas are positive and usually range from 0.7 to 1.5 (Gallinger and Poe, 1995). In our case, the beta for *Flow Rate of Return* is *negative* but not significantly different from zero[2]. The beta for the *Total Quota Rate of Return* is 0.099. This value is also very small and not significantly different from zero. These results show that investments in California dairy quota would have contributed nothing to risk when held in a fully diversified portfolio of equities. Investments in California dairy quota would contribute less risk to the market portfolio than would an investment in a typical common stock and, would in that sense, be expected to offer a lower rate of return for the same expected value of future benefits.

However, the betas associated with a diversified portfolio of common stock less relevant when quota ownership is limited to California dairy producers. Therefore, let us consider the investment in dairy quota in the context of investments more typically held by dairy producers. No data exists on the portfolios held by California dairy producers over the past 30 years. We do have some information, however. In 1996, USDA data indicated that California dairy producers had 11 percent of their wealth invested outside of the farm, indicating some level of portfolio diversification (USDA). Statistical and interviews with representative producers and other experts suggests that investment in assets associated with farm production (cows, land, equipment, machinery, etc.) represent the bulk of the portfolio owned by dairy producers (USDA). Also, dairy farms in California tend to be quite specialized and almost all dairy farm revenue in California comes from milk sales (USDA, Sumner and Wolf, forthcoming 2003). In this context, the total value of dairy quota (about one billion dollars) is about five percent of the magnitude of the approximate value of California dairy farms. As a polar case let us consider how investments in quota perform in the context of a portfolio of investments in the dairy farm production assets. The nature of these data precludes estimating a formal CAPM beta, but as noted by Varian (1992), a beta-type of measure can be derived from a number of pricing models where the market index may be represented by another relevant portfolio.

Obviously, monthly time series data on the rate of return to dairy farm assets are not available. To implement this approach, we need a proxy for monthly returns to investments in dairy production assets in California. As shown in Table 1, we were able to find data on the cost of production for milk in California for the past three decades to match data on milk prices and returns to quota. We therefore use variations in *Relative Margin* (*Per Unit Milk Return* divided by the *Unit Cost*) as an instrument for the variations over time in returns to dairy farming in California. The variations in *Relative Margin* over time reflect variation in milk prices, costs of production, and yield per cow. These are obviously important components of variations in farm net returns, and therefore we expect *Relative Margin* to co-vary positively with the unobservable rate of return to investments in dairy farm assets. So long as relative margin co-varies positively with the rate of return to investments in dairy farm assets, we may use this proxy to estimate consistently the beta-type measure of the contribution of quota to portfolio risk in a portfolio dominated by dairy production assets. In particular, the beta-type estimate in our regression will obviously have the same sign as the true beta. Thus, the sign of the relationship between *Quota Rate of Return* and *Relative Margin,* measured by regression parameter, reflects the sign of a beta between rate of return to quota and rate of return to dairy production assets.

Table 2 presents the estimated beta-type measure between both *Flow Return* and *Total Quota Returns* and *Relative Margin.* Both estimated coefficients are negative. The estimated beta from the regression *Flow Return* on *Relative Margin* is large relative to its standard error and statistically different from zero at a 0.01 level of significance. The flow return estimate is important because most dairy farmers, in fact, make few quota transactions and for them the fact that the monthly returns from owning quota smoothes their net revenue flow from milk sales may contribute positively to the value of quota. The coefficient from the regression of *Total Quota Rate of Return* on *Relative Margin* is also negative, but not large relative to its estimated standard error.

To help interpret the role of quota in the context of a portfolio of dairy production assets, let us consider the variability of the income stream for a farm with both dairy assets and quota. Consider a dairy farmer who owns one unit of quota for every three units of milk production from the farm—roughly the average for the state at the middle of our sample period. Over our sample period the coefficient of variation of returns to this portfolio would have been 0.97. Note that this is substantially smaller than the coefficient of variation for the returns to dairy farming as shown in Table 1. The coefficient of variation for *Relative Margin* shown in Table 1 is 1.25. Thus, quota ownership substantially lowers variability of total returns for California dairy farms that own quota.

Summary and Implications

The measured rates of return to farm-policy-created quotas are typically found to be high relative to the rate of return to other investments. One hypothesis for the high historical rates of return is that policy rules typically require that quota be held by farm producers, and this is also true for California dairy quota. The argument is that, with the lack of diversification typical of farm producers, owning quota adds to the risk of the portfolio of assets owned by farmers, and therefore quota earns a high rate of return to compensate for the additional portfolio risk. Under production or marketing quotas, but not under California dairy quota, returns to quota ownership are tied closely and positively to returns to farming (Lermer and Stanbury, Sumner, Barichello 1996, and OECD 1996). In those cases, quota may be worth less to farmers than to outsiders because quota indeed adds to the risk of the overall enterprise. But the magnitude of this effect is the relevant question.

We find that over a 29-year period, the rate of return to California dairy quota has also been high (2.2 percent on a monthly basis and about 27 percent per annum) compared to other investments and similar to the rates of return observed for other agricultural quotas. The quota return was double that of a diversified portfolio of stocks, although the variability of the quota return was relatively small. We also find that returns to quota had a zero or negative covariance with returns to other investments and generally lowered the risk in the overall portfolio for both a market index of equities or a portfolio of dairy production assets.

Because of its covariance properties, an investment in California dairy quota lower the variability of total returns and reduce overall portfolio risk for California dairy farmers. The implications of this result are that Producers would pay extra for quota because of this negative covariance property. Therefore, restrictions that only dairy farmers may own quota does little (or nothing) to reduce the price of quota because California dairy quota is likely to be more valuable to dairy farm owners than to those outside the business. Quota acts as a hedge in a portfolio comprised of dairy production assets and in that sense the restriction on ownership by non-farmers does not reduce the price of quota and furthermore the portfolio risk characteristics should reduce not increase the measured rate of return to quota.

Portfolio risk cannot account for the high measured rate of return to California dairy quota ownership. The Lermer and Stanbury hypothesis is rejected. And, since the California quota rate of return is similar to that for other farm-policy-created quotas, this evidence suggests that portfolio risk is a weak explanator for the high measure rate of return for other similar quota assets. We therefore come back to the hypothesis that farmers assign a significant probability that the future will be unlike the past and therefore farmers' expected value of future returns is substantially lower than the measured historical returns. That is, default risk not portfolio risk accounts for the high historical rate of return to quota.

Endnotes

1. In July 1978, the CDFA disbursed new quota as a result of ad hoc legislation. To set the value of this disbursal we multiplied the amount of quota disbursed by the July 1978 quota price, divided by the total quota in the system at July 1978. We allocated one-sixth of this total to each month from July 1978 through December 1978.

2. Scott and Brown argued that if the market portfolio and the error co-vary and the error is autocorrelated, then the estimate of beta is biased and unstable. For all the regressions, we checked for the covariance of the market portfolio and the error and autocorrelation. Our estimate of the covariances was zero for all of the models. For the *Flow Rate of Return* regressions, we discovered, using the Bruesch-Godfrey test that the error is autocorrelated. We corrected for the third-order auotcorrelation using the Cochran-Orcutt procedure. The corrected results are reported in Table 2.

Table 1. Summary Statistics on Returns, Prices, and Costs: 1970 to 1998

	Mean	Standard Deviation	Coefficient of Variation
	Dollars per pound of solids-not-fat		*Ratio*
Flow Return to Quota	5.38	1.74	0.32
Capital Gain to Quota	0.52	21.70	41.50
New Quota Return	0.19	0.33	1.73
Total Quota Return	6.09	21.91	3.60
Overbase Milk Price	1.15	0.30	0.26
Unit Cost of Milk Production	1.07	0.25	0.24
Per Unit Milk Return	0.082	0.11	1.36
	Percent		
Flow Rate of Return to Quota	0.017	0.0062	0.36
Quota Rate of Return	0.022	0.072	3.19
Market Index Rate of Return	0.011	0.046	4.01
Relative Margin of Milk Production	0.077	0.095	1.25

Table 2. Covariance Relationships between the Rates of Return to Investments in Quota and Investments in an Index of Equities and Dairy Production Assets

	Estimated Betas[1]	
	Market Index[2]	*Relative Margin*[3]
Flow Rate of Return to Quota[4]	-0.0024	-0.040
	(0.0030)	(0.0045)
Total Quota Rate of Return	0.099	-0.049
	(0.084)	(0.040)

Notes:

1. The values in parentheses are the standard errors of the corresponding betas.
2. Entries in this column represent regression coefficients with *Market Index* (monthly rate of return of the NYSE/AMEX/NASDAQ Value-Weighted Market Index) as the independent variable and *Flow Rate of Return* or *Quota Rate of Return* as the dependent variables.
3. Entries in this column represent regression coefficients with *Relative Margin* [(*Overbase Milk* $Price_t$-*Unit* $Cost_t$)/*Unit* $Cost_t$] as the independent variable and *Flow Rate of Return* or *Quota Rate of Return* as the dependent variables.
4. Using the Breusch-Godfrey test, we rejected the null hypothesis of no autocorrelation for the two regressions with *Flow Rate of Return* as the dependent variable. We used the Cochran-Orcutt method for the regressions of *Flow Rate of Return* to correct for the third-order autocorrelation.

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Appendix: Definitions for Variables in Table 1

Flow Return: the difference between the *Quota Milk Price* and the *Overbase Milk Price* in dollars per hundredweight of milk times the number of days in the month, all divided by 8.7. The difference was fixed at $0.195 per day after December 1993.

Capital Gain: the average monthly *Quota Price* less *Quota Price* of previous month.

New Quota Return: the total new pounds of snf quota given out in January of selected years, multiplied by the January quota price of that year, divided by the total pounds of snf quota already in the system. The return is distributed at the rate of one twelfth per month.

Total Quota Return: the sum of the *Flow Return, Capital Gain* and *New Quota Return.*

Overbase Milk Price: Month pool price for milk in California determined as a weighted average of the various minimum class prices, which vary monthly based on market conditions.

Unit Cost of Milk Production: the weighted average cost of production for market milk in California from surveys by the California Department of Food and Agriculture Milk Pooling Branch. This cost includes feed, hired labor, and miscellaneous costs (herd replacement costs, taxes, insurance, operating costs, depreciation, and marketing costs less miscellaneous income).

Per Unit Milk Return: the *Overbase Milk Price* less the *Unit Cost of Milk Production*.

Flow Rate of Return: the monthly *Flow Return* divided by *Quota Pric.*.

Total Quota Rate of Return: the monthly *Total Quota Return* divided by *Quota Price*.

Market Index Rate of Return: the monthly rate of return of the NYSE/AMEX/Nasdaq Value-Weighted Market Index from returns of the trades of the month. Source is the Center for Research on Securities Prices.

Relative Margin: the *Per Unit Milk Return* divided by the *Unit Cost*.