ECONOMICS RESEARCH REPORT

THE SOCIAL WELFARE CONSEQUENCES OF PRICE STABILIZATION

AND RISK: AN ANNOTATED BIBLIOGRAPHY

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Economics Research Report No. 52

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Abstract

The stated purpose of federal regulation of milk markets is to provide for "orderly" marketing, but very little work has been done on analysis of the social welfare consequences of price or income stabilization in the dairy industry. This omission is surprising, since unpredictable price variability often is listed as a major source of "instability" in milk markets before federal regulation, and stable, predictable prices are often discussed as a major benefit of regulation. This bibliography discusses studies that analyze the social welfare consequences of price stabilization with risk-neutral consumers and producers, as well as those with risk-averse producers. Also discussed are studies that attempt to measure risk aversion.

Introduction

Price stabilization is a policy long pursued by governments. Although the objectives of price stabilization are varied, economists have considered its efficiency consequences using the notion of consumer/producer surplus. From an economic perspective, price stabilization policies that increase the sum of consumer and producer surplus are desirable and vice versa. The first group of studies reviewed examines the effects of price stabilization in a risk-neutral environment. If supply and demand functions are linear and error terms are additive, price stabilization increases the sum of consumer and

producer surplus even though in some cases consumers as a group or producers as a group may lose. A recent study by Turnovsky shows that qualitative certainty about the direction of change in producer or consumer surplus is not present if the assumption of additive error terms is relaxed.

The most restrictive and least realistic assumption made by all the studies in the first group is risk neutrality. Although price changes for any one commodity are likely to have a negligible effect on consumer income so that assuming risk neutrality may be appropriate, the same cannot be said for their effects on producer income. The second group of studies considers the effect of producer risk aversion. Essentially, these studies show that the presence of risk aversion implies that price stabilization will cause a rightward shift in the supply curve. Calculations of the social benefits of price stabilization assuming risk neutrality, then, are biased downward and this bias could be very substantial depending on the degree of risk aversion and the size of reduction in risk.

The third group of articles is composed of empirical examinations of risk aversion among producer groups and others. These studies conclude that producers are almost always risk averse. Using standard measures, most of the coefficients of relative risk aversion for the groups examined lie between 0.5 and 4. Three different techniques were used to estimate risk aversion. Surveys or mind experiments were used in one technique; in another, participants gambled with money under situations in which the probabilities were known; and in the third, data on the demand for risky assets and insurance were used to estimate risk

aversion. Values for risk aversion were more easily attained using the first method, but the consensus was that results of these surveys were unreliable.

This bibliography is not intended as a complete or even nearly complete review of the topics listed above. It was compiled pursuant to the terms of a cooperative agreement between the North Carolina Agricultural Research Service and the Economic Research Service of the United States Department of Agriculture. The cooperative agreement is titled, "The Benefits of Stability and Implications for U. S. Dairy Policy, Especially Federal Milk Marketing Orders." There are scores of important economic articles that examine the effects of price stabilization, analyze the impact of risk aversion on supply, or empirically estimate measures of risk aversion. The studies reviewed below were selected because they were deemed appropriate for the cooperative agreement. The general objective of our cooperative agreement was "to conceptualize and develop analytical methods for assessing the impacts of stability and the likely effects of increased risk and uncertainty in milk prices and markets and to quantify the benefits of stability contributed by U.S. dairy programs and especially milk marketing orders." We selected studies for review if they enabled us better to understand the relationship between price risk, price stabilization and their effects on the dairy industry as it is currently regulated.

I.   Price Stabilization Assuming Risk Neutrality

Waugh, F. V.   "Does the Consumer Benefit from Price Instability?"
     Quarterly Journal of Economics LVIII(August 1944):602-614.

The author establishes the proposition that with a fixed downward-
sloping demand curve and random prices due to stochastic fluctuations in
supply consumers are worse off if these prices are stabilized at their
mean.

He uses as a measure of gain the expected value of consumer surplus
and assumes risk neutrality by ignoring the effect of price
stabilization on the variance of consumers' income. Furthermore, he
assumes a zero covariance between shifts in the demand curve and changes
in price. His analysis is based on a stationary demand curve, in which
case this covariance is trivially zero. Thus, price changes are due
solely to shifts in supply.

Oi, W. Y.   "The Desirability of Price Instability Under Perfect Competi-
     tion." Econometrica XXIX(January 1961):58-64.

The author demonstrates that with an upward-sloping supply curve
and random selling prices due to stochastic shifts in demand, producers
will lose if prices are stabilized at their mean.

He uses as a measure of gain the expected value of producer surplus
and assumes risk neutrality by ignoring the effect of price
stabilization on the variance of producers' income. His analysis is
based on a stationary supply curve, in which case the covariance between
shifts in the supply curve and changes in the price is trivially zero.
Thus, price changes are due solely to shifts in demand.

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Massell, B. F. "Price Stabilization and Welfare." Quarterly Journal of Economics LXXXIII(May 1969):284-298.

The author tries to reconcile the analyses presented by Waugh and Oi and to integrate their results into a single framework. Using the expected value of the change in producer and consumer surplus as a measure of gain and assuming linear demand and supply curves and additive stochastic disturbances in demand and supply, he shows that:

1. producers lose (gain) from price stabilization if the source of price instability is random shifts in demand (supply);

2. consumers lose (gain) from price stabilization if the source of price instability is random shifts in supply (demand);

3. where both demand and supply are random, the gains to each group are indeterminate and depend upon the relative sizes of the variances and upon the slopes of the demand and supply curves;

4. provided neither the demand curve nor the supply curve is perfectly elastic, the total gains from stabilization are always positive, with the gainers being able in principle to compensate the losers;

5. the total gains from price stabilization are larger the greater the degree of price instability.

Hueth, D. and A. Schmitz. "International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices." Quarterly Journal of Economics LXXXVI(August 1972):351-65.

The authors employ the framework used by Waugh-Oi-Massell (WOM) to examine the effects of price stabilization for internationally traded goods. They examine the effects of unstable intermediate and final goods prices on both consumers and producers of final goods. Their conclusion is that whether an individual country benefits from price stability depends critically on the source of the instability. A country gains or loses according to the Waugh and Oi results. They assume that international compensation for gainers and losers does not occur. Still, the overall Massell result holds; namely that if a country loses from stabilization, it can be bribed into accepting stabilized prices by the gainers. In general, if the source of the fluctuations is foreign, it is in a country's interest not to stabilize the price.

Turnovsky, S. J. "The Distribution of Welfare Gains from Price Stabilization: A Survey of Some Theoretical Issues." in Stabilizing World Commodity Markets, F. Gerald Adams and Sonia A. Klein (eds.), pp. 119-148. Lexington, Mass.: Lexington Books, 1978.

The author generalizes the Waugh-Oi-Massell (WOM) analysis, relaxing many of the restrictive assumptions. The WOM model assumes linear supply and demand functions, additive error terms, and known prices. Retaining these assumptions, the author reproduces the main results derived from the WOM model. If the assumptions of linear supply and demand functions are relaxed while retaining the assumption of additive error terms and known prices, the conclusions of WOM are

largely undisturbed. However, if the error terms are assumed to be multiplicative, the distributional conclusions of WOM are changed significantly. In contrast to the Waugh and Oi models, the desirability of price stabilization for either producers or consumers does not depend on the source of price instability (either supply or demand). Instead, gainers and losers among producers and consumers are determined by supply and demand elasticities.

If producers respond to expected rather than to known prices, the main results of the WOM model still hold within a rational expectations model. Using an adaptive expectations model that employs autoregressive forecasting procedures, some of the WOM results do not hold. In particular, the Oi proposition, that producers lose from price stabilization if the source of instability is demand variation, is not true in general, since the distribution of gains and losses depends on the autoregressive properties of the random disturbances and other factors.

II. Theoretical Development of Models for Measuring the Gains of Price
     Stabilization Assuming Risk-Averse Producers

Pratt, J. W. "Risk Aversion in the Small and in the Large."
     Econometrica 32(1964):122-36.

The author introduces and examines two measures of risk aversion. The first is $r(x) = -u''(x)/u'(x)$, where x is a measure of wealth, u is a utility function, and primes indicate derivatives. This measure has come to be called absolute risk aversion. The special case in which $r(x)$ is constant as wealth changes (CARA) is shown to follow from the utility function $u(x) = -e^{-x}$. The second measure of risk aversion is

$r*(x) = xr(x) = -x \, u''(x)/u'(x)$. This measure has come to be called relative (or proportional) risk aversion. Again, the special case in which $r*(x)$ is constant as wealth changes, constant relative risk aversion (CRRA), is shown to follow from the utility functions (1) $u(x) = x^{1-r*}$ for $r* < 1$, (2) $u(x) = \log x$ for $r* = 1$ and (3) $u(x) = x^{-r*+1}$ for $r* > 1$. Notice that CRRA implies decreasing absolute risk aversion.

Sandmo, A., "On the Theory of the Competitive Firm Under Price Uncertainty." <u>American Economic Review</u> LXI(March 1971):65-73.

The author examines firm behavior when firms are expected utility maximizers and must commit to an output before prices are known. The firm's attitude toward risk is modeled by a von Neumann-Morgenstern utility function. Addressing the question, "... how does the optimal output compare with the well known competitive solution under certainty," the author shows that with price uncertainty output is smaller than with price certainty. The result is obtained assuming firms exhibit decreasing absolute risk aversion. His results lead him to conclude that firms with "very high" risk aversion will not enter some industries in which economic profits are nonnegative, whereas risk-neutral firms would and further, that highly risk-averse firms will be, marginal firms in the sense that a small decrease in expected price will cause the firms to leave the industry.

Batra, R. and A. Ullah. "Competitive Firm and the Theory of Input Demand under Price Uncertainty." <u>Journal of Political Economy</u> 92(May/June 1974):537-548.

The authors draw heavily on the seminal work of Sandmo, who examined the output effects of price uncertainty. The main result of

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this paper is to show that an increase in uncertainty will lead to a decline in the firm's output if absolute risk aversion is decreasing with income. Since they are examining input demand, (they present a demonstration that) a risk-averse firm produces an output for which $P > MC$ and $MRP_i > MFC_i$ for each input, but at each level of output the firm minimizes cost.

Menzes, C., C. Geiss, and J. Tressler. "Increasing Downside Risk." American Economic Review 70(December 1980):921-32.

This research was inspired by the results of a survey of executives who were asked to choose from the following distributions:

f(x)	g(x)
Pr {x=1} = 3/4	Pr {x=0} = 1/4
Pr {x=3} = 1/4	Pr {x=2} = 3/4

Almost all of the executives picked $f(x)$, even though the means and variances of both distributions are the same. From the results of this survey the authors infer that downside risk is important. "The general notion of a pure increase in risk involves the spreading of probability weight from the center to the tails of a distribution." "One distribution is said to have more downside risk if it has more dispersion below a specific target or if it is more skewed to the left." Thus, the authors distinguish between the concept of increasing risk and increasing downside risk.

The authors go on to develop the notion of an MVPT [Mean-Variance Preserving Transfer], which is a transfer of the probability distribution from right to left without changing the mean or variance of the distribution. They state that an individual would be made worse off

by an MVPT to greater downside risk if the person is decreasingly risk averse. Using a von Neumann-Morgenstern utility function, if the third derivative is positive, the person is a downside risk averter or decreasingly risk averse.

Newbery, D. M. G, and J. E. Stiglitz. <u>The Theory of Commodity Price Stabilization</u>, Oxford: Clarendon Press, 1981.

The authors review the ways previous studies have modeled risk aversion and conclude that assuming constant relative risk aversion (CRRA) has many advantages. Unlike utility functions that display constant absolute risk aversion (CARA), the CRRA assumption enables investigators to model risk in ways independent of income and of the units in which income is measured.

Using CRRA the authors then provide a framework for measuring the value of price stabilization to risk-averse farmers. They use a Taylor series expansion to show that B, the benefit of price stabilization divided by mean income is approximately

$$\frac{B}{\bar{Y}} = \frac{\Delta\bar{Y}}{\bar{Y}} - 1/2\ R\ \ \Delta\sigma_y^2.$$

The authors call the first term on the right-hand-side of the equation transfer benefits, that is, the gains of producers at the expense of consumers. In the second term, R is the relative risk-aversion coefficient and σ_y is the coefficient of variation in income. The authors identify this second term as the efficiency gain or the net social gain from stabilization of income through price stabilization. To quote the authors, "We wish to know what stabilization is worth to the farmer, that is, what sum of money, B, he would be willing to pay

for the stabilization scheme to be introduced."

Schmitz, A. Shalit, H., and Turnovsky, S. J. "Producer Welfare and the Preference for Price Stability." <u>American Journal of Agricultural Economics</u> 63(February 1981):157-160.

The authors' purpose is to generalize the conditions under which it can be said that producers prefer price stability by reassessing the benefits to producers from price stabilization using a more general utility function of profits.

They argue that the expected profit criterion, which in effect assumes risk neutrality, will be an inadequate measure of welfare if producers are also concerned with the stability of their earnings. Risk aversion must be introduced into the analysis. In doing so, the Oi analysis is generalized. They conclude that in their results (1) a multi-product firm may prefer price stability for some of the products but not for the entire set and (2) a single-product firm may or may not prefer price stability.

Gardner, B. "Is It Wrong To Fluctuate?: Policy Uses of Risk Management Research." Proceedings of the Southern Regional Research Project S-180, March, 1985 published by the Michigan State Agricultural Economics Department.

The author contends that the actual use of risk management research by policymakers is very limited. One reason may be that policymakers are interested primarily in supporting incomes rather than in managing risk. Another reason may be that the underlying theories of risk and welfare economics are not well developed. According to the author, there is little doubt that unchanging farm programs promote stability, but instability is created by uncertainty in the minds of producers as

to possible changes in such programs.

He contends that the area between supply curves before and after stabilization measures the "gross" benefits of risk reductions. The net benefits of stabilization are those obtained after subtracting the costs of achieving the stability. One caveat is that if consumers are risk averse, stability would shift their demand curves to the right, thus implying that a supply-only model underestimates the benefits. Also he notes that estimates of the benefits are likely to be biased upward because the nature of the supply curve at low quantities is undefined, since the shutdown price is P<AVC.

The author also discusses the appropriate argument in the farmer's utility function to analyze risk. He contends that "risk income," or the returns to factors of production for which the operator is the residual claimant should be used. In discussing a study by Thraen and Hammond that shows net benefits to price stabilization for dairy farmers, he notes that the implied R, the coefficient of relative risk aversion, must be greater than four which is higher than most of the studies surveyed by Newbery and Stiglitz.

III. Empirical Estimates of Risk Aversion

Lin, W., G. Dean, and C. Moore. "An Empirical Test of Utility vs. Profit Maximization in Agricultural Production." American Journal of Agricultural Economics 56(1974):497-508.

The authors deduce that utility maximization is superior to profit maximization in predicting behavior of six large California farms. Risk aversion estimates are derived from interviews with these farmers.

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Friend, I. and M. E. Blume. "The Demand for Risky Assets." _American Economic Review_ 65(December 1975):900-922.

The authors examine cross-sectional data from 1962 and 1963 Federal Reserve Board Surveys of the Financial Characteristics of Consumers and Changes in Family Finances. The sample was biased toward upper income households. The authors conclude that for most households, the assumption of constant proportional [relative] risk aversion describes the market place fairly accurately. The results are dependent, however, on the treatment of housing investment, which could be valued at market value, equity value, or zero value (assuming housing is solely a consumption item). The authors must make other judgmental assumptions in their treatment of human capital and life insurance. Given these assumptions, the authors conclude that the coefficient of proportional [relative] risk aversion for households as measured by ratios of risky assets to net worth is greater than one and "probably" greater than two.

Moscardi, E. and de Janvry, A. "Attitudes Toward Risk Among Peasants: An Econometric Approach." _American Journal of Agricultural Economics_ 59(November 1977):710-16.

Attitudes toward risk among peasants in Puebla, Mexico, were derived from survey data in a model of safety-first behavior, in which households maximize the income level below which income will fall only a specified (presumably low) proportion of the time.

By using data on fertilizer inputs and a production function estimated from another, larger experiment, the authors estimated the parameter K which is the marginal rate of substitution between expected net income and risk, i. e., the measure of risk aversion. The results

were a mean value for K of 1.12, a standard error of 0.61, and a range between 0 and 2.0.

The measurements of attitude toward risk were then explained by a set of socioeconomic and structural variables that characterized peasant households. The authors concluded that risk aversion is responsible for substantial differences between the demand for fertilizer without risk and actual demand, discouraging high rates of fertilizer use under safety-first behavior.

Dillon, J. L. and Scandizzo, P. L. "Risk Attitudes of Subsistence Farmers in Northeast Brazil: A Sampling Approach." American Journal of Agricultural Economics 60(August 1978):425-35.

Mind experiments involving choice between risky and sure farm alternatives were used to assess risk attitudes for samples of small farm owners and sharecroppers in Brazil.

The authors presented sample distributions of the risk attitude coefficients derived by assuming mean-standard deviation, mean-variance and exponential utility functions, respectively. For all three utility function models, estimation was based on solution of the relationship that the utility of a risky prospect is equal to that of its certainty equivalent.

Results indicated that most subsistence farmers are risk averse; more than half the farmers typically had relative risk-aversion coefficients greater than three; and the distribution of these coefficients was diverse and not necessarily well represented by an average sample value. Econometric analysis indicated that income level and perhaps other socioeconomic variables influence risk attitude.

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Young, D.L. "Risk Preferences of Agricultural Producers: Their Use in Extension and Research." <u>American Journal of Agricultural Economics</u> 61(1979):1063-70.

With some qualifications it is appropriate to use income variance as a measure of risk, according to the author. There are three ways of measuring risk attitudes: interviews or surveys, experimental methods, observed economic behavior. The author contends that the interview method is flawed because answers are unreliable. He contends that experimental methods are superior to interviews but expensive to conduct in the United States. Finally, observed economic behavior can also be misleading. In a world of certainty, firms equate $MRP_i = MFC_i$ for each input, but with uncertainty the equation would not hold. However, to ascribe all of the failure to equate MRP and MFC to risk is inaccurate, as there could be a variety of other reasons, including operator inefficiency. The author contends that risk aversion in underdeveloped countries appears larger than in developed countries, which is consistent with decreasing absolute risk aversion.

Binswanger, Hans P. "Attitudes Towards Risk: Experimental Measurement in Rural India." <u>American Journal of Agricultural Economics</u> 62(August 1980):395-407.

Attitudes toward risk were measured using two methods: an interview method and an experimental gambling approach, with over 300 individuals randomly selected from six villages in semi-arid rural India. In the experiment, a sequence of games with different levels of payoffs was played seven or eight times over a period of six weeks. The subjects were offered a choice among eight alternatives after which a coin was tossed and the participants paid according to the outcome.

Using the results of this experiment, the local shape of an individual's utility function was inferred by assuming that the choice made yielded higher expected utility than any other alternative.

The author concluded that the evidence for risk aversion from the pure interview method is unreliable, nonreplicable and misleading. His experimental measures indicate that most individuals are risk averse but not very risk averse and react to fluctuations in income rather than consolidating such changes into lifetime wealth. The coefficient of relative risk aversion, R, typically increases from about 0.5 for small fluctuations in income (SD of about one month's wage) to about 1.2 for large fluctuations (SD of about 50 percent of annual income).

Thraen, C. S. and J. W. Hammond, "Price Supports, Risk Aversion, and U. S. Dairy Policy: An Alternative Perspective of the Long-Term Impacts." Economic Report 83-9, Dept. of Agricultural and Applied Economics, University of Minnesota, June 1983.

The objective of this study was to evaluate the long-term impacts of alternative dairy price support policies on the levels of domestic milk production, consumption, and market price over the period 1950 to 1978.

The authors developed a model of the dairy industry, recognizing the elements of risk aversion and the role of rational producer expectations in production decisions. By estimating an econometric model incorporating risk factors and rational expectations by producers in adjusting to price supports, they concluded that price-supports have:

1. a direct price effect whereby a guaranteed price
   increases producers' expected price. This has a
   positive effect on capital stock and on production.

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2.   perceived risk-reducing effects whereby price-

supports eliminate or lessen the risk associated

with random, unpredictable market prices. This risk

reduction results in an additional positive effect

on output and on input use.

As a consequence, they contend that the support program may have resulted in a lower equilibrium market price and larger production and consumption for society. Those benefits may (partially) offset the direct government cost of the price supports.

Szpiro, George G. "Measuring Risk Aversion: An Alternative Approach."
    Review of Economics and Statistics 68 (February 1986):156-159.

The objective of this study was to estimate the coefficient of relative risk aversion using property insurance data. In his first experiment the author tests whether the assumption of constant relative risk aversion (CRRA) can be rejected and finds it cannot. Assuming CRRA, the author estimates the coefficient of relative risk aversion to be between 1.02 and 2.41. These results are derived from regression analysis of simultaneous equations in which total premiums and total claims are functions of an individual's wealth and his degree of risk aversion. The author also views his results as being roughly consistent with those of other studies in different types of markets. The following table appears in his article.

Values for the Coefficient of Relative Risk Aversion

Study	Coefficient	Estimated from
Weber (1970)[1]	2.4, 7.7	Consumer Expenditures
Friedman (1973)[2]	10	Health Insurance
Friend & Blume (1975)	> 1.0	Demand for Risky Assets
Weber (1975)[3]	1.3 to 1.8	Consumer Expenditures
Farber (1975)[4]	3.0, 3.7	Union Negotiations

[1]Weber, W. E. "The Effect of Interest Rates on Aggregate Consumption." American Economic Review 60(Sept. 1970): 591-600.

[2]Friedman, B. "Risk Aversion and the Consumer Choice for Health Insurance." Review of Economics and Statistics 56(May 1973): 209-214.

[3]Weber, W.E. "Interest Rates, Inflation and Consumer Expenditures." American Economic Review 65(Dec. 1975):843-858.

[4]Farber, H. S. "Individual Preferences and Union Wage Determination: The Case of the United Mine Workers." Journal of Political Economy 86(Oct. 1978):923-942.

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