

SHORTER ARTICLES

Output Price Indexes for the U.S. Life Insurance Industry

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ABSTRACT

This article derives a nonparametric index number of output prices for the life insurance industry based on the modern theory of index numbers and the economic theory of the financial firm. The method is illustrated by calculating an output price index for the U.S. life insurance industry for 1976 through 1989. The price index is then used to deflate nominal output to get an index of real output.

For many years analysts have been interested in measuring the cost to consumers of life insurance and in comparing insurance prices across companies.¹ This article focuses on price measurement for the life insurance industry from a different point of view—the price of insurance from the standpoint of the insurance firm. In recent years there have been important advances in the application of index number theory to the financial firm. Barnett (1980) showed how meaningful economic index numbers of monetary aggregates can be constructed using the user cost of each monetary asset as the price of the asset. Hancock (1985) used this user cost concept in developing and testing a theory of the financial firm. Fixler (1988) used modern index number theory and the theory of the financial firm to derive output price indexes for commercial banks. Fixler and Zieschang (1991) used these ideas to measure financial service output for the national income accounts. Weiss (1986) used index number theory to measure total factor productivity for life insurance firms. This article shows how index number theory based on the economic theory of the financial firm can be used to construct meaningful index numbers of output prices for the life insurance industry. It then constructs an index of output prices for the U.S. life insurance industry for 1976 through 1989. Finally, the price

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¹ See, e.g., Lin (1971), Winter (1981, 1982), and Babbal and Staking (1983).

index is used to deflate the nominal value of insurance output to get an index of real life insurance output.

The Measurement Issue

The U.S. life insurance industry is large and diverse, with over 2,000 companies providing a wide variety of services. The industry provides traditional whole life insurance, which includes a savings component through the build up of cash value, and term insurance which does not involve saving. In recent years new kinds of policies, such as universal life and variable life, have grown in importance. The industry also provides loans to policyowners whose policies have cash values. Life insurers also sell annuities, health insurance and financial management services. The remainder of the article deals with life insurance products only.

This diversity of activities and mingling of insurance and savings functions calls for a careful treatment of the important issue of constructing output price indexes for the industry. The output of the life insurance industry is the set of real financial services provided by the policies it sells. Smith (1982) argues that a life insurance policy can be viewed as an options package, providing the policyowner with options such as policy loans and guaranteed renewal at fixed premium rates in addition to death benefits. The output of the industry is the entire set of these real financial services or contingent claims on real goods and services. The illustrative application below is based on the assumption that these real financial services are proportional to the level of real insurance in force measured in 1976 dollars. The application constructs an index of the nominal price of this real output from the standpoint of the life insurer.

Index Numbers of Life Insurance Output Prices

Indexes of Output Prices

The modern theory of output price indexes conceptualizes output price differences between the reference and comparison periods as the ratio of the firm's revenue function with the comparison period's output prices to the revenue function with the reference period's output prices.² The firm's revenue function is

$$R(p;y)=\text{Max}_x [p'x|(x,y)\in T]$$

where p is the $N \times 1$ vector of prices of outputs (to be defined below), x is the $N \times 1$ vector of quantities of outputs, y is the $M \times 1$ vector of inputs, and T is the production possibility or feasible set. In defining the revenue function the levels of inputs are held constant. This revenue maximization process yields the same optimal output results as profit maximization

² See, e.g., Archibald (1977), Diewert (1976, 1987), and Fisher and Shell (1972).

because input levels are fixed. The dollar amount determined by the revenue function can be distributed as payments for intermediate goods, as factor payments to labor and other inputs, and as payments to the shareholders of stock companies or policyowners in the case of mutual companies. The revenue function with inputs fixed is used to focus on the effects of output price changes. When output prices change, the firm will substitute among outputs to achieve the new profit-maximizing combination of outputs. These effects are captured in the output price indexes calculated below.

For a financial firm some of the quantities of financial products may be negative; that is, some of the financial products of the firm may be financial inputs rather than outputs. In this application of the theory of the financial firm, however, all of the financial product quantities will be positive. If, however, policy loans were treated as a separate product rather than subsuming them within the ordinary life insurance product, this new product could have a negative level; that is, policy loans could be an input rather than an output. An asset will be an input rather than an output if it has a rate of return less than the firm's cost of capital. This may have frequently been the case with policy loans. See Fixler (1988) for discussion of the distinction between financial inputs and financial outputs with applications to the commercial banking industry.

The output price index is the ratio of the revenue functions for the reference and comparison situations:

$$I = \frac{R(p^1; y)}{R(p^0; y)} \quad (2.1)$$

where p^1 and p^0 are the comparison and reference prices, respectively. This is a meaningful measure of the price difference between the reference and comparison situations. The number $R(p^0; y)$ is the maximum revenue from the sale of insurance that the firm can produce given that it faces prices p^0 and has available to it fixed input levels y . If output prices change to p^1 and the firm continues to be constrained to inputs y , then the firm will change its output levels to get a new maximum revenue level—and, with inputs fixed, a new maximum profit level—depending on the new output prices. This new maximum is $R(p^1; y)$. The ratio of these two revenue levels measures the difference in output prices. This output price index is analogous to a true-cost-of-living index, which is the ratio of the costs to consumers of attaining a base level of utility at comparison and reference prices. (See, e.g., Samuelson and Swamy, 1974).

Economic Model of the Insurance Firm

This section constructs an economic model of the insurance firm to demonstrate the revenue function and to derive the appropriate output

prices.³ Assume that in the short run the firm wants to maximize the value of the revenue function and that the firm takes the market prices as given; that is, the market is competitive. For illustration, assume further that the firm has two products or activities: policies of type 1 (a life insurance product combining insurance and saving through the build up of cash value), and policies of type 2 (a life insurance product with no savings component). Finally, assume policyowners can borrow some portion of the value of type 1 insurance in force. Let x_{1t} and x_{2t} be the real amounts of life insurance of type 1 and type 2, respectively, in force in time t .

Life insurers collect current insurance premiums on each type of policy; they earn returns on holdings of reserves or assets, including policy loans; and they pay current claims. Assume the levels of administrative and other inputs are fixed. Claims, however, are not held fixed. Subtract these claims to get the net revenue available to be paid to the factors of production. The revenue function is then the maximum of the following net revenue flow for given levels of nonfinancial inputs, where each element of the net revenue flow is expressed as a proportion of the real dollar amount of the policy in force:

$$[\alpha_{1t} - \delta_{1t} + \rho_t \beta_{1t} + (r_t - \rho_t) b_t] x_{1t} + [\alpha_{2t} - \delta_{2t} + \rho_t \beta_{2t}] x_{2t}, \quad (2.2)$$

and where the variables are defined as follows:

- α_1, α_2 : premium rates per real dollar of the two types of insurance in force, (net of surrendered amounts or dividends, if any);
- δ_1, δ_2 : claim rates per real dollar of the two types of insurance in force;
- β_1, β_2 : reserve rates per real dollar of the two types of insurance in force;
- r : rate of return on policy loans;
- ρ : opportunity cost of capital or rate of return on other assets;
- b : policy loans as a proportion of real type 1 insurance in force;

The first bracketed term in expression (2.2) is the sum of revenue from premiums on the first type of life insurance in force and investment earnings from reserves held for that type of life insurance in force minus claims for type 1. This expression distinguishes two kinds of assets—policy loans and other. The term $\rho_t \beta_{1t}$ shows the investment return per real dollar of type 1 life insurance in force, where β_{1t} is the total reserves per real dollar of insurance. The term $(r_t - \rho_t) b_t$ accounts for investment income from reserves held as policy loans, which have typically had a lower rate of return than other assets. The second bracketed term in expression (2.2) accounts in a

³ This model is similar in some respects to the model of the life insurance firm presented by Kellner and Mathewson (1983, pp. 28-32).

similar way for net revenue flows associated with the other type of insurance, except that it lacks the term for policy loans.

This model treats sales commissions as payments for labor inputs and holds these sales efforts, like all other inputs, fixed. If, on the other hand, commissions were proportional to the amount of insurance in force they should be subtracted in calculating the output price. The application of the theory to calculating illustrative indexes below lacks data on commissions and, therefore, treats commissions as fixed.

The terms in the brackets in expression (2.2) are the relevant prices for output price measurement for the firm, because it is changes in these bracketed quantities only that will change the firm's optimal choice of outputs. To see this more clearly, rewrite the profit maximization problem as

$$\max_x [\theta_1 x_1 + \theta_2 x_2 | (x, y) \in T],$$

where θ_1 and θ_2 are the bracketed terms from expression (2.2). The θ s serve as the prices in determining the optimal choices of x_1 and x_2 . Thus, for example, if the premium and claims rates for policies of type 1 both change by the same amount, leaving the first bracketed term θ_1 unchanged, then the profit-maximizing choices of the two outputs given the fixed input levels would be unchanged. Only a change in the bracketed output prices will change the firm's output mix.

Calculating the Output Price Index

The output price index shown in equation (2.1) could be calculated directly by specifying a revenue function, estimating its parameters and calculating the reference and comparison revenue levels. The more practical method is to base index numbers on observables such as prices and quantities, rather than unobservable revenue function parameters. Diewert (1976) suggests the Tornqvist index as a practical way to approximate index numbers such as these.

The Tornqvist price index is the weighted geometric mean of the price ratios for each of N products with the weights being the shares of revenues contributed by the products:

$$I = \prod_{i=1}^N \left[\frac{p_i^1}{p_i^0} \right]^{\frac{1}{2}(s_i^1 + s_i^0)} \quad (2.3)$$

where $s_i^1 = p_i^1 x_i^1 / p^1 x^1$ and $s_i^0 = p_i^0 x_i^0 / p^0 x^0$. An index number is called "superlative" if it is exact for a second-order approximation to the desired revenue function. The Tornqvist index is superlative for the translog second-order logarithmic approximation to the revenue function:

$$\ln R(p; y) = \eta_0 + \sum_{j=1}^N \eta_j \ln p_j + \frac{1}{2} \sum_{i=1}^N \sum_{j=1}^N \lambda_{ij} \ln p_i \ln p_j + \sum_{j=1}^M \gamma_j \ln y_j + \frac{1}{2} \sum_{i=1}^M \sum_{j=1}^M \phi_{ij} \ln y_i \ln y_j + \sum_{i=1}^M \sum_{j=1}^N \mu_{ij} \ln y_i \ln p_j \quad (2.4)$$

That is, if the log of the function $R(p; y) = \text{Max}_x [p'x | (x, y) \in T]$ is approximated with the same translog function above for both the numerator and denominator of equation (2.1), the Tornqvist price index is exact for that approximation.⁴ The benefit of this approach is that while the translog approximation depends on many unobserved parameters, the Tornqvist price index depends only on prices and quantities—it is nonparametric. Also, while the translog revenue function in (2.4) depends on input levels y , the index in (2.3) does not. The importance of these facts is that the index implied by the complicated expression on the right-hand side of (2.4) can be calculated without any knowledge of the expression's many parameters or knowledge of the input levels. This greatly reduces the amount of data required to calculate the index and eliminates costly parameter estimation. This result relies on the assumption that the firms are competitive. See Denny and Fuss (1983) for discussion of the conditions required for calculating exact index numbers using price and quantity data only. Reece and Zieschang (1987) show how the Tornqvist approximation approach can be generalized to the case of the monopoly firm.

Output Price Indexes for the U.S. Life Insurance Industry for 1976 through 1989

This section illustrates the method by showing how one can calculate superlative output price indexes for the life insurance industry by using the Tornqvist index and the prices and outputs discussed above. Specifically, the section calculates the chained version of the Tornqvist index shown in equation (2.3):

$$I(t+1) = \prod_{i=1}^N \left[\frac{p_i^{t+1}}{p_i^t} \right]^{\frac{1}{2}(s_i^{t+1} + s_i^t)} \quad (3.1)$$

⁴ Diewert (1976, pp. 118-121) shows that if the functions in the numerator and denominator of the index, equation (2.1), are approximated with the same function then the ratio of the function is exactly the Tornqvist index. Caves, Christensen and Diewert (1982) generalize this result by showing that when the numerator and denominator approximations are not the same function but do have the same second-order terms the Tornqvist index is the geometric mean of the two ratios formed using first the reference period and then the comparison period as the base. An appendix showing the Tornqvist output price index to be superlative when the numerator and denominator revenue functions are the same is available from the author.

This is a chained index because the base period advances one period with each step through the time series. Thus, the index involves only direct comparisons between adjacent periods, t and $t+1$. Using the alternative, a fixed-base index with all comparisons made relative to a particular period, would require direct comparisons between periods widely separated in time.

Ideally, one would like to construct the index with data distinguishing among the many types of life insurance products available. One would specifically like to be able to treat whole life, universal life and variable life, which include savings components, separately from term insurance, which does not involve savings. Unfortunately, readily available public data do not break down insurance products in this way. Much of the publicly available data for the industry distinguish the following four types of life insurance: ordinary, group, industrial, and credit.

While these data are not ideal, they can be used to construct meaningful output price index numbers. The prices are constructed assuming policy loans, surrender values and policy dividends, which are not available by type of insurance, apply only to ordinary life insurance. Amounts of insurance in force, premiums, claims and reserves are available for each of the four types of insurance. All of the data used in calculating the index, except the average rate of return on policy loans and the CPI, are taken from various issues of the *Life Insurance Fact Book* published by the American Council of Life Insurance. The policy loan rate was constructed by assuming the average rate net of investment expenses and taxes was 3 percent in 1976 and increased by .4 percent in each succeeding year. The all-items Consumer Price Index (CPI) came from the *Statistical Abstract of the United States: 1990* (p. 471) and the *Monthly Labor Review* (October 1990, p. 86).⁵

The output price of ordinary insurance is the amount of premiums net of surrenders and dividends, minus payments to beneficiaries, plus investment income, where all values are expressed as rates per real dollar of insurance in force, measured in 1976 dollars. The amount of real dollars of insurance in force in each year is calculated by dividing the nominal amount of insurance in force by the CPI for that year using 1976 as the base year. Investment income for ordinary life is calculated as the sum of two parts. The first is the product of the assumed rate of interest on policy loans and the amount of policy loans. The second is the product of the average rate of return on all assets and the amount of reserves for ordinary life net of policy loans. For the other three types of policies, the prices are the premium amounts minus payments to beneficiaries plus investment income, where all values are expressed as rates per real dollar of insurance in force. Investment income for each of these three policy types is the product of the average rate of return on assets and the amount of reserves for that type of policy.

⁵ The data are available from the author.

The output prices for each of the four types of insurance are shown in Table 1. The chained Tornqvist output price index for the U.S. life insurance industry constructed using these prices and equation (3.1) is shown in the first column of Table 2. (The index is multiplied by 100.) The index shows industry output prices rising slowly from 1976 to 1981. The early 1980s was a difficult period for the life insurance industry, and this can be seen in the output price index. This was a period of recession in the overall economy. Lapse rates on existing life insurance policies grew rapidly during this period. The output price index fell by 7 percent in 1982 before plunging by almost 17 percent in 1983. Output prices remained low in 1984. These declines primarily resulted from the fact that real ordinary insurance in force increased by 20 percent from 1982 to 1984 while premiums increased by less than 1 percent. The life insurance price index climbed abruptly in 1985 with a 32 percent rise in the price index in that year. The industry increased ordinary insurance premium receipts by almost 20 percent in 1985. Output prices then fell by 7 percent in 1986 and rose by a similar amount in 1987 before plunging again by over 19 percent in 1988. Over the entire period the index shows a slight decrease in output prices of less than 4 percent.

Table 1
Output Prices By Product — 1976 through 1989
(dollars per 1976 dollar of insurance in force)

	Ordinary	Group	Industrial	Credit
1976	.0145	.0026	.0440	.0069
1977	.0157	.0028	.0466	.0076
1978	.0172	.0028	.0519	.0084
1979	.0181	.0032	.0617	.0091
1980	.0186	.0033	.0743	.0088
1981	.0210	.0029	.0843	.0098
1982	.0212	.0027	.1104	.0102
1983	.0176	.0025	.0971	.0119
1984	.0151	.0022	.1118	.0129
1985	.0179	.0028	.1107	.0137
1986	.0198	.0029	.1094	.0115
1987	.0237	.0024	.1042	.0120
1988	.0214	.0029	.1121	.0119
1989	.0206	.0027	.1165	.0111

While the concepts being measured are not quite comparable, it is interesting to compare these results with the implicit price deflator for the entire life-health insurance sector (including insurance other than life) obtained by Weiss (1987, p. 589). She constructed the deflator implied by measures, discussed briefly below, of real and nominal output for the entire insurance sector for 1972 through 1981. For the period between 1976 and 1981, the index in Table 2 shows an increase in life insurance prices of 9.9

Table 2
Output Price Index and Real Output Quantity
For US Life Insurers – 1976 through 1989
 (output in millions of 1976 dollars)

year	price index	real output
1976	100.00	22,264
1977	108.40	22,800
1978	108.22	25,265
1979	107.02	27,196
1980	103.55	28,003
1981	109.90	29,326
1982	102.00	33,488
1983	84.97	37,250
1984	88.56	33,889
1985	117.26	32,145
1986	108.44	41,259
1987	115.26	48,382
1988	92.68	57,962
1989	96.34	55,765

percent, while Weiss calculated an increase of insurance prices of 78.9 percent over that period. Weiss's index includes health insurance prices as well as the prices of other outputs of the life-health insurance industry. The inclusion of health insurance may be in part responsible for the much greater rate of increase in her price index than in the index presented here.

Product prices and output price indexes such as these provide meaningful measures of prices for a variety of important uses, such as in studies of the supply behavior of U.S. life insurance firms. The next section shows that the output price index can also be used to calculate an index of real output.

Indexes of Real Output for the U.S. Life Insurance Industry for 1976 through 1989

One of the principal uses of output price indexes is to deflate nominal output values to measure real output. Measuring the real output of the life insurance industry is a controversial subject. In their study of economies of scale in the life insurance industry, for example, Houston and Simon (1970) used premiums paid to measure output. Hirshhorn and Geehan (1977) and Geehan (1977) measured real output with a weighted average of product volumes with measures of real unit costs as the weights. See Denny (1980) and Hirshhorn and Geehan (1980) for discussion of this approach. Kellner and Mathewson (1983) used the number of policies written and retained to measure life insurer output. Fields (1988) used numbers of various policies and annuities written and numbers of these policies and annuities in force to measure the outputs of insurance firms. Fields and Murphy (1989) used commissions paid to life insurance agencies to measure the agencies' output.

(In studies of economies of scale in the property-liability insurance industry, Doherty (1981) and Skogh (1982) used claims paid to measure output.) Weiss (1986) has measured real output of life insurers in constructing indexes of total factor productivity in the industry. She used Tornqvist indexes of output and input quantities with output prices for various outputs measured as the sums of selling costs, operating expenses, taxes and capital costs per unit. She applied her method to calculate productivity indexes for two illustrative companies. Weiss (1987) considered the national income accounting approach to measuring value-added in the insurance industry. She concentrated on corrections to official U.S. Department of Commerce calculations for nonlife and health insurance; data needed for correcting life insurance value-added calculations were not available.

Returning to the illustrative calculations, observe that in each period the nominal value of output for each type of insurance in force is $p_{it}x_{it}$, the product of the price (per real dollar of insurance in force) of the bundle of financial services associated with that type of insurance and the real amount of that type of insurance in force. Nominal output of the industry is the sum of these over all types of insurance, $p_i'x_i$. Dividing these values by the corresponding price index values for each period yields measures of real output of financial services of the industry. The second column of Table 2 shows the amount of real output (in millions of 1976 dollars) of the U.S. life insurance industry constructed by deflating the nominal output values with the Tornqvist output price index. The index shows the real output of the industry growing at an average rate of 5.6 percent between 1976 and 1981, and then rising rapidly for 1982 and 1983. Output then falls for 1984 and 1985 before rising rapidly in 1986 through 1988. Output falls slightly in 1989.

Conclusion

This article has shown how index number theory based on the economic theory of the financial firm can be used to construct superlative index numbers of output prices for the life insurance industry. It has constructed an index of output prices for the U.S. life insurance industry for 1976 through 1989. The index shows life insurance output prices declining slightly over this period. An output price index such as calculated here could be used in studies of entry and exit of new firms for the industry, or one could use the index in studying stock prices or profitability of the industry. One could use the prices by product to study insurance firm's substitution among products. The article has illustrated another use of the index by using it to deflate the nominal value of insurance output to get an index of real output. This index shows real output of the life insurance industry rising by 150 percent for the period 1976 through 1989.

References

- American Council of Life Insurance, 1990, *1989 Life Insurance Fact Book Update*, Washington, D.C.
- Archibald, Robert B., 1977, On the Theory of Industrial Price Measurement: Output Price Indexes, *Annals of Economic and Social Measurement*, 6: 57-72.
- Barnett, William A., 1980, Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory, *Journal of Econometrics*, 14: 11-48.
- Babbel, David F., and Kim B. Staking, 1983, A Capital Budgeting Analysis of Life Insurance Costs in the United States: 1950-1979, *Journal of Finance*, 38: 149-170.
- Caves, Douglas W., Laurits R. Christensen, and W. Erwin Diewert, 1982, The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity, *Econometrica*, 50: 1393-1414.
- Denny, Michael, 1980, Measuring the Real Output of the Life Insurance Industry: A Comment, *Review of Economics and Statistics*, 62: 150-152.
- and Melvyn Fuss, 1983, A General Approach to Intertemporal and Interspatial Productivity Comparisons, *Journal of Econometrics*, 23: 315-330.
- Diewert, W. E., 1976, Exact and Superlative Index Numbers, *Journal of Econometrics*, 4: 115-145.
- , 1987, Index Numbers, in *The New Palgrave: A Dictionary of Economics*, eds. John Eatwell, Murray Milgate, and Peter Newman, New York: The Stockton Press, 767-780.
- Doherty, Neil A., 1981, The Measurement of Output and Economies of Scale in Property Liability Insurance, *Journal of Risk and Insurance*, 48: 390-402.
- Fields, Joseph A., 1988, Expense Preference Behavior in Mutual Life Insurers, *Journal of Financial Services Research*, 1: 113-129.
- and Neil B. Murphy, 1989, An Analysis of Efficiency in the Delivery of Financial Services: The Case of Life Insurance Agencies, *Journal of Financial Services Research*, 2: 341-356.
- Fisher, Franklin M., and Karl Shell, 1972, *The Economic Theory of Price Indexes*, New York: Academic Press.
- Fixler, Dennis J., 1988, A Commercial Bank Output Price Index, Working Paper 179, Washington, D.C.: U.S. Bureau of Labor Statistics.
- and Kimberly D. Zieschang, 1991, Measuring the Nominal Value of Financial Services in the National Income Accounts, *Economic Inquiry*, 29: 53-68.
- Geehan, Randall, 1977, Returns to Scale in the Life Insurance Industry, *Bell Journal of Economics*, 8: 497-514.
- Hancock, Diana, 1985, The Financial Firm: Production with Monetary and Nonmonetary Goods, *Journal of Political Economy*, 93: 859-880.

- Hirshhorn, Ron, and Randall Geehan, 1977, Measuring the Real Output of the Life Insurance Industry, *Review of Economics and Statistics*, 59: 211-219.
- , 1980, Measuring the Real Output of the Life Insurance Industry: A Reply, *Review of Economics and Statistics*, 62: 152-154.
- Houston, David B., and Richard M. Simon, 1970, Economies of Scale in Financial Institutions: A Study in Life Insurance, *Econometrica*, 38: 856-864.
- Kellner, S., and G. Frank Mathewson, 1983, Entry, Size Distribution, Scale, and Scope Economies in the Life Insurance Industry, *Journal of Business*, 56: 25-44.
- Lin, Cheyeh, 1971, A Price Index for Life Insurance, *Journal of Risk and Insurance*, 38: 563-570.
- Reece, William S., and Kimberly D. Zieschang, 1987, Output Price Indexes for Regulated Monopoly, *Economics Letters*, 25: 85-89.
- Samuelson, P.A., and S. Swamy, 1974, Invariant Economic Index Numbers and Canonical Duality: Survey and Synthesis, *American Economic Review*, 64: 566-593.
- Skogh, Göran, 1982, Returns to Scale in the Swedish Property-Casualty Insurance Industry, *Journal of Risk and Insurance*, 49: 218-228.
- Smith, Michael L., 1982, The Life Insurance Policy as an Options Package, *Journal of Risk and Insurance*, 49: 583-601.
- U.S. Bureau of the Census, 1990, *Statistical Abstract of the United States: 1990*, Washington, D.C.: U.S. Government Printing Office, 471.
- U.S. Department of Labor, 1990, *Monthly Labor Review*, 113: 86.
- Weiss, Mary A., 1986, Analysis of Productivity at the Firm Level: An Application to Life Insurers, *Journal of Risk and Insurance*, 53: 49-83.
- , 1987, Macroeconomic Insurance Output Measurement, *Journal of Risk and Insurance*, 54: 582-593.
- Winter, R. A., 1981, On the Rate Structure of the American Life Insurance Market, *Journal of Finance*, 36: 81-96.
- , 1982, On the Choice of an Index for Disclosure in the Life Insurance Market: An Axiomatic Approach, *Journal of Risk and Insurance*, 49: 513-538.

