An Economic Analysis of Life Insurance Company Expenses

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Summary of Results

This paper estimates the acquisitionand maintenance costs associated with life policies as a function of the amount of insurance and number of policies of an insurer by estimating a cost function for our sample of insurers. Our sample consists of firms that responded to a survey requesting information regarding the number of employees and agents employed by the firm from 1995 to 1998. We excluded very small firms from the analysis. The final sample consists of 448 firm-year observations. The overall costs associated with life policies, that is, acquisition and maintenance costs, are computed as the marginal cost of the cost function, which represent the present value of total costs.

We examine several statistical characteristics of these costs – at the mean and at the median of the sample, and for different company sizes. The data indicate that there is a large variation among life insurance companies and that the costs associated with life policies of the largest insurers are much higher than the corresonding costs of other firms. Comparing the costs between firms that use branches as their main distribution system (henceforth referred to as "branch firms") and firms that use other marketing systems ("non-branch firms") reveal that the costs of branch firms are generally higher.

Given the estimated marginal costs, we illustrate an "Expense Table" using the following assumptions: (1) the ratio of acquisition (maintenance) expenses to total costs is 69.37% (30.63%), (2) the average duration of whole (term) life policy is 14 (11) years, and (3) the discount rate is 10%. The Expense Table is constructed separately for branch firms and non-branch firms.

Expense Table– Illustration

First Year Charges ($) per Policy and Amount of Insurance for Branch and Non-Branch Firms

	Branch Firms		Non-Branch Firms	
	Whole	**Term**	**Whole**	**Term**
Policy	149.00	149.00	158.00	158.00
Amount (000)	9.40	2.60	6.70	1.00

Maintenance Charges ($) per Policy and Amount of Insurance for Branch and Non-Branch Firms

	Branch Firms		Non-Branch Firms	
	Whole	**Term**	**Whole**	**Term**
Policy	9.30	10.70	9.80	11.40
Amount (000)	0.58	0.19	0.41	0.07

I - Methodology

The purpose of this study is to develop a methodology that can be used to construct life insurance industry benchmark expense factors. To do so, an illustrative Expense Table ("the Expense Table") is constructed based on reported expense experience for U.S. insurers during 1995-98. The costs reflected are all operating expenses of the life insurance line of business except commissions and taxes.

When estimating the costs associated with life insurance policies, one needs to take into account the multi-product nature of the life insurance industry. Broadly, the products of life insurance companies can be classified into three lines of business: life insurance, annuities and other accumulation products, and Accident & Health (A&H). As these product types are different in nature, so too are the costs associated with each of them. The National Association of Insurance Commissioners (NAIC) Annual Statement shows both the total costs associated with the entire operation of the insurer and the costs associated with each line of business. However,

the allocation of the total costs across lines of business crucially depends upon the allocation method used by each insurer. Since insurers may employ different cost allocation methods, each of which may provide different allocations of the same costs, relying on the allocations made by the companies may provide distorted results as to the "true" costs associated with each line of business. Therefore, our approach to the problem of identifying the costs associated with life insurance policies is to first estimate the portion of total costs attributed to the life insurance line of business, and then to compute the costs associated with each life insurance policy.

To identify the costs associated with each line of business, among other important economic aspects of the firms' operations, economics theory suggests the estimation of cost function, where the costs to be allocated are modeled as a function of *input prices* and *physical outputs.* The costs associated with each line of business can be estimated by computing the marginal cost of the cost function for each output; i.e., using the estimated cost function, the marginal cost with respect to each line of business proxies for the costs associated with each product. Since the cost function is estimated based on a sample of insurers, the estimated marginal costs represent the average marginal costs of the sample and therefore the average cost of each line of business.

For our purpose, we estimate the cost function, where costs are defined as the insurance total operating expenses as summarized in Exhibit 5 of the insurers' regulatory Annual Statements. Total operating costs, however, consists of both the costs associated with selling and issuing new policies (acquisition costs) and the costs of maintaining existing policies (maintenance costs). Assuming that the ratio of issuance expenses to maintenance expenses is stable over time, and that technology, mortality rates, lapse rates and other factors that have an effect on a company's operations do not change dramatically over the years, the estimated

marginal costs are not only the costs attributed to new policies, but also the costs of selling and maintaining the policies as long as they are in force. To put it differently, the estimated marginal costs represent the present value of the overall costs associated with the policies.

The construction of our illustrative Expense Table consists of two steps. In the first step, the estimated marginal costs are assigned to acquisition and maintenance costs, which represent the present value of these costs. To separate total costs into acquisition and maintenance costs, one needs to make an assumption regarding the portion of total costs that is attributed to these two functions. In the second step, one needs to compute the yearly charges such that the present value of first year charge and those of subsequent years would equal the acquisition and maintenance costs obtained from the estimated marginal costs, respectively. To operationalize the second step, assumptions regarding the average duration of a typical life policy and on discount rate are required.

Based on results of other studies, insurer characteristics that need to be addressed when constructing the Expense Table are distribution systems and the size of the insurers. Since most insurers employ more than one distribution system, it is hard to define (and measure) the insurer's "exact" distribution system. Therefore, we broadly classify the firms into two groups according to their primary distribution system – branch and all other systems. The distribution system is accounted for in the regression estimation, as well as in the computations leading to the Expense Table.

Our results show that size of insurer may be an important factor in determining the Expense Table. In general, based on our sample, larger firms exhibit higher operating expenses for each line of business. One potential reason is that large insurers may not be as efficient as

small insurers, and therefore their costs of selling new policies and maintaining existing policies are higher.

The remainder of this study is organized as follows. The next section provides a description of the outputs and of the input prices that are used in the estimation of the cost function. Section III describes the cost function and the estimation method, and Section IV provides the estimation results. Section V describes and illustrates suggested methodology to construct the Expense Table using the marginal costs of the cost function.

II– Outputs, Input Prices[1] and Data

The estimation of cost function requires physical outputs and input prices. Several previous studies have estimated the cost function of the life insurance industry. While most studies agree on input definition, they differ in output definition and measurement. Below, we provide a short description and critique of the outputs used in the literature, and then describe the outputs and input prices that are used in this study.

Outputs

Outputs in the Literature

As with all service sectors, output definition and measurement are not trivial. Most studies define the outputs by lines of the business, that is, life policies, annuities and accident and health (A&H), whereas some studies add investment income as an additional output. Similarly, the major differences among studies of the cost structure of the life insurance industry are in the area of output measurement.

[1] The Glossary provides exact definition of each variable and its reference in the Annual Statement

Geehan (1986) provides a useful discussion of the issues involved and presents a comparison of major studies that use different output measures. Grace and Timme (1992), Gardner and Grace (1993), and Fecher et al. (1993) measure outputs as the dollar value of premiums and annuity considerations. Premiums, however, are a questionable measure of life policies and annuities, some of the later for which are recognized as deposits. They do not represent physical output but rather revenues (price per unit multiplied by the number of units of insurance). Furthermore, for whole life insurance policies, only a portion of the premium covers the risk-bearing that life insurance companies provide to the insured. The remaining portion covers the cash value of the policy, future expected dividends (in the case of participating policies), and the expenses of the company. Thus, a portion of the premium actually belongs to the insured and should not be considered as revenue for the insurer.

Yungert (1993) measures outputs by additions to reserves. The major problem with the use of additions to reserves as an output measure is that reserves change when policies age, regardless of whether new policies are sold. Furthermore, the change in reserves measures the change in liabilities, rather than the outcome of the selling effort.

In a more recent study, Cummins and Zi (1998) distinguish between the two principal services provided by life insurance companies: risk bearing/pooling and intermediation services. As a proxy for risk bearing/pooling, they use incurred benefits by line of business, whereas for the intermediation service they use additions to reserves. Here again the proxy for output is disputable, as benefits represent incurred obligations that were established in the past. Hence they do not measure current output but past cumulative output.

Following Cummins and Zi (1998), we characterize the outputs by their primary service. Life policies provide either pure risk protection (e.g., term life policies) or a mix of risk

protection and intermediation services (e.g., whole life policies). Annuities can be viewed as a saving vehicle, and therefore, the service can be characterized as intermediation. A&H policies, on the other hand, provide risk protection services alone.

Life insurance output

The risk bearing/pooling that life insurance companies provide for new policies can be approximated by the total amount of insurance sold during the year. The total amount of insurance sold during the year measures the outcome of the selling effort and the additional risk that the company bears and, therefore, can represent the output of the life insurance line of business. Furthermore, the total amount of insurance measure of output may be appropriate to all types of life policies, both those that provide pure risk protection (term life) and those that serve also as savings vehicle.

Since the costs associated with whole life policies are different from those associated with term life policies, we separate the total amount of insurance sold into whole life policies' amount of insurance sold and term life policies' amount of insurance sold.

Part of the costs associated with life policies is fixed, that is, expenses that are not related to the size of the policy. Therefore, we include the number of life policies as another dimension of output. We assume that the fixed cost associated with life policies is the same for term and whole life policies.

In summary, we use three outputs for the life insurance line of business: number of life policies sold during the year, whole life policies amount of insurance sold, and term life policies amount of insurance sold.

Annuities output

The profits/losses of life insurance companies from annuities stem from the difference between the actual return on investments and the return credited to the contracts. Assuming a positive spread, the larger the annuity considerations, the higher is the expected profit. Hence, a plausible proxy for the output is annuity considerations, which represent the increase in the earning "base" of this line of business.

A&H output

A&H policies provide primarily risk protection. Since we could not quantify the amount of risk associated with each new policy, we use A&H premiums as a proxy for the A&H output. In equilibrium, where the risk associated with A&H policies is priced correctly, premiums are a good proxy for risk.

To summarize, we use five outputs: number of new life policies sold, whole life policies' amount of insurance sold, term life policies' amount of insurance sold, total annuity considerations, and total A&H premiums.

Inputs and Input Prices

The operating costs of life insurance can be classified broadly into labor-related expenses, capital expenses, and materials consisting of all other expenses.

Price of Labor

Labor is defined as the total number of employees and agents employed by the company. We compute the price of labor as the total cost of employees and agents divided by the total number of agents and employees. The total cost of agents is computed as the sum of direct commissions, contributions for benefit plans, payments under non-funded benefit plans and other agent welfare. The total cost of employees is the sum of salaries, contributions for benefit plans,

payments under non-funded benefit plans and other employee welfare. The price of labor is a surrogate for the average cost of employees. Therefore, for companies for which the computed price of labor is less than $15,000 we change the price of labor to $15,000, and for companies for which the computed price of labor is greater than $120,000 we change the price of labor to $120,000[2].

Price of Capital

Capital is defined as the sum of capital expenses: rent, equipment rental, and depreciation. Since we cannot obtain the price of each of the capital expenses, we compute the price of capital as the ratio of capital expense to the number of employees and agents, effectively computing capital expense per employee. However, assuming that capital per employee (the space each employee occupies and the quality of equipment each operates) is equal across companies, this ratio may serve as a proxy for the price of capital.

Price of Materials

The third input, materials, consists of all other expenses that appear in Exhibit 5 – Exhibit of General Expenses in the statutory Annual Statements, other than labor and capital expenses. Most of the expense items are directly related to selling new policies and servicing existing policies. Therefore, a reasonable price for materials would be the ratio of materials expense to the total number of policies sold and serviced. However, since we cannot obtain an estimate of the number of policies serviced during the year, we use instead the number of policies that were sold and terminated during the year in the denominator. We compute the number of policies terminated during the year as the number of policies at the end of year (t-1) plus the number of

[2] Note that the computed price of labor depends on the number of employees, data that were provided by the companies included in the sample. Since some companies may have counted part time employees as full time employees or gave just an estimate of the number of employees, the resultant price of labor has significant variation across companies. In addition, for some companies the average yearly price of labor is unreasonable (below $1000

policies sold during year (t) minus the number of policies at the end of year (t). Hence, for each line of business[3], we compute the number of policies that were sold and terminated during the year as

2# of policies sold + # of policies at the end of year t-1 - # of policies at the end of year t*

Data

The insurance financial data were obtained from the regulatory Annual Statement filed by insurers as reported in the National Association of Insurance Commissioners (NAIC) life insurance data tapes for 1995-1998. The NAIC tapes do not include information as to the number of employees and agents that insurers employ. The number of employees and agents is required in order to compute adequate measures of labor and the price of labor and capital. Therefore, we include in the sample only companies which responded to a survey that requested the number of employees and agents, or companies for which we have these data from LOMA's Expense Management Program (EMaP). EMaP is a detailed expense study of life insurance companies that chose to participate in the program.

The initial sample consists of 733 observations (companies-years). We exclude firms for which the data are not consistent or show negative direct premiums, revenues, benefits, commissions, amount of insurance, labor related expenses, and capital expenses (154 observations). In addition, we exclude from the sample small companies that either had less than 10 employees and agents, operating costs less than $1,000,000, or sold less than 1,000 life policies (131 observations). The final sample consists of 448 observations, 111 firms in 1995, 114 in 1996, 111 in 1997, and 112 in 1998. Milliman & Robertson, Inc. provided data on the

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or above $200,000). Hence, we had to modify the price of labor to make it more reasonable. Alternatively, we could have omitted these observations, but that would have reduced the statistical power of the analysis.

[3] The data do not contain information as to the number of insureds under A&H group master policies. Therefore, for the computation we use the number of master policies.

sample firms' distribution systems, on the estimated ratio of issuance costs from total costs, and on estimated average duration of whole and term life policies.

III-Cost Function

Define

Pl = price of labor
Pk = price of capital
Pm = price of materials
WAMT = whole life policies amount of insurance sold
TAMT = term life policies amount of insurance sold
LIFPOL = total number of life policies issued
ANN = total annuity considerations
AH = total A&H premiums
C = total insurance general expenses (=labor expense + capital expense + materials expense)
L_SH = the share of labor related expenses of total costs = labor expense/C
K_SH = the share of capital related expenses of total costs = capital expense/C
M_SH= the share of materials related expenses of total costs = materials expense/C
D = dummy variable for marketing system: 0 if branch and 1 otherwise

Note that since total cost is equal to the sum of labor, capital and materials expenses, the sum of labor share, capital share and materials share must equal one, where each share represents the percentage of total cost devoted to each of the inputs.

Let,

$$C_{it}=Pl_{it}^{\alpha 1}Pk_{it}^{\alpha 2}Pm_{it}^{\alpha 3}LIFPOL_{it}^{\beta 1}WAMT_{it}^{\beta 2}TAMT^{\beta 3}ANN_{it}^{\beta 4}AH_{it}^{\beta 5} \qquad (1)$$

Where all the variables are as defined above, i index firms, and t stands for year. Equation (1) defines total costs as a non-linear function of inputs and outputs. This form of function is commonly referred to as a Cobb-Douglas cost function. In order to estimate the function, we transform it to linear form by taking the natural log of both sides of the equation. Equation (1) constrains the economies of scale to be constant for all firms. This constraint seems to be too restrictive, especially for the life insurance industry. To allow scale economies to differ across firms we add half times the square of the natural log of all outputs (the firms index and the time

index are suppressed). In addition, to examine whether the cost structure of firms that use primarily branch offices as a distribution system are different than the cost structure of firms that use other distribution systems, we also add D (a dummy variable) times all the variables that involve outputs. So equation (1) becomes:

$$\ln(C) = \sum_{1}^{3} \alpha_i P_i + \sum_{1}^{5} \beta_k Y_k + \tfrac{1}{2}\sum_{1}^{5} \delta_k Y_k^2 + \sum_{1}^{5} \lambda_k D*Y_k + \sum_{1}^{5} \gamma_k D*Y_k^2 \quad (2)$$

i = L, M, K
Y_k = LIFPOL, WAMT, TAMT, ANN, AH
D=0 if branch, 1 otherwise

The marginal costs of the outputs are computed as the first derivative of total costs with respect to each of the outputs. Using equation (2), the marginal cost with respect to term life policies amount of insurance sold (TAMT) of a non-branch company (D=1) is computed as follows

$\partial \ln(C)/\partial \ln(TAMT) = (TAMT/C)* \partial C/\partial TAMT$

$\rightarrow MC_{TAMT} = \partial C/\partial TAMT = (C/TAMT)*(\partial \ln(C)/\partial \ln(TAMT))$, so

$$MC_{TAMT(D=1)} = \P C/\P TAMT = (C/TAMT)*[\beta_{TAMT} + \delta_{TAMT} ln(TAMT) + \lambda_{TAMT} + \gamma_{TAMT} ln(TAMT)] \quad (3)$$

And, the marginal cost with respect to term life policies amount of insurance sold (TAMT) of a branch company (D=0) is

$$MC_{TAMT(D=0)} = \P C/\P TAMT = (C/TAMT)*[\beta_{TAMT} + \delta_{TAMT} ln(TAMT)] \quad (4)$$

Similarly, we compute the marginal costs of the remaining outputs: LIFPOL, WAMT, ANN and AH.

The marginal costs of LIFPOL,

$$MC_{LIFPOL(D=1)} = \P C/\P LIFPOL = (C/LIFPOL)*[\beta_{LIFPOL} + \delta_{LIFPOL} ln(LIFPOL) + \lambda_{LIFPOL} + \gamma_{LIFPOL} ln(LIFPOL)] \quad (5)$$

$$MC_{LIFPOL(D=0)} = \partial C/\partial LIFPOL = (C/LIFPOL)*[\beta_{LIFPOL} + \delta_{LIFPOL} ln(LIFPOL)] \quad (6)$$

The marginal costs of WAMT,

$$MC_{WAMT(D=1)} = \partial C/\partial WAMT = (C/WAMT)*[\beta_{WAMT} + \delta_{WAMT} ln(WAMT) + \lambda_{WAMT} + \gamma_{WAMT} ln(WAMT)] \quad (6)$$

$$MC_{WAMT(D=0)} = \partial C/\partial WAMT = (C/WAMT)*[\beta_{WAMT} + \delta_{WAMT} ln(WAMT)] \quad (7)$$

The marginal costs of ANN,

$$MC_{ANN(D=1)} = \partial C/\partial ANN = (C/ANN)*[\beta_{ANN} + \delta_{ANN} ln(ANN) + \lambda_{ANN} + \gamma_{ANN} ln(ANN)] \quad (8)$$

$$MC_{ANN(D=0)} = \partial C/\partial ANN = (C/ANN)*[\beta_{ANN} + \delta_{ANN} ln(ANN)] \quad (9)$$

And, the marginal costs of AH,

$$MC_{AH(D=1)} = \partial C/\partial AH = (C/AH)*[\beta_{AH} + \delta_{AH} ln(AH) + \lambda_{AH} + \gamma_{AH} ln(AH)] \quad (10)$$

$$MC_{AH(D=0)} = \partial C/\partial AH = (C/AH)*[\beta_{AH} + \delta_{AH} ln(AH)] \quad (11)$$

Specification and Estimation

Before estimating the model one needs to impose the homogeneity constraint - the sum of α_1,α_2, and α_3 must equal one. The reason is that if all prices increase by the same proportion, then total costs must increase by the same proportion (see equation (1)). We impose the homogeneity constraint by dividing all input prices and total costs by one of the input prices[4], so the empirical model of equation (2) becomes

$$\ln(C^*) = \alpha_0 + \alpha_1 \ln(Pl^*) + \alpha_2 \ln(Pk^*) + \sum_1^5 \beta_k Y_k + \tfrac{1}{2}\sum_1^5 \delta_k Y_k^2 + \sum_1^5 \lambda_k D^* Y_k + \sum_1^5 \gamma_k D^* Y_k^2 + \varepsilon \quad (12)$$

[4] The results of the estimation of the cost function are invariant to the price we use as a scaler

where C*=C/Pm, Pl*=Pl/Pm, Pk*=Pk/Pm, α_0 is the intercept, ε is the disturbance term which is assumed to be homoscadastic and normally distributed with zero mean and variance σ^2. All other variables are as defined above.

To estimate equation (12), economic theory suggests imposing additional constraints on the model by adding two share equations to the system, that is,

$$\ln(C^*) = \alpha_0 + \alpha_1 \ln(Pl^*) + \alpha_2 \ln(Pk^*) + \sum_1^5 \beta_k Y_k + \sum_1^5 \delta_k Y_k^2 + \sum_1^5 \lambda_k D^* Y_k + \sum_1^5 \gamma_k D^* Y_k^2 + \varepsilon \quad (13)$$

$$L\_SH = \alpha_1 + \varepsilon_l \quad (14)$$

$$K\_SH = \alpha_2 + \varepsilon_k \quad (15)$$

The introduction of the share equations into the system assures that the shares implied by the estimated cost function are as close as possible to the actual cost shares. We include in the estimation only two share equations, since the sum of the cost shares is 1. The system of equations (13-15) is estimated using the Seemingly Unrelated Regression Equations (SURE) procedure.

IV - Results

Table 1 – Descriptive Statistics (Number of Obseravtions=457)

Variable	MEAN	MIN	Q1 (25th Percentile)	MEDIAN	Q3 (75th Percentile)	MAX
COST ($000)	92,577	1,055	4,912	15,992	57,548	3,663,918
TAMT (000)	2,372,869	0	14,410	195,340	1,377,000	57,091,000
WAMT (000)	1,290,050	0	37,840	184,550	958,930	26,258,000
ANN ($000)	141,912	0	163	7,064	40,597	5,315,036
AH ($000)	134,137	0	443	9,137	62,073	6,562,188
LIFPOL	91,452	1,000	6,233	15,944	56,017	3,708,830
PL	32,117	15,000	15,000	20,243	37,602	120,000
PK	2,975	20	390	1,490	3,744	40,009
PM	174	1	34	86	197	2,798
L_SH	0.56	0.02	0.50	0.58	0.64	0.84

K_SH	0.10	0.04	0.07	0.10	0.13	0.33
M_SH	0.33	0.03	0.25	0.31	0.38	0.96

Table 1 provides descriptive statistics of the variables that are used in the estimation of the cost structure. The table indicates that there is a great amount of variation across insurers, and that the sample consists of relatively small and relatively large companies. Total cost ranges from $1 million to $3.6 billion, amount of term life insurance sold ranges from 0 to $57 billion, and amount of whole life insurance sold ranges from 0 to $26 billion. Our measures of input prices also vary substantially: Pk, the price of capital, ranges from $20 to $40,000, whereas Pm, the price of materials ranges from $1 to $2800. The mean labor expense share of total cost is 58%, while the shares of capital expenses and materials expenses are 10% and 31% respectively.

Table 2 – Estimated Coefficients of the Cost Function

Variable	Coefficient	Estimate	Standard Error
Intercept	α_0	7.726	1.199
PL	α_1	0.553	0.005
PK	α_2	0.102	0.002
LIFPOL	β_{LIFPOL}	-0.454	0.708
TAMT	β_{TAMT}	0.112	0.373
WAMT	β_{WAMT}	-0.184	0.109
ANN	β_{ANN}	0.098	0.070
AH	β_{AH}	-0.171	0.062
$LIFPOL^2$	δ_{LIFPOL}	0.065	0.063
$TAMT^2$	δ_{TAMT}	0.003	0.020
$WAMT^2$	δ_{WAMT}	0.016	0.010
ANN^2	δ_{ANN}	-0.006	0.007
AH^2	δ_{AH}	0.020	0.006
D*LIFPOL	λ_{LIFPOL}	0.152	0.750
D*TAMT	λ_{TAMT}	-0.206	0.374
D*WAMT	λ_{WAMT}	0.173	0.112
D*ANN	λ_{ANN}	-0.169	0.073
D*AH	λ_{AH}	0.014	0.067
$D*LIFPOL^2$	γ_{LIFPOL}	-0.014	0.068
$D*TAMT^2$	γ_{TAMT}	0.009	0.020
$D*WAMT^2$	γ_{WAMT}	-0.013	0.010
$D*ANN^2$	γ_{ANN}	0.018	0.007

$D*AH^2$	γ_{AH}	0.004	0.006

Table 2 presents the estimated coefficients of the cost function along with their standard errors. The coefficient of PL, α_1, the estimated labor share, is 0.553, while the actual mean of the labor share is 0.56. Similarly, the estimated capital share, 0.102, is very close to the mean of the actual capital share, 0.1. Since the cost shares add up to 1.0, the estimated materials share is 0.344. The R-Sq. of the regression is fairly high, 84%, indicating that the correlation between the natural log of costs and the variables on the right hand side of the regression is over 90%.

Using equations 4-11 and applying the relevant coefficients from the estimated cost functions, we compute the marginal costs of the outputs for branch and non-branch companies.

Table 3 – Marginal Costs of Each Output, Evaluated at the Means, by Distribution System

Output	Branch (D=0)	Other (D=1)
Life Policy	$207	$194
Term Life Amount of Insurance	0.0035	0.0014
Whole Life Amount of Insurance	0.0120	0.0087
Annuity Premiums	0.0089	0.0540
A&H Premiums	0.0800	0.1300

Table 3 shows that the fixed cost of acquiring (not including commissions) and issuing a life policy is $207 for companies which use branch office as their main distribution system and $194 for companies which use other distribution systems. The marginal costs expressed in terms of amount of insurance (term and whole) are higher for branch companies. For branch (non-branch) companies the marginal cost of whole life amount of insurance is $12 ($8.70) per thousand, while the marginal cost of term life amount of insurance is $3.50 ($1.40) per thousand. For both types of distribution systems, the marginal cost of whole life amount of insurance is greater than that of term life amount of insurance. The marginal costs of annuity and A&H

policies, however, are lower for branch companies. According to Table 3, as an illustration, the marginal cost of term (whole) life policy with $100,000 amount of insurance of a branch company is $557 ($1,407). Note that these marginal costs represent both the acquisition and maintenance costs of the policy; that is, these are the average present values of the total costs associated with a term (whole) life policy of the sample firms.

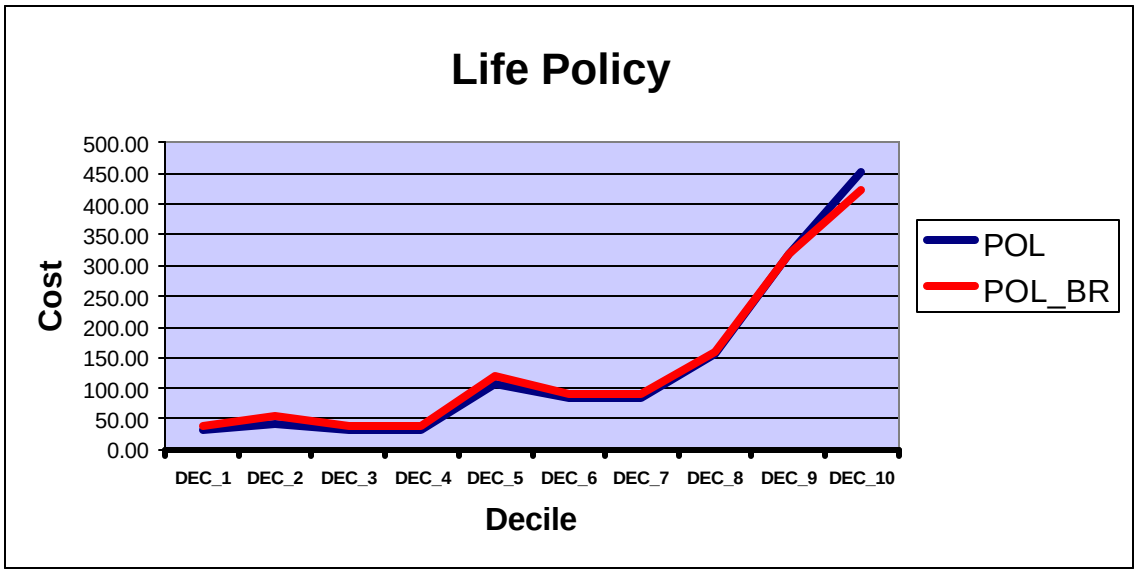
Table 4 and subsequent graphs show the marginal costs of the outputs by deciles of size of insurer (measured using total costs) for the two marketing systems.

Table 4 – Marginal Costs ($) of Each Output, Evaluated at the Means of Deciles

	DEC_1	DEC_2	DEC_3	DEC_4	DEC_5	DEC_6	DEC_7	DEC_8	DEC_9	DEC_10
POL	31.60	41.26	32.44	33.46	105.67	83.49	84.09	157.35	320.49	452.07
POL_BR	38.66	53.73	38.21	37.30	119.60	89.44	89.25	160.84	318.55	423.58
WAMT	41.81	17.54	7.81	6.74	7.70	8.99	7.76	4.72	13.66	15.65
WAMT_BR	13.10	8.80	4.86	4.12	5.71	7.32	6.10	3.62	12.16	14.98
TAMT	-12.10	3.38	2.97	2.18	3.42	3.35	3.92	1.70	4.84	8.84
TAMT_BR	2.57	3.00	1.84	1.07	1.23	1.08	1.39	0.58	1.41	2.40
ANN	294.66	69.92	9.72	20.65	8.22	0.92	0.71	3.13	-5.85	-22.63
ANN_BR	-76.03	41.78	22.00	67.29	55.79	35.00	24.52	50.90	55.70	129.46
AH	21.91	59.17	70.03	41.77	104.44	101.51	60.32	64.45	139.62	130.29
AH_BR	100.86	102.65	115.69	69.38	189.78	157.02	94.98	99.20	214.18	189.61

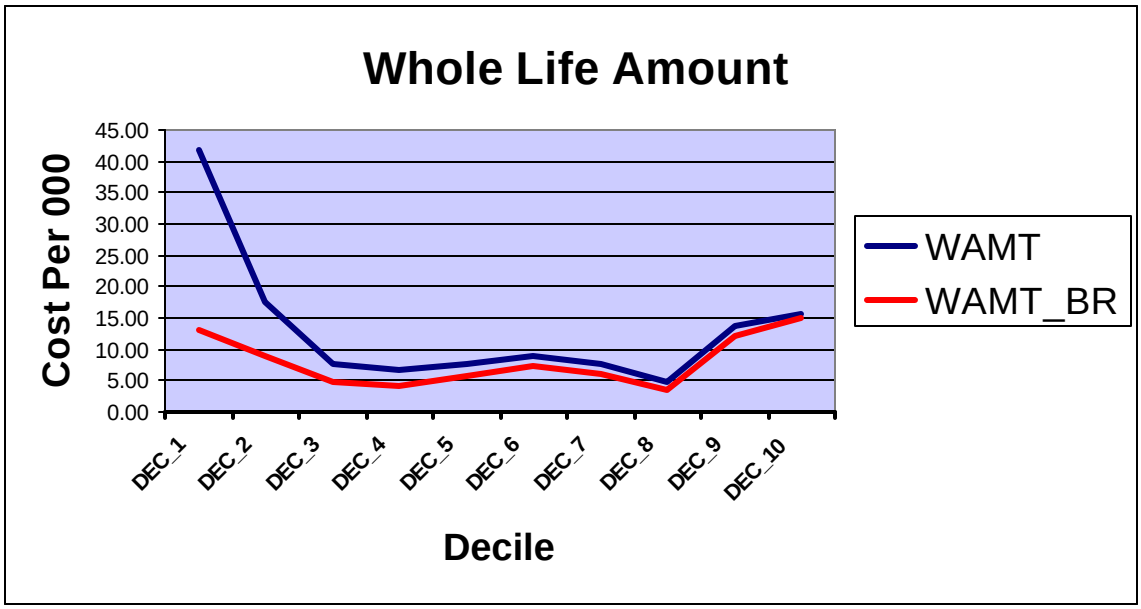
Notes:

1. POL_BR, WAMT_BR, TAMT_BR, ANN_BR, AH_BR represent the marginal cost of LIFPOL, WAMT, TAMT, ANN, and AH of ***branch*** companies, respectively.
2. POL, WAMT, TAMT, ANN, AH represent the marginal cost of LIFPOL, WAMT, TAMT, ANN, and AH of ***non-branch*** companies, respectively.



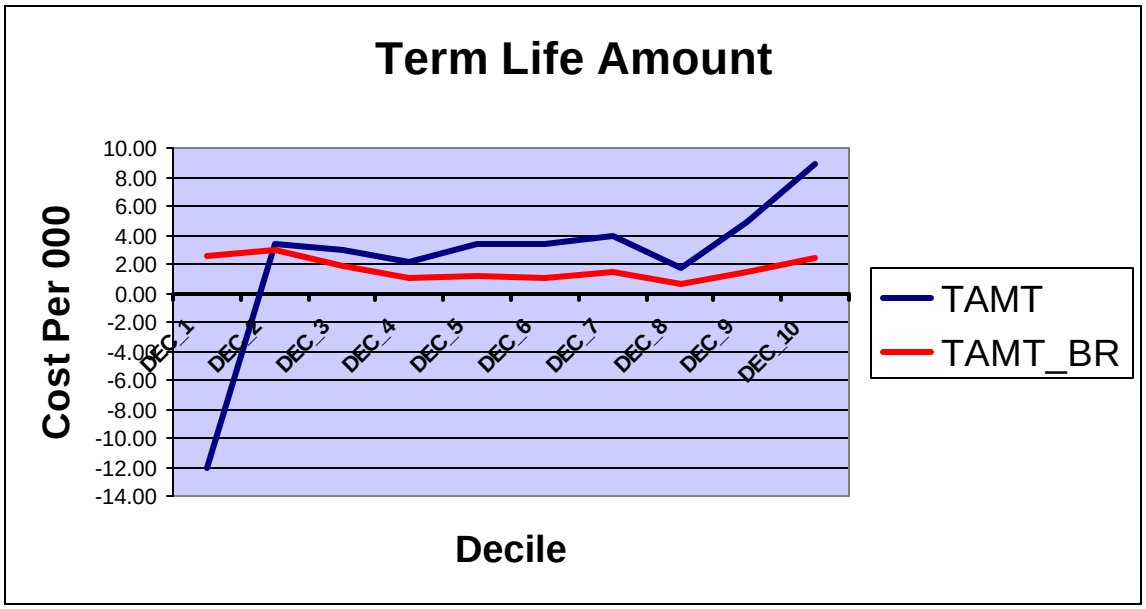
Notes:

1. POL_BR (POL) represents the average marginal cost of LIFPOL of ***branch (non-branch)*** companies, respectively.



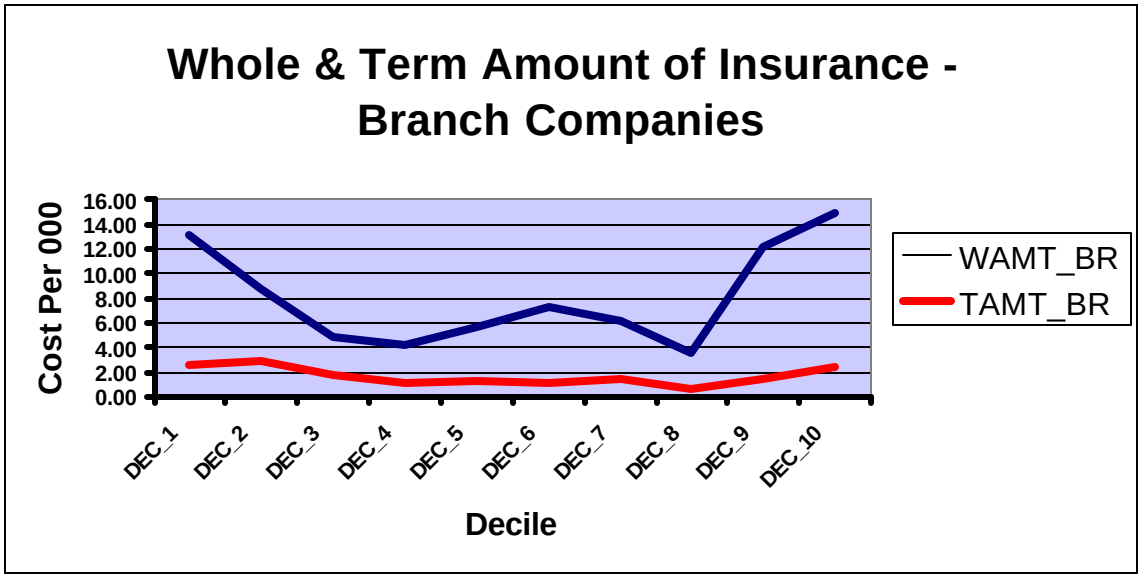
Notes

1. WAMT_BR (WAMT) represents the average marginal cost of WAMT of ***branch (non-branch)*** companies, respectively.



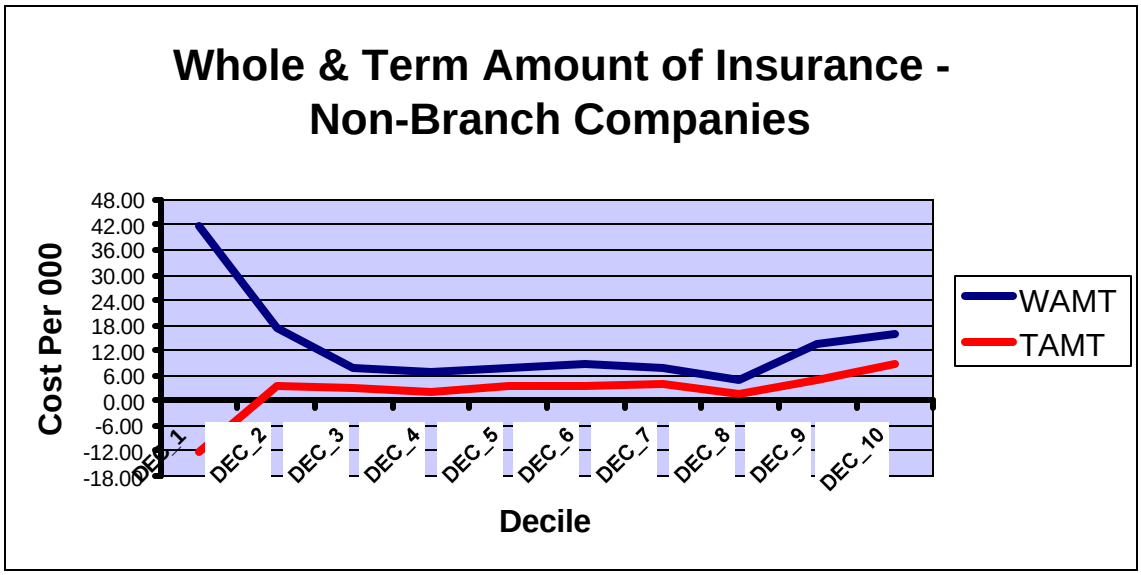
Notes:

1. TAMT_BR (TAMT) represents the average marginal cost of TAMT of ***branch (non-branch)*** companies, respectively.



Notes:

1. WAMT and TAMT represent the average marginal costs per thousand of amount of insurance of whole life and term life polices, respectively.



Notes:

1. WAMT and TAMT represent the average marginal costs per thousand of amount of insurance of whole life and term life polices, respectively.

Decile 1 includes all the companies for which total cost is less than the 10th percentile of total cost, decile 2 includes the companies for which total cost is between the 10th and 20th percentiles of total cost, and so forth. Decile 10 includes the largest insurers in the sample. The marginal costs of LIFPOL, TAMT and WAMT at the means of the first seven deciles are similar. However, for the largest insurers (decile 8 and up) the marginal costs are much higher. For example, the marginal cost per life policy in the 8th decile is more than twice marginal cost per life policy than that in the 7th quartile ($255 vs. $124). These results suggest that the Expense Table should be stratified according to size.

Comparing between branch and other distribution systems reveals that the marginal costs of branch companies are generally lower. However, for WAMT and LIFPOL, the differences seem to be remote for most deciles. In addition, the graphs show that the marginal cost of WAMT is consistently greater than the marginal cost of TAMT. This is expected since whole life policies incur additional administrative costs for policy loans, transfers to and from non-forfeiture status, payment of surrender values, policy changes involving changes in cash values, etc. That suggests that the Expense Table should be constructed separately for whole life and term life policies.

Table 5 presents the ratio of *actual* total costs to the *estimated* total costs (ACT (C)/EST (C)). This ratio measures how much the predicted total costs, according to the cost function, deviate from the actual total costs. We compute the estimated total costs by taking the exponent of the estimated ln (C) and multiplying it by the price of materials. The mean (median) of the ratio of actual costs to estimated costs is 1.24 (1.01). That is, for the median firm of the sample the predicted total cost using the estimated cost function deviates by 1% from the actual total costs. The table also indicates, as is common in regression analysis, that there are outliers in the

data, such as the two extremes – Min and Max in the table. In addition, as can be seen from the table, certain values for annuities are negative, indicating that the models used may not be appropriate for the extremes for annuity writers or that extreme variation occurs for the small relative amount of business. Looking at 80% of the data, from the 10^{th} to the 90^{th} percentiles we find that the ratio ranges from 0.44 to 2.3. Given the substantial variation across the sample firms, we believe that the variation of the ratio of actual costs to estimated costs is reasonable.

Table 5 – Ratio of estimated costs to actual costs

Percentile	ACT (C)/EST (C)
MEAN	1.24
Min.	0.11
10^{th}	0.44
20^{th}	0.59
25^{th}	0.66
30^{th}	0.70
40^{th}	0.89
Med.	1.01
60^{th}	1.17
70^{th}	1.41
75^{th}	1.63
80^{th}	1.77
90^{th}	2.31
Max.	6.04

V – Expense Table

To construct the Expense Table we rely on the marginal costs of the life insurance outputs, LIFPOL, WAMT and TAMT, which are evaluated at the sample means and appear in Table 3. The Expense Table is constructed separately for branch and non-branch firms. It also specifies the first year and subsequent years' charges for whole and term life policies.

Before proceeding with the analysis, it is important to note that the marginal costs represent the present value of all costs associated with life policies through their duration.

Therefore, the present value of the issuance and maintenance costs prescribed by the Expense Table must be equal to the marginal costs obtained from the cost function.

The first step of the analysis requires an assumption for the relative weights of acquisition/issuance and total maintenance costs. The second step consists of the computation of the yearly charges such that the present value of these charges equal the marginal cost of the life policy (term and whole) which was obtained from the estimated cost function. This step requires assumptions regarding interest rate/s and average duration of the policy.

The following analysis provides a step-by-step description of the construction of the Expense Table. The analysis consists of several assumptions. Each of the assumptions can be changed – the following is just an illustration of the Expense Table *given* these assumptions.

Step 1 – Separate total costs to issuance and maintenance costs.

Table 6 shows the marginal costs per policy and amount of insurance for whole life and term life policies and for branch and non-branch firms (the table replicates the results in Table 3).

Table 6 - Marginal Costs ($) of Each Output, Evaluated at the Means, by Distribution System

	Branch Firms		Non-Branch Firms	
	Whole	Term	Whole	Term
Policy	195.00	195.00	207.00	207.00
Amount ($000)	12.20	3.50	8.74	1.40

To separate total costs to acquisition/issuance and maintenance costs we assume that the acquisition (maintenance) expense account for 69.37% (30.63%)[5] of total costs. These ratios of acquisition and maintenance expense of total costs are provided by Milliman & Robertson, Inc.

[5] Note that the implied ratio of acquisition expense to maintenance expense is the industry's average. Generally, faster (slower) growing companies would incur a higher (lower) than average ratio of acquisition expense to maintenance expense.

Multiplying the marginal costs of LIFPOL, WAMT and TAMT by these ratios, we compute the present value of acquisition and maintenance expenses for branch and non-branch firms:

Table 7 – Present Value ($) of Acquisition and Maintenance Expenses of Term and Whole Life Policies, By Distribution System

	Branch Firms				Non-Branch Firms			
	Acquisition		Maintenance		Acquisition		Maintenance	
	Whole	Term	Whole	Term	Whole	Term	Whole	Term
Policy	135.30	135.30	59.70	59.70	143.60	143.60	63.40	63.40
Amount ($000)	8.50	2.40	3.70	1.10	6.10	0.90	2.70	0.40

Step 2 – Computation of the annual charges for the first year and subsequent years

The first year charge covers acquisition expenses whereas the subsequent yearly charges cover the maintenance expenses. This step relies on the following assumptions:

1. All charges are paid at the end of the year.

   This assumption is made to simplify the computation. Alternatively, one can assume that the charges are made at the beginning or middle of the year or are made on a monthly basis.

2. Acquisition expenses are recovered in the first year of the policy and maintenance expenses are recovered in subsequent years.

3. Average duration of whole (term) life policy is 14 (11) years. Acquisition expenses are assumed to be recovered over these periods.

   These assumptions are based on information provided by Milliman & Robertson, Inc. The duration of the whole and term life policies determines the period in which both the acquisition and maintenance expenses must be recovered. It follows that maintenance expenses associated with whole (term) life policies are recovered in 13 (10) years, because the first year charges cover acquisition expenses only. Since the

marginal costs in Table 7 equal the present value of acquisition and maintenance expenses, the present value of the first year charge must equal the marginal cost of acquisition expense. Also, the present value of the maintenance charges for 13 (10) years of whole (term) life policies must equal the marginal cost of maintenance expenses.

4. The discount rate of the yearly charges is 10%.

First Year (FY) Charges

Given assumptions (1) and (4), the FY charges for each policy is computed as acquisition expense per policy times one plus the discount rate, 1.1. Similarly, the FY charge per thousand of amount of insurance is computed as the acquisition expense per thousand of amount of insurance times 1.1, as shown in Table 8.

Table 8 – FY Charges ($) per Policy and Amount of Insurance for Branch and Non-Branch Firms

	Branch Firms		Non-Branch Firms	
	Whole	**Term**	**Whole**	**Term**
Policy	149 (=135.3*1.1)	149	158 (=143.6*1.1)	158
Amount ($000)	9.4 (=8.5*1.1)	2.6 (=2.4*1.1)	6.7 (=6.1*1.1)	1(=0.9*1.1)

Subsequent Years' Charges

Given assumptions (1) - (4), the maintenance costs are charged from year 2 until the policy is terminated. The charges, however, are determined so that their present value over the average duration period of the policy equals the maintenance costs obtained from the cost function, as presented in Table 7. To illustrate, the overall maintenance cost per whole life policy for branch firms is $59.70 (Table 7). The constant yearly charge from year 2 to year 14, denoted X, is the solution to the following formula:

59.7 = PV (X, 13yrs, 10%)/1.1

The PV formula in the brackets provides the present value of X for 13 years at a 10% discount rate from the end of year 14 to the end of year 1. This present value needs to be further discounted to the present, and therefore is divided by 1.1. Applying the same formula to the maintenance cost per amount of insurance, we get the yearly charge for the amount of insurance. Similarly, we compute the maintenance charges for term life policy, where the average duration of the policy is 11 years and repeat the analysis for non-branch firms. The results are reported in Table 9.

Table 9 – Maintenance Charges ($) per Policy and Amount of Insurance for Branch and Non-Branch Firms

	Branch Firms		Non-Branch Firms	
	Whole	**Term**	**Whole**	**Term**
Policy	9.3	10.7	9.8	11.4
Amount (000)	0.58	0.19	0.41	0.07

GLOSSARY

Variable Name	Definition	NAIC Annual Statement References (98 Format)
C	Insurance General Expenses Incurred	Exhibit 5; (L10, col. 5 – L10, col. 4)
TAMT	Amount of Term Life Insurance Sold During the Year	Exhibit of Life Ins.; L2 , col. 4 less line 29D, col. 2
WAMT	Amount of Whole Life Insurance Sold During the Year	Exhibit of Life Ins.; L29, col.. 2
ANN	Total Annuity Considerations	Exhibit 1 Pt 1; L20a, col. 4 + col. 7
A&H	Total Accident and Health Premiums	Exhibit 1 Pt 1; L20a, col. 8 + col. 9 +col.10
LIFPOL	Total number of life policies issued during the year	Exhibit of Life Insurance, L1 (col. 1+col.3+col.5+col.8)
P_l	Price of Labor = total labor expense/number of employee and agents	**Total Labor Expense =** Exh. 1 Pt 2, L31, Col. 1+Exh 5, col. 5-col. 4, (L2-L3.32+L7.1-L7.3)
P_k	Price of Capital = total capital expense/ number of employee and agents	**Capital Expense=** Exh. 5, col. 5-col. 4, (L1 + L5.5+L5.6+L9.1)
TOTPOL	Total number of policies sold and terminated = 2*Policies issued during year + Policies in Force (t-1) + Policies in Force (t)	**Polices in Force (t-1):** Exh. of Life Insurance, L1 (col. 1+col.3+col.5+col.8) + Exh. of Number of Policies, Contracts…; Supp. Contracts, L1 (col. 1-col.4) + Annuities, L1 (col. 1+col.2 +col.4) + A&H Insurance, L1 (Col.1+Col.3+Col.5) **Policies in Force (t):** Same exhibits and col.., L20, L9, L9, L10 **Policies Issued during year:** Same exhibits and col.., L2
P_m	Price of Materials = Materials Expense /TOTPOL	**Material Expense =** Exh. 5, col. 5-col. 4, (L4.1-L5.4 + L6.1-L6.8+L9.3)

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