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Do Life Insurers' Asset Allocation Strategies Influence Performance within the Enterprise Risk Framework?

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In this paper we examine the impact of asset allocation strategies on the investment performance of life insurers in the U.S. We are especially interested in comparing the effects of active portfolio management to the effects of passive holding strategies. We define three novel quantitative indices of static/dynamic strategies to represent important dimensions of the active/passive spectrum of investment strategies. The indices are computed from portfolio allocations reported in the firms' annual statement data. Using cluster analysis, we partition the population of life insurers into three groups, characterised by generally having static (passive), dynamic (active) and mixed asset allocation strategies, respectively. There are major differences among the three clusters in terms of risk profile, size and other factors. We model investment performance and allocations among the major holdings of bonds, stocks, cash and mortgages explicitly as simultaneously interacting phenomena. In order to isolate the effect of allocation strategies from the confounding effects of other risks, we imbed a spectrum of enterprise risks, treated as exogenous or predetermined, within the model framework of endogenously interacting performance and asset allocation variables. The strategy indicators are also exogenous variables. We find that the most active cluster enjoys the greatest relative performance, even controlling for allocations among asset classes.

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Introduction

In this paper we examine whether following an active or passive investment strategy influences the performance of U.S. life insurers. We assess the investment strategy of each life insurer on three novel indices of passivity. The indices evaluate the extent to which insurer asset allocation decisions remain static over time (exhibiting passivity) or dynamic (exhibiting activity). The framework for our analysis assumes that investment performance and asset allocation decisions mutually interact. That is, not only does the allocation of investment funds among asset classes affect performance, but also performance affects allocation. The analysis controls for a spectrum of enterprise risks. The time period, 1994–2003, includes a complete market cycle – bull market build-up, crash and start of recovery. Over this time period, we find that insurers that followed dynamic (active) investment strategies tended to have better

Table 1 Summary statistics for performance and major portfolio components (2003)

<i>Variable</i>	<i>Total</i>	<i>Mean</i>	<i>Median</i>	<i>Std. dev.</i>
Performance	\$174,489,547,484	\$172,933,149	\$4,838,230	\$747,374,648
Value of bond portfolio	\$1,960,197,200,000	\$1,816,679,487	\$49,530,537	\$7,732,795,447
Value of common stocks	\$116,507,892,047	\$107,977,657	\$198,295	\$553,340,443
Value of cash and short-term investments	\$76,290,899,626	\$75,610,406	\$5,216,026	\$446,910,045
Value of mortgage portfolio	\$253,581,686,008	\$251,319,808	\$0	\$1,500,268,531
Value of preferred stocks	\$30,764,247,194	\$28,511,814	\$0	\$226,212,460
Value of real estate portfolio	\$14,060,741,056	\$13,935,323	\$0	\$136,181,103
Total invested assets ^a	\$2,560,550,600,000	\$2,537,711,156	\$88,833,153	\$10,756,803,639

Source: Annual statements of all U.S. life insurers in the NAIC database.

^aIncludes all other invested assets.

investment performance than insurers that followed static (passive) strategies, even after controlling for asset class allocations and enterprise risks.

By performance, we essentially mean realised and unrealised income from invested assets. Table 1 summarises the performance and major asset components of the life industry's investment portfolio for 2003. Our main model explicitly posits that performance and asset allocations are mutually interrelated. Thus, we employ a simultaneous equations model for performance and four of the major components of the investment portfolio shown in Table 1 (combining common and preferred stocks and omitting real estate to avoid a singularity). Because investment results are strongly related to risks assumed, we include appropriate controls for a range of important enterprise risks of life insurers, such as product, asset, operational, regulatory, market discipline and financial risks, as detailed in Baranoff and Sager¹ and in Baranoff *et al.*² We also include controls for size, such as total assets and premiums written.

As can be seen, the largest asset class by value is bonds. Second is mortgages followed by stocks, cash, preferred stocks and real estate. Figure 1 shows the trend in the performance and asset components of life insurers from 1994 to 2003. These charts use industry totals. However, this large portfolio is aggregated from about 1,000 individual companies, which employ various investment strategies. Therefore, it is interesting to see which asset allocation strategy provides greater performance.

In our analysis, we first examine the period 1994–2003 for evidence of dynamic changes in the relationship between the investment portfolio mix and portfolio performance for the entire industry. The focus is on aggregate asset classes (total bonds, total stocks, total cash and short-term investments, total mortgages) and the aggregate investment income of the whole insurer portfolio. We find evidence of year-to-year variation that argues against fitting one overall model for the entire period. Therefore, we provide the analysis on a year-by-year basis and show selected years only.

¹ Baranoff and Sager (2006, 2007).

² Baranoff *et al.* (2007).

Figure 1. Trends in asset class proportions, 1994–2003, aggregate industry data.

Second, we divide the population of life insurers into three groups. Each group is fairly homogeneous in its asset allocation strategy. The first group pursues a static allocation strategy; the second is dynamic; and the third is intermediate, or mixed. To group insurers, we use cluster analysis based on three novel indices of passivity/activity in allocation decisions that we created. In portfolio management, the phrase “passive investment strategy” suggests the strategy of an index fund, which attempts to match the composition, and hence performance, of a market index, such as the S&P 500. The literature entertains a broader notion of passivity/activity, but focused on the common idea of passively tracking some pre-existing pattern of asset allocations.³ Our passivity indices are motivated by the latter idea. We are not privy to boardroom discussions in which investment strategy may be set. Therefore, we look to annual statement figures to reveal the insurer’s strategy. The three indices measure the extent to which available investment funds are allocated to asset classes in the same proportions

³ For example, Ibbotson and Kaplan (2000).

over time, or in proportion to redemptions of asset classes, or in proportion to the values of portfolio asset classes, respectively. Since each of our indices measures the degree to which some aspect of allocation policy remains static over time, we shall refer to our indices as *static/dynamic* indices, to distinguish them from the broader class of passive/active indices. But we emphasise that they do represent aspects of investment behaviour that would generally be considered passive/active strategies.

- Static/Dynamic Index 1 shows whether insurers invest in asset classes in the same proportions from year to year. We interpret a pattern of allocating available investment funds in line with the insurer's historical portfolio proportions of bonds, stocks, mortgages, cash and real estate as a revealed preference for a static allocation strategy.
- Static/Dynamic Index 2 shows whether insurers invest in asset classes in the same proportions as they redeem assets. We interpret evidence that an insurer reinvests redemptions back into the same asset classes, in the same proportion as redemptions, as a static strategy.
- Static/Dynamic Index 3 shows whether insurers invest in asset classes to maintain their existing portfolio proportions. This static strategy eschews deviations from existing percentages for bonds, stocks, mortgages, cash and real estate in the portfolio. This strategy is consistent with Myers.⁴

A low score on an index indicates static strategy; a high score indicates dynamic strategy. An insurer with a low score on one index tends to have low scores on the other indices.

Third, we model the performance–allocation interaction for the life insurance industry and include indicators for our allocation strategy clusters to gauge if performance varies from one strategy to another. We explicitly account for the possibility that performance may interact reciprocally with allocation by modelling both allocation and performance as endogenous. We adjust for the effects of both internal and external risk attributes by including several risk proxy measures as controls, treated as exogenous or predetermined. Internal risk measures include financial leverage, asset risk (opportunity asset risk, per Baranoff *et al.*⁵), product risks (represented by premiums in different lines of insurance, which also proxy for liabilities in asset-liability matching, Williamson,⁶ Baranoff and Sager,⁷ and more general variables in Titman and Wessels⁸), operational risks (represented by organisational structure and membership in a group of affiliated companies, and use of derivatives – also operational risk per Cummins *et al.*,⁹). External risk measures include market discipline (A.M. Best Ratings), regulatory pressure (risk-based capital)

⁴ Myers (2001).

⁵ Baranoff *et al.* (2007).

⁶ Williamson (1985, 1988).

⁷ Baranoff and Sager (2002, 2003).

⁸ Titman and Wessels (1988).

⁹ Cummins *et al.* (2006).

and investment opportunities (see Colquitt *et al.*,¹⁰ Colquitt and Hoyt,¹¹ Baranoff and Sager¹²).¹³ For quantifiable measures of asset allocation decisions, we take the invested asset portfolio mix. Since the endogenous performance and asset class variables are in dollar units and so are related to the size of the insurer,¹⁴ we also include size as a control in the form of the logarithm of total assets and the logarithm of total premiums.

To our knowledge, a study of the temporal dynamics of asset allocation among multiple asset classes and the relationship between financial performance and allocation decision strategies within the enterprise risk framework has not been undertaken previously for the U.S. life insurance industry. There are various studies for financial institutions such as that of Binay,¹⁵ but none of them singles out the life industry using insurers' statutory data as we do. Also, many of them concentrate on stocks and or comparative analysis of various institutional investors. An example is Blake *et al.*¹⁶ who analysed asset allocation dynamics and pension fund performance, using proprietary data on more than 300 U.K. pension funds' asset holdings. They focused on the importance of strategic asset allocation and timing decisions for the variability of performance over time. They examine whether the strategic decision to add funds to an asset class has significant impact on the performance of the asset mix and find that "most funds would have been better off with strategic asset allocations placed in passive index funds". In the same vein, using balanced mutual fund and pension fund data, Ibbotson and Kaplan¹⁷ tried to estimate the proportion of performance attributable to the effect of asset allocation policy. They find, using balanced mutual funds and pension fund data, that "about 90 per cent of variability in returns of a typical fund across time is explained by policy, about 40 per cent of the variation of returns among funds is explained by policy, and on average about 100 per cent of the return level is explained by the policy".¹⁸ Theoretical work in the area is mostly in relationship to optimal asset allocation portfolio in light of various risks expanding the mean-variance analysis of Markowitz¹⁹ and relating to Brennan *et al.*²⁰ who used the phrase "strategic asset allocation" to describe this farsighted response to time-varying investment opportunities. In the vein of theoretical and empirical work, a summary literature review is

¹⁰ Colquitt *et al.* (1999).

¹¹ Colquitt and Hoyt (1997).

¹² Baranoff and Sager (2002, 2003).

¹³ It is important to note that the insurance industry is highly regulated by the states. Each state has an investment model law that restricts the amounts to be invested in various investment categories. Since each state adopts its own investment model law regulation, there are variations among the states.

¹⁴ Baranoff *et al.* (1999, 2004).

¹⁵ Binay (2005).

¹⁶ Blake *et al.* (1999).

¹⁷ Ibbotson and Kaplan (2000).

¹⁸ More examples of related work are: Chen *et al.* (2000); Grauer and Shen (2000) who looked into whether constraints improve portfolio performance; Daniel *et al.* (1997); Del Guercio (1996); Grinblatt and Titman (1989a, b); Jensen (1968), to mention just a few.

¹⁹ Markowitz (1952).

²⁰ Brennan *et al.* (1997).

provided by Campbell *et al.*,²¹ Chan and Viceira,²² Bajeux-Besnainou *et al.*²³ and Elton and Gruber²⁴ among more recent studies. Expanding upon Merton,²⁵ these authors study optimal asset allocation relative to risk factors in a multi-period framework. Risk factors and other determinants are incorporated in our study here.

Unlike other studies in the area of mutual funds or large pension funds, where one management makes the asset allocation decisions, we cannot say that there is one unified decision making here, as each insurer or group of insurers has its own management team. But we extrapolate an overall decision for this large industry by clustering the insurers into the three static/dynamic groups noted above.

The next section discusses the methodology and data. The following section highlights the results and the final section summarises and interprets the findings.

Data, variables and methodology

We use data for the period 1994–2003 obtained from life insurers' annual statements submitted to the National Association of Insurance Commissions (NAIC) and A.M. Best Ratings.

We employ a simultaneous equation model to assess the interrelationship between financial performance and allocation of invested assets. In the structural form of the model below, we have a financial performance measure P_t , and four other endogenous variables. P_t is the sum of:

- gross income from invested assets;
- gross realised capital gains/losses from invested assets;
- gross unrealised capital gains/losses from invested assets.

Y_1, Y_2, Y_3, Y_4 are either the amounts or proportions of investment funds allocated to various asset classes – bonds, stocks, mortgages, cash and short-term investments, respectively.²⁶ Since the sum of all asset allocation proportions is 1, it is necessary to omit one asset class in order to avoid a singularity. In this illustration, real estate is omitted. There is also a vector of exogenous/predetermined enterprise risk variables X_t , and random errors ε_t . The number of endogenous and predetermined variables may expand or contract depending on our particular application of the model.

²¹ Campbell *et al.* (2003).

²² Chan and Viceira (2003).

²³ Bajeux-Besnainou *et al.* (2003).

²⁴ Elton and Gruber (2000).

²⁵ Merton (1969, 1971, 1973).

²⁶ We investigated two forms of the endogenous variables – as ratios, or as gross levels – for example, performance as total income or performance as total income divided by invested assets, or bonds as total bonds or bonds as bonds divided by invested assets. In general, the ratio models have lower explanatory power because division by invested assets implicitly removes size as an explanatory factor, whereas the level models incorporate size as an explicit control. Nevertheless, rather similar patterns are obtained, and in the interest of space, we report on only the level model forms here.

Table 2 Predetermined/exogenous/instrumental enterprise risk variables used in the study

<i>Variable</i>	<i>Description</i>
Logarithm of total premiums	Proxy for size
Logarithm of total assets	Proxy for size
Opportunity asset risk	A volatility-of-returns measure, per Baranoff <i>et al.</i> ^a
Regulatory asset risk	An insolvency risk measure, like C-1 in Life RBC law
Leverage	Total liabilities/total assets
Investment opportunity	Percent change in total assets from 3 years ago, per Colquitt <i>et al.</i> ^b
RBC ratio	Risk-based capital ratio = $100 \times \text{book value of capital} / (2 \times \text{Authorised capital})$, per Life RBC law
Capital ratio	Book value of capital/total assets
Annuity premium proportion	Annuity premiums/total premiums
Health premium proportion	Health premiums/total premiums
Life premium proportion	Life premiums/total premiums
Derivative use? (0/1)	Indicator of derivative activity by insurer (1 = Yes), per Colquitt and Hoyt ^c
Stock company? (0/1)	Organisational type (1 = stock, 0 = mutual)
In affiliated group? (0/1)	Indicator for member of affiliated group (1 = yes)
Best rating	Likert scale treatment of A.M. Best Rating, in the manner of Colquitt <i>et al.</i> ^d

^aBaranoff *et al.* (2007).^bColquitt *et al.* (1999).^cColquitt and Hoyt (1997).^d*Ibid.*

Structural Model

$$\begin{aligned}
 P_t &= \alpha_0 + \beta_{01} Y_{1t} + \beta_{02} Y_{2t} + \beta_{03} Y_{3t} + \beta_{04} Y_{4t} + \gamma'_0 X_{0t} + \varepsilon_{0t} \\
 Y_{1t} &= \alpha_{10} + \beta_{11} P_t + \gamma'_1 X_{1t} + \varepsilon_{1t} \\
 Y_{2t} &= \alpha_{20} + \beta_{21} P_t + \gamma'_2 X_{2t} + \varepsilon_{2t} \\
 Y_{3t} &= \alpha_{30} + \beta_{31} P_t + \gamma'_3 X_{3t} + \varepsilon_{3t} \\
 Y_{4t} &= \alpha_{40} + \beta_{41} P_t + \gamma'_4 X_{4t} + \varepsilon_{4t}
 \end{aligned}$$

The main reason for using a simultaneous equations model is to capture the reality that allocations to each asset class are influenced by portfolio performance, just as portfolio performance is affected by asset allocation, as well as by given predetermined/exogenous variables representing the enterprise risk space of the insurers. Our implementation of the simultaneous equation model is two-stage least squares. Two-stage least squares is well known to be consistent, although not necessarily efficient.

In the first stage for the industry as a whole, *all* predetermined variables from Table 2 are used as instruments for each of the endogenous variables. The trends of some of these instruments are featured in the various trend-graphs in Figure 2. The first stage analysis yields a reduced form estimate that expresses each endogenous variable as a function of all instruments noted in Table 2. In the second stage, each

Figure 2. Trends in enterprise risk variables, 1994-2003, Industry Data.

Table 3 Summary statistics for the enterprise risk predetermined/exogenous/instrumental variables (2003, $N = 1,009$)

<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>Std. dev.</i>
Logarithm of total premiums	17.0899	17.4766	3.1869
Logarithm of total assets	18.6923	18.4651	2.8319
Opportunity asset risk	6,538,042	257,558	24,478,117
Regulatory asset risk	65,744,805	1,328,220	285,000,000
Leverage	0.6717	0.7723	0.2818
Investment opportunity	0.5879	0.1599	4.6944
RBC ratio	2,036	422	12,037
Capital ratio	0.3232	0.2157	0.2830
Annuity premium proportion	0.1710	0.0001	0.3042
Health premium proportion	0.2841	0.0345	0.3746
Life premium proportion	0.3836	0.2599	0.3784
Derivative use? (0/1)	0.1635	0	0.3700
Stock company? (0/1)	0.9158	1	0.2779
In affiliated group? (0/1)	0.7522	1	0.4319
Best rating	11.0221	11	2.1045

endogenous variable used on the right-hand side of the Structural Model above is replaced by its reduced form instrumental estimate. However, not all of the predetermined/exogenous variables listed in Table 2 are used in $\mathbf{X}_t$ in stage 2. Stage 2 includes the asset allocation strategy indicators developed later in this section. Each structural equation in the model uses a different selection of the most relevant predetermined/exogenous predictors, as suggested by the subscripts in $\mathbf{X}_{0t}$, $\mathbf{X}_{1t}$, $\mathbf{X}_{2t}$, $\mathbf{X}_{3t}$, $\mathbf{X}_{4t}$ (Table 3).

We investigated the possibility of constructing a single model for the entire time period for the whole industry. In that related model, the performance equation from the simultaneous equation model was estimated for the entire study period with time-varying coefficients and with an expanded $\mathbf{X}_t$ predictor set. The GEE (generalised estimating equations) approach was used to account for autocorrelation in our panel data set. Time invariance is signalled by lack of significance in the interaction between a predictor and the year variable. For each predictor tested, time-invariance was strongly rejected. We then ran the model for each year separately, for the industry as a whole and for each of our three clusters. The separate-year analysis can reveal historically dynamic changes as year-to-year changes in the coefficients, and within the clusters. We found that *not* all asset components contribute significantly to explaining performance in all the years, but that performance is significant in each of the asset component equations in all years. Moreover, the coefficients appeared qualitatively to vary dynamically from year to year. We also found significant differences among the clusters. In the interest of conserving space, we curtail detailed exposition of most of these results, except for the performance equation results by cluster. We now focus on our main question, which is whether allocation strategies matter for performance.

As noted, we are interested primarily in the effect of static and dynamic asset allocation decisions on the financial performance. Since we lack direct access to

insurer investment policies, we infer strategy from data on insurer invested assets and their year-to-year changes:

1. For one type of static strategy, the firm buys asset classes each year in the same proportions as it bought asset classes the previous year. We construct an index to assess this type of passivity by aggregating the absolute differences between the current year's and the previous year's corresponding proportions of new purchases of bonds, stocks, mortgages, etc. Averaged across years, this measure is StaticDynamicIndex1. In symbols,

$$\text{StaticDynamicIndex1 for year } t = \frac{1}{p} \sum_{i=1}^p \left| \frac{I_{i,t}}{\sum_{i=1}^p I_{i,t}} - \frac{I_{i,t-1}}{\sum_{i=1}^p I_{i,t-1}} \right|,$$

where $I_{i,t}$ = amount invested in asset class i in year t , and p = number of asset classes.

2. A second type of static strategy is to invest in asset classes in the same proportions as those asset classes are redeemed. Absolute differences between the current year's proportions of new purchases of bonds, stocks, etc. and the current year's corresponding proportions of sold, matured or redeemed bonds, stocks, etc. are aggregated. Averaged across years, this yields StaticDynamicIndex2. In symbols,

$$\text{StaticDynamicIndex2 for year } t = \frac{1}{p} \sum_{i=1}^p \left| \frac{I_{i,t}}{\sum_{i=1}^p I_{i,t}} - \frac{S_{i,t}}{\sum_{i=1}^p S_{i,t}} \right|,$$

where $S_{i,t}$ = amount sold, matured or redeemed from asset class i in year t .

3. A third type of static strategy is to purchase asset classes in the same proportion as the entire existing portfolio allocation of those asset classes in the firm portfolio. We aggregate absolute differences between the current year's proportions of new purchases of bonds, stocks, etc. and the corresponding proportions of those asset classes in the total market value²⁷ of the firm's portfolio. Averaged across years, this yields StaticDynamicIndex3. In symbols,

$$\text{StaticDynamicIndex3 for year } t = \frac{1}{p} \sum_{i=1}^p \left| \frac{I_{i,t}}{\sum_{i=1}^p I_{i,t}} - \frac{V_{i,t}}{\sum_{i=1}^p V_{i,t}} \right|,$$

where $V_{i,t}$ = total value of asset class i in year t .

A low value on one or more of the indices suggests an investment philosophy that reflects a static strategy. High values on all three indices suggest that the firm employs a dynamic investment strategy. Many firms have low scores on all three indices. To

²⁷ Mortgages are valued at book; all other assets at market value.

Table 4 Summary statistics of the static/dynamic indices by cluster, 1994–2003

<i>Cluster</i>	<i>N</i>	<i>Variable</i>	<i>Mean</i> (%)	<i>Median</i> (%)	<i>Std. dev.</i> (%)	<i>Minimum</i> (%)	<i>Maximum</i> (%)
(1) Most Static	823	StaticDynamicIndex1	1.94	1.83	1.65	0.00	10.00
		StaticDynamicIndex2	2.42	2.09	2.29	0.00	13.49
		StaticDynamicIndex3	1.78	1.54	1.70	0.00	8.67
(2) Most Dynamic	303	StaticDynamicIndex1	14.91	14.24	6.97	0.00	40.00
		StaticDynamicIndex2	13.10	12.90	6.38	0.00	40.31
		StaticDynamicIndex3	14.08	12.46	8.20	0.00	61.15
(3) Mixed	526	StaticDynamicIndex1	6.86	6.50	2.62	0.00	17.94
		StaticDynamicIndex2	5.41	5.11	2.73	0.00	14.15
		StaticDynamicIndex3	6.96	6.49	3.68	0.00	25.33

obtain a basis for classifying an insurer as a static or dynamic investor throughout the study period, we average each index by insurer over the years of the study.

We then examine whether the life insurance industry could be divided into natural groups on the basis of the three static/dynamic indices. We use hierarchical agglomerative cluster analysis (Ward's method) and find the industry can be divided into three groups.²⁸ Firms in the first group, Cluster 1, have generally low scores on all three indices. We characterise them as static investors. Cluster 2 is characterised by high scores on all three indices. We characterise them as dynamic investors. Cluster 3 firms have medium scores on all three indices. They are mixed – partly static, partly dynamic. Table 4 shows some summary statistics on the indices by cluster.

Because of the importance of the asset allocation strategy clustering to this research we show the differences among static and dynamic clusters in Tables 5 and 6 for 2003 only. Compared with the static cluster, the dynamic cluster most notably tends to have smaller insurers that assume less financial risk (leverage and capital ratio), less product risk (sell more life insurance and less health insurance), but assume more asset risk (as proxied by the opportunity asset risk measure of Baranoff *et al.*²⁹ – also note the much larger stock portion of the portfolio and much smaller bond portion). In addition, dynamic insurers have greater risk-based capital exposure (lower RBC ratio), lower rate of affiliation with insurer groups, greater prevalence of stock companies and less use of derivatives.

Having determined three relatively homogeneous clusters of insurers practicing investment allocation strategies that occupy different points on the static/dynamic spectrum, we next examine the impact of static vs. dynamic allocation strategy on performance.

²⁸ More than three groups capture additional aspects of strategic differences among insurers, but three groups seem both simple and suitable.

²⁹ Baranoff *et al.* (2007).

Table 5 Summary statistics for performance, its components and major portfolio components by strategic asset allocation cluster (2003)

<i>Cluster</i>	<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>Std. dev.</i>
(1) Most static (<i>N</i> = 528)	Performance/invested assets	0.0584	0.0589	0.0286
	Bonds/invested assets	0.8134	0.8784	0.2120
	Common stocks/invested assets	0.0172	0.0001	0.0536
	Cash and short-term inv/invested assets	0.1187	0.0424	0.1927
	Mortgages/invested assets	0.0257	0.0000	0.0644
	Preferred stocks/invested assets	0.0083	0.0000	0.0223
	Real estate/invested assets	0.0010	0.0000	0.0043
(2) Most dynamic (<i>N</i> = 115)	Performance/invested assets	0.0958	0.0608	0.1967
	Bonds/invested assets	0.3733	0.3630	0.2768
	Common stocks/invested assets	0.2606	0.0766	0.4402
	Cash and short-term inv/invested assets	0.2816	0.1999	0.2707
	Mortgages/invested assets	0.0615	0.0000	0.1227
	Preferred Stocks/invested assets	0.0237	0.0000	0.0583
	Real estate/invested assets	0.0151	0.0000	0.0380
(3) Mixed (<i>N</i> = 346)	Performance/invested assets	0.0700	0.0635	0.0737
	Bonds/invested assets	0.7072	0.7497	0.2399
	Common stocks/invested assets	0.0871	0.0240	0.1453
	Cash and short-term inv/invested assets	0.1276	0.0535	0.1938
	Mortgages/invested assets	0.0471	0.0000	0.0862
	Preferred stocks/invested assets	0.0157	0.0000	0.0401
	Real estate/invested assets	0.0049	0.0000	0.0184

Cluster counts differ from those of Table 4 because of the effect of missing values.

Statistical analysis

First, we run the Structural Model for each year for the whole industry. We include indicator variables for the clusters exhibiting the least and the most dynamic allocation strategies (clusters 1 and 2, respectively), with the omitted cluster 3 providing a baseline. Strategy matters if the coefficient of one or the other of these clusters is significant. We find that strategy mattered during the run-up of the Millennial stock market boom and afterward, but not before. Table 7 displays the results for the performance equation of the Structural Model for selected years (omitting the results for the bonds, stocks, cash and mortgages equations).³⁰ The most dynamic strategy is statistically significant for most of the displayed years. After controlling for portfolio component sizes, insurer size and other controls, we find that insurers with the most dynamic strategies (cluster 2) enjoyed higher performance than those that practiced the most static strategy (cluster 1). Curiously, cluster 1 enjoyed higher performance than cluster 3, which practices a medium, or mixed, static and dynamic strategy, although the advantage of the most static strategy was frequently not significant.

³⁰ In all the results for the structural equations for the asset components, performance always plays an important role. The results are available.

Table 6 Summary statistics for predetermined/exogenous enterprise risk space instrumental variables by strategic asset allocation cluster (2003)

<i>Cluster</i>	<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>Std. dev.</i>
(1) Most static (<i>N</i> =528)	Logarithm of total premiums	17.6517	17.9516	2.8515
	Logarithm of total assets	19.1291	18.9941	2.7494
	Opportunity asset risk	6,108,572	346,684	20,781,501
	Regulatory asset risk	56,344,093	1,473,987	243,181,499
	Leverage	0.7138	0.8358	0.2667
	Investment opportunity	0.6831	0.1808	5.9156
	RBC ratio	1,580	408	4,520
	Capital ratio	0.2809	0.1619	0.2650
	Annuity premium proportion	0.2110	0.0020	0.3295
	Health premium proportion	0.2770	0.0286	0.3760
	Life premium proportion	0.3641	0.2184	0.3711
	Derivative use? (0/1)	0.1747	0	0.3800
	Stock company? (0/1)	0.5930	1	0.4916
	In affiliated group? (0/1)	0.5079	1	0.5002
	Best rating	11.0955	11	2.1820
(2) Most dynamic (<i>N</i> =115)	Logarithm of total premiums	14.5282	14.6318	2.8676
	Logarithm of total assets	16.6660	16.2309	2.2894
	Opportunity asset risk	4,224,925	37,042	26,577,682
	Regulatory asset risk	38,821,066	449,590	242,450,501
	Leverage	0.5437	0.6188	0.3082
	Investment opportunity	0.8629	0.1099	4.6452
	RBC ratio	1,335	414	4,076
	Capital ratio	0.4320	0.3917	0.3223
	Annuity premium proportion	0.0642	0.0000	0.2066
	Health premium proportion	0.2620	0.0160	0.3809
	Life premium proportion	0.4847	0.5389	0.4292
	Derivative use? (0/1)	0.0079	0	0.0887
	Stock company? (0/1)	0.3696	0	0.4835
	In affiliated group? (0/1)	0.2112	0	0.4089
	Best rating	9.1463	9	3.2292
(3) Mixed (<i>N</i> =346)	Logarithm of total premiums	17.2939	17.5914	3.2427
	Logarithm of total assets	18.9258	18.6387	2.7129
	Opportunity asset risk	8,331,574	332,665	29,152,226
	Regulatory asset risk	92,761,572	2,455,650	355,834,158
	Leverage	0.6711	0.7652	0.2698
	Investment opportunity	0.3485	0.1520	1.7323
	RBC ratio	2,544	442	18,062
	Capital ratio	0.3344	0.2448	0.2741
	Annuity premium proportion	0.1552	0.0008	0.2868
	Health premium proportion	0.2925	0.0768	0.3624
	Life premium proportion	0.3866	0.3061	0.3654
	Derivative use? (0/1)	0.1853	0	0.3891
	Stock company? (0/1)	0.5798	1	0.4941
	In affiliated group? (0/1)	0.5057	1	0.5004
	Best rating	10.8392	11	2.3830

Table 7 Structural equation for performance (1999–2003)

<i>Variable</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>
	<i>Parameter estimate</i>	<i>Parameter estimate</i>	<i>Parameter estimate</i>	<i>Parameter estimate</i>	<i>Parameter estimate</i>
Intercept	−111,321,016	−116,352,399	−422,706,796	406,925,815	−443,391,624
In Cluster 1? (0/1)	3,742,223	24,766,283*	7,815,200	43,947,918*	37,413,134**
In Cluster 2? (0/1)	40,541,330*	53,443,590*	22,921,258	80,519,044*	105,970,486*
Value of bond portfolio	0.0403*	0.0486*	−0.0141	0.1011*	0.0377
Value of stock portfolio	0.0605	−0.0501	−0.0434	0.0784	0.0320
Value of cash and short-term investments	0.3418*	−0.1196	0.4623	−0.2632	−0.1230
Value of mortgage portfolio	0.2429*	0.3118*	0.4290*	−0.0440	0.3282***
Log of total assets	7,170,578	8,245,472	20,253,209*	−18,940,631*	24,283,476
Capital/total assets	−14,066,854	13,206,715	79,195,294**	−82,444,464***	79,470,801
Annuity premiums/total premiums	−11,493,905	−25,320,959	46,195,706	−76,009,051*	−63,069,849***
Stock company? (0/1)	−17,187,479	−64,346,940*	37,867,333	−84,795,597	−51,791,072
In affiliated group? (0/1)	2,032,863	15,140,938	−9,924,873	26,985,969	5,318,379
<i>R-square</i>	0.972	0.952	0.919	0.902	0.919

* p -value < 0.05 ; ** $0.05 < p$ -value < 0.10 ; *** $0.10 < p$ -value < 0.15 .

To our conclusion that dynamic portfolio management seems to have value for performance, it may be objected that the market cycle should be considered. For example, during a bull market, insurers that invest substantial amounts in stocks might be expected to perform better than insurers that hold relatively more bonds. In a bear market, the reverse performance may be expected. To this objection, we note first that the years displayed in Table 7 cover a bull market run-up to 2000, crash in 2001–2002 and the beginning of the recovery in 2003, and yet the advantage to dynamic allocation persists. Second, and more importantly, the analysis shown in Table 7 controls for the four most significant components of the asset portfolio. Thus, the analysis compares clusters 1 and 2 for insurers that are statistically equalised in terms of portfolio composition. Thus the advantage enjoyed by dynamic asset allocation cannot be attributed to holding more or fewer stocks or bonds. The analysis suggests that the advantage of dynamic allocation may originate from modifying the firm's historical investment patterns to adapt to changing investment circumstances. To be sure, some insurers may change inappropriately – switching to stocks just before a market peak, for example. However, the persistent advantage enjoyed by dynamic allocators suggests that inappropriate switchers may be outnumbered by appropriate switchers.

We also ran the Structural Model separately for each of the three static/dynamic-based clusters. Of course, we must drop the cluster indicators, but the models are otherwise the same. Results for the performance equation are shown for clusters 1 and 2 in Table 8.

By examining differences between the coefficients of static and dynamic investors, we can determine how the roles of the asset portfolios differentially affect performance

Table 8 Structural equation for performance, by cluster (1999–2003)

Variable	1999	2000	2001	2002	2003
	Parameter estimate	Parameter estimate	Parameter estimate	Parameter estimate	Parameter estimate
<i>Cluster 1 – Most static</i>					
Intercept	–85,880,000	–82,260,000	–680,100,000	649,390,000	–174,200,000
Value of bond portfolio	0.0598*	0.0524*	–0.0427	0.1077*	0.0499
Value of stock portfolio	0.1361**	–0.1044	–0.0089	0.4825	–0.4264
Value of cash and short-term investments	0.2156*	0.0752	0.9018	–0.1550	0.0261
Value of mortgage portfolio	0.1457*	0.2631*	0.4458*	–0.1776**	0.3238
Log of total assets	5,939,960	8,314,282	34,370,698**	–29,310,000**	15,695,368
Capital/total assets	10,971,963	26,083,898	117,130,000	–139,500,000	30,154,229
Annuity premiums/total premiums	–5,189,366	–29,750,000	34,975,819	–87,920,000**	–107,400,000**
Stock company? (0/1)	–25,930,000**	–97,530,000*	40,007,919	–89,210,000	–137,000,000**
In affiliated group? (0/1)	2,393,059	27,742,413**	–15,740,000	26,688,934	29,986,040
R-square	0.990	0.969	0.801	0.838	0.882
<i>Cluster 2 – Most dynamic</i>					
Intercept	62,233,688	–32,431,694	–73,431,923	10,121,150	–66,373,362
Value of bond portfolio	0.2072***	0.1088	0.1852**	0.0414*	–0.0333
Value of stock portfolio	0.1622*	0.1054*	0.0734*	–0.0001	0.0406*
Value of cash and short-term investments	0.8893	0.8166	–0.2327	0.3824*	0.3217**
Value of mortgage portfolio	–1.1905***	–0.2991	0.3779***	0.2130*	–0.2956
Log of total assets	–4,755,066	–490,925	3,399,574	–403,905	3,057,839
Capital/total assets	–1,527,615	–2,365,530	14,877,225	1,605,390	14,468,410
Annuity premiums/total premiums	29,678,817	4,745,447	–46,899,069*	–14,997,836**	50,034,932
Stock company? (0/1)	12,780,425	40,138,562	12,222,638	–5,859,183	8,820,137
In affiliated group? (0/1)	1,146,474	–2,049,653	–3,366,939	366,060	138,088
R-square	0.932	0.889	0.887	0.818	0.821

* p -value < 0.05 ; ** $0.05 < p$ -value < 0.10 ; *** $0.10 < p$ -value < 0.15 .

for insurers that follow static and dynamic strategies. We mention some of the highlights:

- Bonds play a major role in the performance of statically allocating insurers (cf. pattern of significance for bonds in Table 8).
- Stocks play a major role in the performance of dynamically allocating insurers (cf. pattern of significance for stocks in Table 8).
- The reciprocal impact of performance on stocks is different for static insurers than for dynamic insurers. It is also different among the periods: before, during and after the Millennial stock market boom.
- The reciprocal impact of performance on bonds is different for static insurers than for dynamic insurers.

Summary

In this paper we are primarily interested in the effect of static (passive) and dynamic (active) portfolio management strategies on the financial performance of life insurers in the U.S. We conduct the study in context of the interrelationship between asset allocation of U.S. life insurers and the performance of their invested assets.

First, there is evidence that the relationship between performance and asset allocations changed throughout in the period 1994–2003. Therefore, we fit our model on each year separately. Second, we create three indices for the extent of static/dynamic management of invested assets. By means of these indices, we are able to identify three clusters of life insurers, differing in terms of their degree of static or dynamic management of their portfolios. These three clusters display substantial differences in performance, asset allocation and other characteristics.

We ran the Structural Model for each year for the whole industry with indicator variables for the clusters. We find that strategy mattered during the run-up to the Millennial stock market boom and afterwards, but not before. The most dynamic strategy is statistically significant in contributing more to the performance of insurers. When we run our model separately in each cluster, we find that the impact of bond allocation decisions on performance is insignificant for the most dynamic cluster, whereas the impact of stock allocation decisions on performance is insignificant for the most static cluster. The results control for asset portfolio composition and a variety of enterprise risks and therefore avoid confounding the performance effects of allocation strategies with portfolio composition, risks and other controls.

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