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INTRODUCTION

A total of 11 papers in this volume represent recent research on important topics in finance. The contributions include analyses of issues relating to asset prices, the behavior of stock returns, and capital-raising activities. Hodges et al., employ stochastic dominance arguments to show that the efficiency of time diversification depends on the degree of autocorrelation in security returns. In their study of the announcement effects of 93 minority equity investments, Chan et al., find a neutral stock price response on average for acquiring firms but a significantly positive response for selling firms. Nguyen et al., provide evidence on the returns structure of U.S. information technology stocks surrounding the bursting of the internet bubble in early 2000. In a study of the informational effects of auditor reputation, Godbey and Mahar find that implied volatilities for firms audited by Andersen have increased relative to those for firms audited by other Big Five firms. Charaput and Cheung find that the usage of installment receipts enhances liquidity in Canadian secondary equity offerings.

The contributions to this volume also examine important issues in international finance and financial institutions. Brailsford et al., use a VECM technique to examine Purchasing Power Parity and causality between the yen and the dollar. Sarmas studies the impact of Hong Kong's fixed exchange rate system and Singapore's floating exchange rate system on the correlation between the U.S. and the two respective countries' stock markets. Povel develops a theoretical model to explain multiple banking as a commitment device. Baer et al., develop a model and empirically examine how the creation of a futures clearinghouse can reduce the need for margin in bilateral and multilateral settings. Roberts and Siddiqi provide an empirical analysis of the link between collateralization and the number of lenders in private debt contracts. Finally, Tripp et al., empirically examine the relative efficiency of single versus multiple common bond credit unions.

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the length of the desired investment horizon. Lee (1990) and Reichenstein and Dorsett (1995) offer support for this position by arguing that time diversification will hold true if stock returns are mean reverting across time. In this case, returns have negative autocorrelation so that volatility is reduced, because a positive or negative price movement tends to be followed by a price movement in the opposite direction. While numerous empirical studies employing a mean-variance framework have been conducted on the efficacy of time diversification, they have yielded conflicting results and have failed to resolve the issue.[2]

We use stochastic dominance (SD) to analyze the issue of time diversification. Data from Ibbotson Associates *2001 Yearbook* is used to generate simulated return distributions for portfolios of small stocks, common stocks, long-term corporate bonds, and U.S. Treasury bills for various holding periods. For each holding period, we apply stochastic dominance tests to determine whether preferences can be established among the equity and fixed-income portfolios. Our analysis is first conducted under the assumption that returns are independent across time and then under the assumption that security returns are correlated across time so that potential mean reversion in equity returns is captured.

We employ stochastic dominance because it is a more general, analytical technique than mean-variance analysis. Stochastic dominance examines the entire distribution of returns and, thus, considers all the moments of the return distribution. Furthermore, SD does not require any specific distributional assumption such as normality. Empirical studies of time diversification based on mean-variance analysis ignore higher moments, such as skewness and kurtosis, and are not consistent with maximizing expected utility unless the return distributions are normal. Albrecht (1998) demonstrates the pitfalls of applying mean-variance-based performance measures to non-normal security return distributions.

In this paper, the stochastic dominance results clearly show that the issue of time diversification is ultimately a question of autocorrelation in security returns. When returns are independent across time, no dominance exists among the stock and bond portfolios, even for long holding periods. This is consistent with the assumptions and analyses by Merton and Samuelson. When autocorrelation across security returns is captured, however, stock portfolios dominate the bond portfolios for sufficiently long holding periods. This is consistent with the practitioner view that stock returns are mean reverting so that lengthening the investment horizon reduces risk.

2. STOCHASTIC DOMINANCE

Stochastic dominance has important advantages over the mean-variance framework that underlies other empirical time diversification studies. It is theoretically unimpeachable, requires no distributional assumptions, and takes all the moments of the return distributions into account. Furthermore, SD requires only very general assumptions about investor behavior.

In discriminating between the performance of the stock and bond portfolios, stochastic dominance provides an effective method for placing investment choices into mutually exclusive sets: an efficient set containing desirable investment alternatives and an inefficient set containing the undesirable ones. Return distributions of alternative portfolios are compared against one another to determine which would be preferred (i.e. in the efficient set versus not in the efficient set). The preference criteria is that the investor prefers more return per dollar invested to less, is risk averse, and prefers positive skewness (potential for great gain with limited downside risk) in a return distribution.

The basic principle underlying stochastic dominance is quite straightforward.[3] Consider the two arbitrary return distributions shown in Fig. 1 and the corresponding cumulative distributions in Fig. 2. In this example, *G* might correspond to the return distribution of corporate bonds and *F* might correspond to the return distribution of common stocks. Assuming that investors prefer more return to less (first derivative of the utility function is positive), an investor wanting to maximize expected utility would prefer return distribution *F*, which lies to the right of distribution *G*. With distribution *F*, the chance of earning a higher return is always greater than with *G* regardless of whether the investor likes or dislikes risk. Formally, investment *F* dominates *G* for all utility functions if, and only if, $F(r) \leq G(r)$ for all *r* (with at least one strict inequality), where *F* and *G* are cumulative distributions. This constitutes first degree stochastic dominance (FSD).

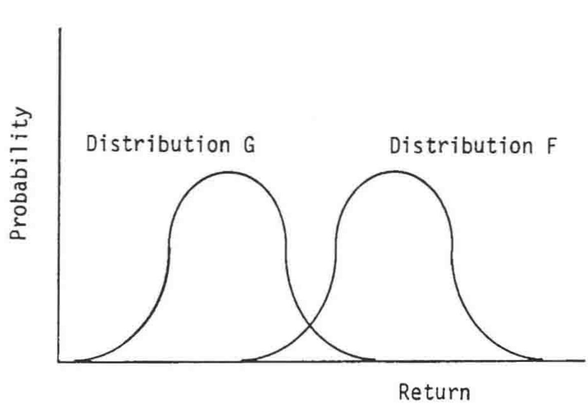

Fig. 1. Return Distributions.

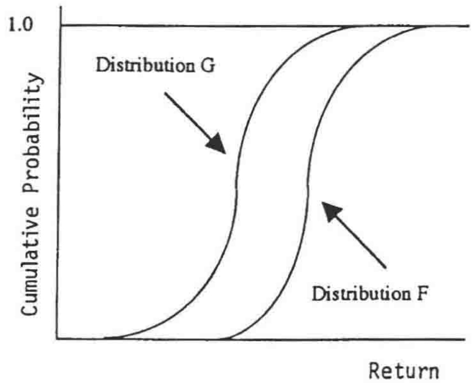

Fig. 2. Cumulative Return Distributions.

In the case where $F(r)$ lies entirely to the right of $G(r)$, preference is readily apparent. When two cumulative distributions cross, other factors than return (e.g. risk aversion) must be considered in order to establish dominance. Further assuming that investors are risk averse (second derivative of the utility function is negative), second degree stochastic dominance (SSD) can be applied. Formally, F dominates G for all risk-averters if and only if:

$$\int_{-\infty}^{r} [G(t) - F(t)] \ \mathrm{dt} \geq 0 \tag{1}$$

for all values of r, and the inequality is strict for at least one value of r. $G(t)$ is the cumulative distribution associated with G. $F(t)$ is the cumulative distribution associated with F. When $F(t)$ lies to the right of $G(t)$, the integral of $G(t) - F(t)$ is positive.

Figure 3 shows that, when the conditions of Eq. (1) are met, $F(t)$ lies far enough to the right of $G(t)$ so that investment F would be preferred to investment G. This is because the expected utility gained from the positive area to the left of R_0 is more than the decrease in expected utility lost between R_0 and R_1.

Analysis of third degree stochastic dominance (TSD) is similar except that it assumes that investors' absolute risk aversion decreases, which implies that investors prefer positive skewness. Formally, the TSD rule asserts that F dominates G if, and only if:

$$\int_{-\infty}^{r} \int_{-\infty}^{v} [G(t) - F(t)] \, \mathrm{dt} \, \mathrm{dv} \geq 0 \tag{2}$$

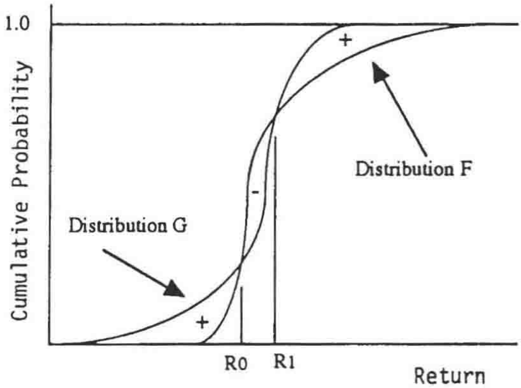

Fig. 3. Cumulative Return Distributions – *F* Preferred to *G* with Risk Aversion.

for all *r* and the expected values are:

$$E_F(r) \geq E_G(r)$$

with at least one strict inequality.

Equation (2) can be interpreted as another measure of how far to the right the cumulative distribution of investment *F* is relative to that of investment *G*. The inside integral is merely Eq. (1). If this function is less than zero at any point, second degree stochastic dominance is violated. Third degree stochastic dominance, on the other hand, balances the areas where the function (i.e. the inside integral) is positive against the areas where the function is negative. Hence, there may not be dominance by SSD, even though a dominance by TSD prevails.

3. METHODOLOGY AND RESULTS

We now analyze the stock and bond return distributions under the assumption that the returns are independent and then repeat the analysis allowing for autocorrelation in the returns.

3.1. Independent Returns

We use simulation to generate sample return distributions for portfolios of small stocks, common stocks, long-term corporate bonds, and U.S. Treasury bills for holding periods of one to 20 years.[4] Annual returns for each portfolio from 1926 through 2000 are collected from the Ibbotson Associates data. For a specified holding period of n years and a given portfolio, we randomly select (with replacement) n returns out of the 75 sample returns. We then compute the holding-period return (HPR) by:

$$\mathrm{HPR}_n = \prod_{i=1}^{n}(1 + R_i) - 1 \tag{3}$$

where: $\mathrm{HPR_n}$ = return for holding period of n years. R_i = ith return observation. n = number of years in holding period.

This procedure is repeated 250 times. Thus, we generate sample return distributions for each portfolio for annual holding periods of one to 20 years. Note that this procedure is consistent with an efficient market because it generates independent returns.

To illustrate, consider the case of a five-year holding period and the small-stock portfolio. Five annual returns are selected at random from the 1926 through 2000 historical returns and the five-year holding-period return is computed. This is repeated until a sample distribution of 250 five-year holding-period returns is obtained.

Table 1. Mean Returns (Independent Returns).

Holding Period (Years)	Small Stocks	Common Stocks	Corporate Bonds	U.S. T-Bills
1	0.1865	0.1396	0.0648	0.0384
2	0.4054	0.2843	0.1278	0.0785
3	0.5815	0.4185	0.1941	0.1218
4	0.8796	0.6009	0.2583	0.1676
5	1.2431	0.8002	0.3331	0.2134
6	1.8269	1.0992	0.4115	0.2609
7	2.2701	1.3921	0.4995	0.3076
8	2.7225	1.6361	0.5898	0.3593
9	3.5033	2.0382	0.6727	0.4123
10	3.8916	2.3164	0.7651	0.4705
11	5.1126	2.8870	0.8718	0.5284
12	6.2349	3.3905	0.9705	0.5863
13	7.6834	4.0060	1.0974	0.6504
14	9.1426	4.5933	1.2477	0.7159
15	9.9900	5.1838	1.3798	0.7828
16	12.7609	6.0751	1.5451	0.8558
17	14.0832	6.9254	1.6772	0.9282
18	16.3932	8.0484	1.8342	1.0045
19	19.2132	9.0971	2.0083	1.0790
20	22.3442	10.3712	2.1812	1.1584

Table 2. Standard Deviation (Independent Returns).

Holding Period (Years)	Small Stocks	Common Stocks	Corporate Bonds	U.S. T-Bills
1	0.3415	0.2033	0.0896	0.0314
2	0.6124	0.3345	0.1249	0.0469
3	0.7956	0.4242	0.1467	0.0604
4	1.2163	0.5871	0.1970	0.0735
5	1.5884	0.7082	0.2279	0.0903
6	2.6733	1.0491	0.2724	0.1057
7	3.3439	1.2709	0.3218	0.1083
8	4.0323	1.4675	0.3602	0.1281
9	5.5973	2.0399	0.4054	0.1339
10	5.2954	2.0537	0.4472	0.1486
11	7.1563	2.6574	0.4706	0.1556
12	10.6047	3.3833	0.5106	0.1798
13	11.0493	3.7438	0.5969	0.1836
14	14.0722	4.5057	0.6794	0.1929
15	13.7674	4.8308	0.7560	0.2115
16	19.5160	5.6614	0.9234	0.2422
17	25.6209	6.8283	0.9225	0.2426
18	31.3195	9.1775	1.0202	0.2637
19	28.5125	8.6184	1.1158	0.2757
20	37.1234	10.1819	1.2254	0.2884

Descriptive statistics are computed for each sample return distribution. Tables 1 through 3 list the portfolio means, standard deviations, and skewnesses, respectively. Table 1 shows that the mean return for all portfolios increases with the length of the holding period. The mean return for Treasury bills, for example, grows from 3.84% for a one-year holding period to 115.84% for a 20-year holding period. The corresponding mean returns for small stocks are 18.656% and 2234.42%. One might be tempted to conclude that a long-term (20-year investment horizon) investor should invest in small stocks rather than Treasury bills since the expected return is larger.

Risk, however, also increases with the length of the holding period. Table 2 shows that the standard deviation of returns for Treasury bills increases from 3.14% for a one-year holding period to 28.84% for a 20-year holding period. The corresponding standard deviations for small stocks are 34.151% and 3,712.34%. Risk, as measured by the standard deviation, grows much more rapidly with the length of the holding period for small stocks than for Treasury bills.

Skewness coefficients given in Table 3 are generally positive and are inconsistent with normally distributed random variables.[5] Indeed, the Kolomogorov-D statistics

Table 3. Skewness (Independent Returns).

Holding Period (Years)	Small Stocks	Common Stocks	Corporate Bonds	U.S. T-Bills
1	0.5975	−0.4003	1.4384	0.7029
2	1.1294	0.1592	1.0429	0.6224
3	1.2845	0.5065	0.9985	0.5907
4	2.3293	1.0858	1.1416	0.6260
5	2.2293	0.7606	1.1480	0.5535
6	3.2641	1.5186	1.1102	0.4931
7	3.7829	1.3195	1.4880	0.5776
8	3.2042	1.3104	1.4324	0.4032
9	3.8482	2.3178	1.5495	0.3976
10	2.9023	1.4604	1.5989	0.1392
11	3.2793	1.9264	1.1260	0.0740
12	4.9828	2.4399	0.9811	0.4420
13	3.1690	1.8461	1.2939	0.3889
14	3.8513	2.3279	1.2871	0.3007
15	2.9038	2.1656	1.3420	0.4111
16	2.9743	1.9926	1.6586	0.7835
17	6.0588	2.9756	1.1446	0.3990
18	6.7478	4.3287	1.4233	0.5260
19	2.7802	1.9004	1.2256	0.4745
20	4.5362	2.2607	1.5443	0.3502

reject normality at the 1% significance level for all the stock and bond portfolios for all holding periods. Thus, preferences established strictly on the basis of a mean-variance analysis would not be valid.

Stochastic dominance tests are run to determine whether preferences can be established among the portfolios for each holding period. The SD algorithms for discrete distributions used here are discussed in Levy (1992).[6] The results of the 20 tests are summarized in Table 4 which shows membership in the TSD efficient set.[7] As the results are the same for all holding periods, we only show the results in five-year increments. The SSD and FSD results are identical to the TSD results.

Table 4 shows no evidence that time diversification results in preferences among the portfolios for risk-averse investors who prefer positive skewness. The efficient set for each holding period includes all four portfolios. This means that an investor with a 20-year investment horizon could rationally select any of the stock, bond, or T-bill portfolios. Thus, with independent returns, time diversification fails and Merton and Samuelson are correct.