Improved Estimates of the Identities and Characteristics of Marginal Investors

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Conventional economic analysis indicates that the marginal buyers and sellers of any commodity are the parties who set the commodity's price. Within the framework of demand and supply curves, the marginal buyers (sellers) are those buyers (sellers) whose preferences are shown by the segments of the demand (supply) curve closest to the intersection. They are the buyers and sellers who would be willing to change their decisions to purchase or sell for the smallest change in price. The economic analysis of investment markets is no exception, and, within this framework, the prices of investments are set by the preferences of marginal investors.

The Capital Asset Pricing Model (CAPM) provides an economic framework for the pricing of the attributes of investments. There are several sets of assumptions which lead to the model, but any of the sets has either the assumption that there exists a state of complete markets in which any attribute of any investment may be separately bought or sold or that the marginal investor in each asset is the same. Under these assumptions, the absence of arbitrage profits leads the CAPM to the economic law of one price, and risk which is not diversifiable within the macroeconomy (Beta) has the same price in all investments. This unity of the price of Beta is the principal practical implication of the CAPM.

It can be demonstrated that neither of these two necessary assumptions is true. While the diversity of securities and contingent contracts which are available in financial markets has ballooned in recent years, financial markets remain far from complete. In a state of complete financial markets, the attributes of any investment for taxation, cash flow, risk, and various other features may be separately sold. In this state Beta must have the same price on all investments if all investors have increasing risk aversion . It can be demonstrated that when some investors are exempted from taxation, and transactions costs are zero or there is a state of complete markets, then every investor would be able to avoid taxes on all investment returns. The same logic would indicate that the presence of any risk-preferring or risk-neutral investors would drive the price of risk to zero. Similarly, if some investors are risk averse, but they do not have increasing risk aversion, the least risk averse investors will become the marginal purchasers and sellers of risk.

Whether or not the absences of both complete financial markets and frictionless trading have an important impact on the one-price implication of the CAPM is an empirical matter. Black (date) noted that the relationship between return and Beta is non-linear, and he offered the explanation of differing rates of interest for borrowing and lending. Black's research was one of the first attempts to model returns with incomplete financial markets and significant transactions costs. Numerous other studies have attempted to explain the non-linear relationship between returns and Beta. There is, however, no universally accepted explanation for this non-linear relationship.

While most of the research on CAPM has centered on the pricing of risk, the pricing of the tax consequences of investment ownership are also potentially important. In general,

the literature on CAPM assumes that taxes at the investor level are an irrelevant problem. Several papers have attempted to discern if there is a dividend tax effect. In one of the earliest studies, Black and Scholes concluded that the available data is insufficient to statistically show the existent of a dividend tax effect. Beginning with Litzenberger and Ramaswamy (date) subsequent research in this area has centered on data around the dates on which a security goes ex-dividend. This research has also been inconclusive. In their seminal paper showing that there is no significant tax effect around ex-dividend dates Miller and Scholes note that the absence of a strong ex-dividend day tax effect does not imply that no long-term tax effect exists. Despite this absence of conclusive statistics, academic researchers have suspected that taxes and transactions costs are sufficiently important in the pricing of stocks that these factors are often offered as the explanation of anomalies such as the small firm effect.

While academic research has been unable to demonstrate the existence of a tax effect in the pricing of dividends, the literature on the pricing of bonds is unambiguous as to the existence of a tax effect. The seminal work showing a tax-effect in the pricing of bonds was published by McCulloch (1974) but the evidence here is so strong that even casual observers of bond yields note the tax effect. The tax effect in bond pricing lead to an early study to determine the identity of the marginal investor in a particular class of securities. Observing that banks are granted a special tax provision which permits them to deduct the interest on money used to purchase municipal bonds, Skelton looked at the relationship of municipal bond returns to Regulation Q restrictions on bank borrowing. Through this study he demonstrated that commercial banks are the marginal investors in municipal bonds.

The fact that it is easy to demonstrate a tax effect in the pricing of bonds, while there are no conclusive statistics in the pricing of stocks may have several sources. First, the data on stocks is noisy and expected returns cannot be estimated with the same precision as expected returns on bonds. Second, stockholders use the cash method to account for taxable dividends while bondholders accrue interest. This makes it easier for a dealer (who may deduct realized losses in stock price from dividend income) to arbitrage any short-term tax effects which may take place around ex-dividend dates, and there is evidence which indicates that financial institutions are the marginal investors around ex-dividend dates in stocks which regularly pay high dividends (Elton and Gruber, 1970). Finally, different classes of securities may have different marginal investors so that while investors in some stocks desire the cash flow of a dividend to a greater extent than they dislike the tax consequences, investors in bonds pay a premium to avoid taxable income. .

The fact that tax effects are an integral part of the formulas for pricing bonds implies that there are important consequences to the facts that securities markets are not frictionless and that we do not have complete markets. Furthermore, the data on ownership indicates that average ownership is not the same for every class of security, and some securities are either absent from the portfolios of financial institutions or are held only in miniscule quantities. While financial institutions (banks) are the marginal investors in municipal bonds and, around some ex-dividend date periods, foreign insurance

companies are the marginal investors in certain stocks, it is difficult to believe that financial institutions are the marginal long-term investors in all securities. By its very nature, the marginal investor must be a decision maker, so the marginal investor cannot be an index fund. Since the marginal investor is not an index fund it is unlikely that the marginal investor would have positions in every security. It is therefore virtually impossible that the marginal investor in all securities has the same identity, or that the marginal investor has positions in all securities. Hence, the use of Beta to indicate a linear risk-return tradeoff is a misspecification of risk.

Identification of the marginal investor allows the possibility of determining returns attributable to taxes, transactions costs, risk, and any other factors which influence an investment's returns. Furthermore, if the identities and characteristics of marginal investors are different for different securities, then it is possible to determine the exact components of optimal portfolios for any investor when we know that investor's own tax rates, transactions costs and risk aversion. Identification of the marginal investor is therefore an answer to the most important questions of investment management within the framework of economic pricing of securities. An economic securities pricing model which identifies different marginal investors for each investment offers the possibility of determining unique optimal portfolios for each investor. By contrast, the one factor CAPM implies that the optimal portfolio for each investor is the market portfolio with various amounts of leverage or ownership of a risk-free security.

One may wonder why researchers have accepted the assumption that the marginal investor is the same in every security when there is strong evidence for different marginal investors. The answer may lie in the difficulty of trying to determine the identities of the correct marginal investors for each security. Published data is limited to showing the average investors in various classes of securities, and none of the published data sources are complete. Even when complete data on average ownership is assembled, it is a major step to estimate marginal investors from this average data.

II. Data

While there is no one source of data which provides a complete list of who owns which financial assets in the United States, several sources may be combined to provide an approximate list of ownership. The list is only approximate due to the use of different definitions by the original sources.

Comprehensive data on individual ownership of some classes of financial assets are produced every three years in the Federal Reserve's Survey of Current Finances (SCF). Individuals are grouped by age, income, and net worth, but, as already noted, the skew in the ownership of financial assets is so great that individuals whose incomes and net worths are lower than the top categories own a very small portion of total financial assets. It is intuitive that those less affluent individuals are very unlikely to be the marginal investors. Therefore, grouping individuals by the available income categories or the available categories of net worths would not provide much value for

the purpose of determining the characteristics of marginal investors, which is the purpose of this study. I therefore use the SCF's groupings according to age.

If it is not difficult to arbitrage the returns of one class of assets against another, the two classes, the marginal investor in either class would effectively be the same. Otherwise, it would be possible to easily earn arbitrage profits. Consequently, any useful definition of asset classes must be such that it is not easy to arbitrage the returns of one class against those of another. . The SCF which is the primary source of data on individual investment ownership breaks financial assets into several classes. I will use those classes since, for the most part, they would be difficult to arbitrage, and these are the only classes for which comprehensive data on ownership is available. The SCF has the following categories:

1. Transactions Accounts
2. CD's
3. Savings Bonds
4. Bonds
5. Stocks
6. Mutual Funds
7. Retirement Accounts
8. Life Insurance
9. Other Managed Assets
10. Other Financial Assets

In addition to these categories, the SCF has non-financial assets. Most of these are assets for personal use, but Investment Real Estate is an investment asset, so I include it in the study.

In order to make the definitions of asset classes consistent with those of other sources of data, I combine Transactions Accounts and CD's into the category of Cash Equivalents. Other Managed Assets and Other Financial Assets (items numbered (and 10 on the above list) are combined under the category of "Other Investments"

While the SCF reports the population (GpPop) and mean and median net worths (GpMean and GpMed) of each class of individual investor, for the various classes of assets, it only reports the percent of each group who own the asset (GpPct) and the median amount owned by the members of the group who own the asset (GpMedAst). In order to estimate the total ownership of each asset by a group of individuals (TotGpAst) , I multiply for each group:
(GpPop) (GpMean)/GpMed) (GpPct) (GpMedAst) = TotGpAst

Data on the new money and assets owned by Pension Funds are from the Money Market Directory of Pension Funds.

Data on new investment real estate available for sale are from the U.S. Bureau of the Census, Current Construction Reports.

Data on the assets owned by foreign investors are from the Survey of Current Business "The International Investment Position of the United States at Yearend 1998" , except for data on bonds which comes from the Federal Reserve Bulletin.

Data on the assets of IRA's and Keogh's are from the 1999 Mutual Fund Factbook. Data on the assets of Life Insurance Companies are from the 1999 Life Insurance Factbook.

All other data on ownership of assets, and asset availability come directly from the Federal Reserve Bulletin.

This study also required data on tax rates and transactions costs. Tax rates are all Federal only and come from the Internal Revenue Code. I have already described the assumptions on the tax rates of domestic individual investors. .Foreign investors are assumed to be taxed at the rate of 30% (for federal purposes only), representing their required rate of withholding. Transactions costs include price impact and brokerage fees. Brokerage fees are from published advertisements by brokerage firms. I assume that the individuals pay midway between the rates published by Schwab and Merrill Lynch while institutions are able to obtain the lowest institutional rates. For price impact, I assume that individuals lose half of the bid-ask spread for all securities transactions while institutions lose only one-quarter of the bid-ask spread.

III. Methodology

In order to estimate the characteristics of marginal investors in various classes of investment assets, I first attempt to simulate the *tatonnement* process by which markets create prices. This *tatonnement* is sometimes described as an auction in which each participant can either buy or sell at any time. The process ends when no participant chooses to either buy or sell at the final price.

The end result of the auction is a *pareto optimum* allocation of the items sold; i.e., no one can be made better off without making someone else worse off. The only useful definition of utility is that it is simply whatever market participants act to maximize. The auction process therefore maximizes the total utility of the participants, subject to the constraint that each participant's spending is limited by that participant's budget and that the total amount of each commodity purchased by all of the investors is limited to the amount of that commodity which is available. In order to simulate this process I make the following assumptions:

1. The utility function for each investor can be expressed by an equation which takes the expected dollar returns of a portfolio net of taxes, transactions costs, and monitoring costs, and adjusted for risk.
2. Each investor's tax rate, monitoring costs, and transactions costs may be different for each investment but are constant as more or less is invested.
3. Each investor has a constant degree of risk aversion.

4. Within any group of investors, the existing portfolios and characteristics of the investors are homogeneous.
5. Among individual investors, the marginal investors are likely to have the highest tax rates during working years and slightly lower tax rates in retirement years.
6. Transactions costs for each group are near to the average for that group.

The first assumption is fairly standard. In essence, it is saying that utility is some function of expected future cash flows, discounted to the present. The second assumption is one of constant rates for taxation, transactions costs and monitoring costs. Many of the lowest cost brokerage firms charge a constant rate per share and, within reasonable ranges of trading, market impact also tends to be a constant amount per share. While at some times for some monitoring costs, there are increasing returns to scale, at other times the returns to scale are decreasing. For the most part, expressing these costs as constant is only a simplification to make the programming easier. This simplification does not affect the results of the study as long as these costs are constant at the margin.

The constant degree of risk aversion is less compatible with academic literature than is the constancy in the second assumption. The reader should keep in mind, however, that these assumptions are simplifications which are unlikely to effect the overall results. The simulation is not intended to measure investor utility but only to determine the identity of marginal investors. The results for this purpose are the same as if we assumed that the rate of increase or decrease in risk aversion is the same for each group of investors. If the trade-offs between risk and the factors in the second assumption increase or decrease at the same rate for each group of investors, then the identity of the marginal investor is not effected by the assumption of constant risk aversion. The constant risk aversion only makes the programming easier. The risk aversion is described by the function

$U = W - r \ s.d.\ W;$

where U is equal to the investor's utility, W is the present value of expected future returns net of taxes and transactions costs, s.d.W indicates the standard deviation in the monthly returns of W, and r is the risk aversion. This indicates that if the risk aversion is, for example, 3 then the investor is indifferent between $100 expected present value of investments with a standard deviation of .05 and $85 of risk-free investments.

The fourth assumption can only be justified by comparing it with the alternative of the present literature. The present literature implicitly or explicitly assumes that, at the margin, all investors are homogeneous with respect to tax rates, transactions costs, monitoring costs and risk aversion. . The fourth assumption is therefore less restrictive than the *status quo*. At the same time, some degree of homogeneity is likely among investors in a given class. To start, the distribution of wealth among individuals is very skewed so that most investment is coming from individuals who have incomes of over $100,000 per year during their working years. On the whole, however, taxable income falls in retirement years, so it makes sense to model the marginal investor for those years accordingly.

Data was input through a screen as shown on Table I.

TABLE I

Under 44

New Money: 800

Income Tax Rate: .4

Risk Aversion: .01 Inflation Aversion: 0 Cash Flow Needs: 0

	Cash Equivalents	Stocks	US Govt. Bonds	Other Bonds	Real Estate	Mutual Funds	Retirement Accts.	Other Fin. Assts
Transaction Cost	0	.005	.01	.0075	.02	.003	0	0
Monitoring Cost	0	0	0	0	0	0	0	0
Sales Penalty	0	0	0	0	0	0	0	0
Inflation Sens.	0	0	0	0	0	0	0	0
Cash Flow	0	0	0	0	0	0	0	0
Percent Taxable	100	50	80	100	25	60	0	0

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Relying on these assumptions, I create equations expressing the utility for each investor. Let Awi through Nwi indicate the amount invested in assets A through N by investor i. Let Axi through Nxi indicate the tax rate of investor i for assets A through N Let Ati through Nti indicate the transactions costs of investor i for assets A through N. Let Ari through Nri indicate the risk aversion of investor I for assets A through N, given the investor's current portfolio.

$$Ui = \sum_{\alpha=A}^{N} (\alpha wi)\, \alpha xi \quad \alpha ri$$

Then, in order to replicate the allocations of investments which would be made by the auction process, I maximize the sum of utilities of all investors subject to the constraints that:

1. the total amount of investment in any one asset by all investors is equal to one percent (.01) of the total amount of that asset to be available
2. the total amount of investments in all assets by any one investor is equal to one percent (.01) of the total investment money of that one investor

Since the equations are linear, maximization will normally give only one asset to each investor. That would prevent the investors from enjoying the risk reduction of a diversified portfolio. In order to allow diversification with linear maximization, the process is first performed for one percent of each investor's wealth and one percent of the available assets. The results of that one percent allocation are added to the original portfolios of each investor, and the incremental risk of each asset for each investor is re-calculated for the new portfolio. With the new calculations, the risk of any risky asset which was added in the first one percent allocation will increase since that asset is now a larger part of the portfolio. Hence, the asset which was added in the first round is less desirable in the second round, and it becomes increasing less desirable after each round where it is added. Repetition of the process allows the system to select portfolios with optimal diversification within a margin of one percent The process is repeated ninety-nine times, after which all of the new assets have been allocated.

Results

The result of this process gave the allocation of assets shown on Table II.

TABLE II

8A

Maximum Advantage Asset Allocation System

	Cash Equivalents	Stocks	US Govt. Bonds	Other Bonds	Real Estate	Mutual Funds	Retirement Accts.	Other Fin. Assts
Under 44	0	0	0	0	79	0	641	80
Age 45 - 54	0	0	0	0	320	0	200	280
Age 55 - 64	0	0	0	0	239	0	359	202
Age 65 - 74	0	120	0	0	237	285	0	158
Over75	0	80	0	0	315	125	0	280
IRAs _Keoghs	479	0	0	9	0	312	0	0
Pensions	0	0	761	0	0	39	0	0
Life Insurance	320	0	479	1	0	0	0	0
Charitable	401	0	360	0	0	39	0	0
Foreign Investors	0	200	0	0	0	400	0	200
Others	0	800	0	0	0	0	0	0
Subject	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

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In order to test the ability of the allocations shown on Table II to predict actual ownership, I assembled a similar grid showing asset ownership in 1995. This is Table III.

Table III Reported Ownership of Selected Assets

investors	investor totals	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retiremen t accts	other
under 44	1857.475673	241.539	62.5413	33.4272	18.978	698.737	113.221	666.388	22.6443
45-54	3352.696838	354.826	159.205	22.8345	71.1418	1195.85	254.728	1234.97	59.1332
55-64	3307.59066	296.204	152.683	12.9958	17.4805	1337.71	508.501	933.193	48.8248
65-74	2561.230141	386.416	153.52	14.4991	168.19	828.725	389.487	567.172	53.2204
over 75	1298.325354	358.785	227.417	26.1369	119.581	141.788	222.078	123.318	79.2222
ira's, keogh	1288	261	369	0	92	0	472	0	94
pens total	2241	124	1296	143	557	72	49	0	0
:ife Insurance	1969	0	371	409	1080	52	57		
foreign	1745	103	465	389	533	255			
Charity	188.0688259	12	113.684	15	40.3846	5	2		
other	6375.010406	188	318.767	39.5073	90.7098	2610.42	775.683	2241.47	110.449
asset totals	26183.3979	2325.77	3688.82	1105.4	2788.47	7197.24	2843.7	5766.51	467.494

This reported ownership of assets was then compared with a hypothetical ownership showing allocations if all assets were indexed and investors only held indexed portfolios. This is shown in Table IV.

Table IV. Ownership if All Assets were Indexed

investors	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retiremen t accts	other
asset fraction	0.088827472	0.14089	0.04222	0.1065	0.27488	0.10861	0.22024	0.01785
under 44	164.9526159	261.625	78.3993	197.769	510.456	201.686	408.983	33.1565
45-54	297.7496869	472.25	141.516	356.985	921.405	364.056	738.241	59.8495
55-64	293.8412782	466.051	139.658	352.299	909.31	359.277	728.55	59.0639
65-74	227.4871564	360.809	108.121	272.744	703.973	278.147	564.032	45.7263
over 75	115.298059	182.87	54.7993	138.236	356.797	140.974	285.87	23.1756
ira's, keogh	114.4097842	181.461	54.3771	137.171	354.048	139.888	283.668	22.9971
pens total	48.58862731	77.0646	23.0934	58.255	150.361	59.4089	120.471	9.7666
:ife Insurance	174.9012928	277.404	83.1278	209.697	541.243	213.85	433.65	35.1562
foreign	155.0039391	245.846	73.6709	185.841	479.669	189.522	384.317	31.1567
Charity	16.69956478	26.4866	7.93703	20.0218	51.6778	20.4184	41.4049	3.35671
other	566.2751355	898.148	269.141	678.932	1752.37	692.38	1404.02	113.825

I then subtracted all of the figures in Table IV. from the corresponding figures in Table III

And divided each remainder by the total assets owned by the corresponding group of investors. This gave me a new table (Table V.) which shows the percentage by which actual ownership exceeds the hypothetical ownership of all investors only holding an index of all assets.

Table V. Excess Ownership over Indexing as a Percentage of Investor Wealth

investors	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retiremen t accts	other
under 44	0.04124	-0.1072	-0.0242	-0.0963	0.10139	-0.0476	0.13861	-0.0057
45-54	0.01702	-0.0934	-0.0354	-0.0852	0.08185	-0.0326	0.14815	-0.0002
55-64	0.00071	-0.0948	-0.0383	-0.1012	0.12954	0.04512	0.06188	-0.0031
65-74	0.06206	-0.0809	-0.0366	-0.0408	0.04871	0.04348	0.00123	0.00293
over 75	0.18759	0.03432	-0.0221	-0.0144	-0.1656	0.06248	-0.1252	0.04318
ira's, keogh	0.11381	0.1456	-0.0422	-0.0351	-0.2749	0.25785	-0.2202	0.05513
pens total	0.03365	0.54392	0.05351	0.22255	-0.035	-0.0046	-0.0538	-0.0044
:ife Insurance	-0.0888	0.04753	0.1655	0.442	-0.2485	-0.0797	-0.2202	-0.0179
foreign	-0.0298	0.12559	0.1807	0.19895	-0.1288	-0.1086	-0.2202	-0.0179
Charity	-0.025	0.46382	0.03757	0.10831	-0.2483	-0.098	-0.2202	-0.0179
other	-0.0593	-0.0909	-0.036	-0.0923	0.1346	0.01307	0.13136	-0.0005

I then made similar tables showing the excess over indexing determined as an optimal allocation for investors by the program already described.

Table VI. Program Recommended Allocations in Excess of Indexing

Investor	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retiremen t accts	other
under 44	-164.9526159	-261.63	-78.399	-197.77	-46.756	-201.69	844.217	106.944
45-54	-297.7496869	-472.25	-141.52	-356.98	-10.705	-364.06	1609.66	33.5505
55-64	-293.8412782	-466.05	-139.66	-352.3	242.79	-359.28	1380.65	-12.364
65-74	-227.4871564	-360.81	-108.12	-272.74	832.627	746.253	-564.03	-45.726
over 75	-115.298059	94.23	-54.799	-138.24	292.203	175.226	-230.17	-23.176
ira's, keogh	850.4902158	-181.46	-54.377	185.929	-354.05	-139.89	-283.67	-22.997
pens total	-48.58862731	-77.065	-23.093	2182.75	-150.36	-59.409	-120.47	-9.7666
:ife Insurance	1167.398707	-277.4	488.872	-155	-541.24	-213.85	-433.65	-35.156
foreign	-155.0039391	1129.45	-73.671	-185.84	-296.77	-189.52	-384.32	155.643
Charity	2.10043522	-26.487	-7.937	149.178	-51.678	162.482	-41.405	-3.3567
other	-566.2751355	1138.45	263.859	-678.93	732.526	628.12	-1404	-113.82

Table VII . Program Recommended Allocations in Excess of Indexing as a percentage of the Total Asset Owned by Each Investor

Investor	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retiremen t accts	other
under 44	-0.088827472	-0.1409	-0.0422	-0.1065	-0.0252	-0.1086	0.45461	0.05759
45-54	-0.08880098	-0.1408	-0.0422	-0.1065	-0.0032	-0.1086	0.48007	0.01001
55-64	-0.088854333	-0.1409	-0.0422	-0.1065	0.07342	-0.1086	0.41749	-0.0037
65-74	-0.088827472	-0.1409	-0.0422	-0.1065	0.32512	0.29139	-0.2202	-0.0179
over 75	-0.088827472	0.0726	-0.0422	-0.1065	0.22512	0.135	-0.1773	-0.0179
ira's, keogh	0.66031849	-0.1409	-0.0422	0.14435	-0.2749	-0.1086	-0.2202	-0.0179
pens total	-0.021681672	-0.0344	-0.0103	0.974	-0.0671	-0.0265	-0.0538	-0.0044
:ife Insurance	0.592889135	-0.1409	0.24828	-0.0787	-0.2749	-0.1086	-0.2202	-0.0179
foreign	-0.088827472	0.64725	-0.0422	-0.1065	-0.1701	-0.1086	-0.2202	0.08919
Charity	0.011172528	-0.1409	-0.0422	0.7935	-0.2749	0.86426	-0.2202	-0.0179
other	-0.088827472	0.17858	0.04139	-0.1065	0.11491	0.09853	-0.2202	-0.0179

The excess percentages in Table V. were then compared with the excess percentages in Table VII. . For this purpose, all of the investments and investors labeled "other" were omitted due to the fact that the description of the "other" investor had no scientific basis. The correlation coefficient for the remaining seventy figures (ten investors times seven investments) f from the two tables was determined by Excel to be .27. With seventy observations that gives a t statistic of 4.616. A t statistic of 2.648 shows significance at the .995 level for seventy degrees of freedom, so it is virtually certain that this correlation is not random.

Implications for the Identities of Marginal Investors

It has always been known that investors do not hold portfolios which are indexed with all assets. This research demonstrates that a linear programming model with reasonable assumptions concerning investors taxes, transactions costs, monitoring costs and risk aversion can produce portfolios similar to those actually held by investors. The same linear programming model identifies marginal investors in each asset. The fact that asset allocations recommended by the program are highly correlated with actual investor decisions is consistent with the program accurately replicating the investment allocation process. If the program is accurately replicating the investment allocation process, then it may also correctly identify the marginal investors in each asset, along with tax rates, transactions costs, monitoring costs and risk aversion for the particular portfolio held by each marginal investor.

For each investor and for each asset, the program determines the sum of the factors which reduce the value of the investment's returns for each investor, and that sum is subtracted from unity (1.0) to determine the investment's value to the particular investor.

Table VIII. shows the identified marginal investors in each asset by displaying the figure showing the investment's value to that investor as described.

Table VIII. Marginal Investors in Each Asset and the Value of the Expected Returns in that Asset

investors	cash equiv	stocks	US Govt bond	other bonds	Real Estate	Mutual funds	Retirement accts	other
under 44							0.9919	
45-54								
55-64								
65-74					0.8877			
over 75								1.0203
ira's, keogh	1			0.9932				
pens total			0.9964			0.9956		
:ife Insurance								
foreign								
charit total								
other		0.9782						

These values of returns in the hands of marginal investors make the determination of optimal portfolios for any class of investor a relatively easy task. It is only necessary that the investor find the assets for which the investor's own values exceed (are less than) those of the marginal investor by the greatest (smallest) amount. The program is able to do that for any subject investor, while simultaneously considering the subject investor's basis for optimization of capital gains along with any expected changes in the investor's tax rate as the investor grows older.

While the identities of marginal investors are established primarily through macroeonomic asset classes ("stocks" for example), it is also possible to apply the system to determine the identity of the marginal investor in a narrowly defined asset (such as the stock in a single corporation.) When such an application is made, we are able to find the portfolio of the marginal investor in the individual stock and, as a result, we are able to determine the incremental risk of that stock in the marginal investor's portfolio. A casual experiment indicates that the Beta of a stock may change by 25% or more simply by adjusting for the fact that the marginal investor in the stock does not hold a market portfolio. The effect of the marginal investor's taxes, transactions costs and monitoring costs will often have an even greater magnitude.

Conclusion

The assumption that the marginal investor is the same in all securities and that this marginal investor holds the market portfolio is clearly incorrect, yet it is the basis of virtually all of the economic analysis of expected returns on investments. Substituting a better defined marginal investor for the ubiquitous indexed investor provides important new information on the expected returns of investments.

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