The role of effective corporate decisions in the creation of efficient portfolios

J. B. Guerard, Jr.
H. Markowitz
G. Xu

Chief executive officers and chief financial officers seek to implement corporate financial decisions that maximize the stock price and stockholder wealth. Real assets may be tangible, such as machinery or factories, or intangible, such as technical expertise or patents. These real assets must be paid for. To finance the real assets, the financial manager makes decisions regarding the magnitude of common stock issuance and stock repurchases, long-term debt issuance, and debt repurchases. Cash flows are generated by real assets, and the stockholders receive dividend payments based on the net income generated by the corporation. Empirical evidence shows that the dividend payment decision and stock and debt repurchase decisions can increase stock prices and returns. A variable, denoted as corporate exports—which incorporates the amount of dividends, net stock issuances, and net debt repurchases—is used as an expected return to create an initial efficient frontier. A stock selection model is used as a constraint in the portfolio process in conjunction with the corporate exports variable to further increase returns. We use a data mining corrections test for establishing the statistical significance of our portfolio returns.

Introduction

Students of corporation finance are taught that management, primarily chief executive officers and chief financial officers, seek to maximize stockholder wealth. Brealey et al. [1] stated that the goal of corporate finance is to implement corporate decisions to enhance stockholder wealth by maximizing the stock price. In the world of business, real assets must be acquired for the growth of corporations and must be financed. Real assets generate cash flows that are used to pay dividends and to finance these real assets. The financial manager makes decisions regarding the magnitude of common stock issuance and stock repurchases, long-term debt issuance, and debt repurchases. Empirical evidence shows that the dividend payment decision and stock and debt repurchase decisions can increase stockholder wealth. We calculate a variable, referred to as corporate exports, composed of dividend payments, common stock issuance and stock re-purchases, long-term debt issuance, and debt re-purchases. We show that companies generating larger corporate exports increase in price relative to firms that generate lower corporate exports. Gerstner [2] stated that managers need the relevant information, make decisions based on the critical information, and communicate the information throughout the organization to enhance performance. Corporate exports are composed of variables that help maximize stockholder wealth. Gerstner reminded us that the marketplace, through demand and supply determining the company stock price, is the driving force behind all corporate activities, and corporate measures of success are ultimately customer satisfaction and shareholder value.

We show that corporate decisions with respect to dividend, stock, and debt directly affect stock prices and stockholder returns. We examine dividend payments, common stock issuance and stock re-purchases, long-term debt issuance and debt re-purchases for all publically traded United States firms for the 1971 to 2011 period. As mentioned, we create a "corporate exports" variable that incorporates the dividend, stock and debt issuance and buy-backs decisions. Schwartz and Aronson [3] stated that a balanced economic growth

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model equates the income from capital and the total of aggregate savings with real investment. If the cash flow generated by operating assets exceeds the possible net real investment, then the overall corporate sector will have more funds than it can desirably re-invest in business. The corporate sector will have funds to distribute to the rest of the economy. Schwartz and Aronson called the excess of corporate funds to be distributed to the rest of the economy "corporate exports". When Schwartz and Aronson discussed corporate exports in 1966, they included dividends paid, interest paid, stock issued, and debt issued. Schwartz and Aronson reported that dividends and interest paid substantially exceeded new funds raised on the capital markets. In the United States during a fifty-year period ending in 1965, corporations raised the necessary cash primarily by issuing debt. Stock repurchases were so infrequent that the Compustat database did not include a stock repurchase variable until 1971. In 2007, Guerard and Schwartz [4] refined corporate exports to include dividends paid, interest paid, stock issuance and repurchase, and debt issuance and repurchase. Share repurchases have grown dramatically since 1971. The updated corporate exports variable can be used in conjunction with a stock selection model to identify under-valued stocks. In this paper, we calculate corporate exports for all stocks traded in the United States from 1971 to 2011 and use IBM data as an example. Companies generating larger, positive corporate exports appreciate more in price than firms with lower, or negative corporate exports.

We integrate managerial finance and investment analysis to show how corporate exports—incorporating dividend policy, debt and equity issuance and repurchase decisions, and leverage—can be used to maximize portfolio returns. We illustrate Markowitz [5, 6] portfolio optimization using the corporate exports as an expected returns variable. The corporate exports variable is statistically significant in producing positive active returns for portfolios. If one produces portfolios using the corporate exports expected returns variable and further constrains portfolios to only include stocks that are identified as attractive using a stock selection model [7, 8], then portfolio active returns increase substantially. Finally, we apply the Markowitz-Xu [9] data mining corrections test to assess the whether these returns could have been produced randomly.

Corporate financial decisions

We specifically examine dividend, debt and equity issuance and buy-back strategies, and the implied leverage decisions of firms. Miller and Modigliani [10] demonstrated that dividend policy was irrelevant to the value of the firm. In the presence of taxes, Fama and Babiack [11] reported that dividends are highly correlated with earnings. As earnings rise, there is usually some lag before former payout levels are resumed. A forecast of dividend levels can be obtained by studying past payout rates and attempting to predict future earnings levels. The amount left after common dividends are paid represents retained earnings or earnings reinvested in the firm. Buy backs are more difficult to predict than dividends. Before the prevalence of buy backs, Dividend Discount Models were more valid for companies that had a "normal," or consistent, dividend payout policy.

Equity repurchases increased substantially during the 1971 to 2012 time period, particularly since the post-crash period beginning in 1987. Grullon and Michaely [12] state that one explanation for the sudden growth in share repurchases is the Security Exchange Commission (SEC) adoption of Rule 10b-18 in 1982, which protected firms from prosecution on the basis that share repurchases manipulated their stock prices. Share repurchases increase with economic "boom" conditions and diminishes in recessions. Excess returns have been associated with share repurchases [12].

A tender offer is a general offer to stockholders to buy their stock. Equity repurchases, whether privately negotiated or via a tender offer, generally specify the number of shares the firm seeks to repurchase, the tender price at which it will repurchase shares, and the expiration date of the tender offer, which the firm may extend. Dann [13] examined 143 cash tender offers to repurchase equity during the 1962 to 1976 period, made by 122 different firms, and reported a 22.5% tender offer premium, relative to the previous day of the announcement (20.9% relative to the one month period before the announcement). Large excess returns are associated with share buybacks. Firms repurchase equity to enhance stockholder wealth. There were marginal debt effects, and approximately 95% of the enhanced value was accrued to stockholders. Lakonishok and Vermaelen [14] found excess returns to repurchases continued to 1986, but at a (slightly) diminished rate. Lakonishok and Vermaelen reported premiums of 21.8%, 24.1%, and 18.5% on tender offers during the 1962 to 1986, 1962 to 1979, and 1980 to 1986 periods, respectively. They also reported cumulative abnormal returns, or cumulative excess returns, relative to the market, of 12.5%, 14.6%, and 9.8% to non-tendering stockholders during the corresponding periods. Smaller firms produced the highest abnormal returns. The level of current and projected earnings has an impact on dividend policy and potential buy backs (Bierman [15, 16]). Firms adopt a target debt ratio by choosing between debt and equity repurchases as well as choosing between debt and equity issuances [17]. Repurchases and dividends are motivated by contracting investment opportunities [18].

Dhrymes and Kurz [19] proposed an explicit link among these dividend, investment, and debt issuance decisions and econometrically estimated a simultaneous equations system using a sample of 181 industrial and commercial firms during the period 1947 to 1960. Dhrymes and Kurz reported that debt was issued to finance capital expenditures and dividend payments. Investment and dividends were positively associated with new debt issuance. Guerard, Bean, and Andrews [20] updated the Dhrymes and Kurz analysis and reported: (1) a strong interdependence is evident between the investment and dividend decisions; and (2) a strong interdependence is evident between the investment and new debt financing decisions. Retained earnings add to the equity of the common shareholders. Retained earnings, the net income of firms not paid to stockholders in the form of dividends, represents the majority of funds that can be used to finance real assets [1, 4]. An increase in assets financed by ownership capital as opposed to debt improves the credit standing of the firm and enables it to issue debt at a relatively lower rate. Debt and internally generated funds are the primary sources of aggregate investment outlays [19].

New debt issues exceed new equity issues by a multiple exceeding eight times, a result consistent with Dhrymes and Kurz [19], Guerard et al. [20], and Myers [21]. New debt issued is identified with the financing capital expenditures in the simultaneous equation modeling. Funds represented in earnings should increase the future profits of the shareholders and eventually result in buy backs or higher dividends. It is not the increment in the book value of the shares, but a hoped-for sequence of increased earnings that makes retained earnings of value to the shareholder.

Defining and calculating corporate exports

In this paper, we calculate the net export of funds variable (CE), defined in Guerard and Schwartz [2] and Guerard [22], as:

$$CE = \textit{Dividends Paid} + \textit{Interest Paid} + \textit{Net Equity Repurchased} - \textit{Net Debt Issued}. \quad (1)$$

In 1971, the corporate sector exported over $46 billion of funds, and by 2011, the corporate sector funds exported grew to over $248 billion. The surplus of funds over any possible reasonable capital investment policy is the rationale behind the cash buy back of shares and the payment of dividends. In short, the corporate sector has continued to be a net exporter of funds to the rest of the economy, and has risen almost consistently throughout the 1971 to 2011 period, except when net equity re-purchases fell and new debt issues rose in the mid to late-1990s and during the financial crisis of 2007 and its aftermath. The CE variable can be criticized for ignoring cash on the balance sheet. Cash is another source of funds and may be directly distributed to stockholders as additional dividends. We find corporate exports without cash has better stock return predictive power than corporate exports including cash, although both corporate export variables are highly statistically significant. We address the predictive power of the corporate exports variable in the next section.

In **Table 1**, we show annual statistics of the components of CE as reported in the Compustat database. A second way to examine the corporate sector net export of funds is to examine the dividends paid less equity repurchased, which also is shown in Table 1. Dividends paid exceeded equity repurchased of the Compustat firms from 1971 to 2011, although equity repurchases have risen relatively to dividends since 1982. We examine the 1971 to 2011 period because Compustat does not maintain debt and equity issuance, and repurchases, prior to 1971.

An analysis of the CE components reveals that interest paid has risen faster than dividends paid during the 1971 to 2011 time period. Net debt issues have risen at an undiminished rate, with the notable exception of 2001 to 2005 and 2009, shown in **Figure 1**. As we mentioned before, we use the WRDS Compustat database of stocks in the United States in this paper. Stock repurchases rose substantially following the crash of October 1987. Net equity repurchases increased substantially in the 2002 to 2006 time period, and fell dramatically with the financial crisis.

Guerard [22] reported the ten largest and smallest corporate exporter firms in 1983 to illustrate the corporate fund generating process. The largest corporate exports firms included AT&T, IBM, and several large oil companies. These firms dominated positive corporate exports in 1983 because they paid large dividends and interest and generally re-purchased more debt than was issued (which made a great deal of sense given the level of interest rates in 1983). A similar process occurred in 2006 as Microsoft, Pfizer, and the oil companies dominated the largest corporate exporting firm (IBM fell to only the twenty-fourth largest exporter in 2006). IBM is a very interesting individual case, as it is generally a large net corporate exporter of funds, except in 1993, its near-bankruptcy year. IBM pays large dividends, repurchases huge amounts of equity, is a net issuer of debt, and issues no new equity after 1995. Indeed, IBM's repurchase of equity far exceeded its dividends paid during the 1995 to 2006 time period (see **Figure 2**). IBM's dividends exceeded its net new equity issues and net new capital issues in all years except 1993.

A stock selection model

There are many approaches to security valuation and the creation of expected returns. Fundamental data—such as earnings, book value, cash flows, and sales—have been statistically associated with stock excess returns for decades [23–28]. Chan, Hamao, and Lakonishok [25] and Lakonishok, Shleifer, and Vishny [27] are widely cited references on contrarian, or fundamentally based, investment strategies. We use a stock selection model that has evolved over the past two decades. Bloch et al. [26] used an eight-factor model to identify under-valued stocks. The eight factors are composed of current ratios of earnings, book value, cash flow, sales, and the relative variables. The relative variables are the current ratios divided by their 60-month averages. Guerard, Xu, and Gultekin [7] and Guerard,

Table 1 Corporate exports (CE), net debt issued, and net equity repurchased for all common stocks and for IBM, in the Wharton Research Data Services (WRDS) U.S. Compustat database for the 1970 to 2011 period. Data is in units of millions of dollars.

	All WRDS stocks			*IBM*		
Year	*CE*	*Net debt issued*	*Net equity repurchased*	*CE*	*Net debt issued*	*Net equity repurchased*
1970	4,610.1	0.0	0.0	59.7	0.0	0.0
1971	2,483.6	1,610.2	−708.4	35.0	20.2	9.8
1972	3,212.3	1,470.7	−656.6	33.7	39.9	30.2
1973	2,893.7	2,550.4	−982.3	54.7	15.6	27.7
1974	3,242.4	4,283.6	−946.6	92.5	5.3	37.0
1975	2,835.0	5,092.1	−1,665.6	78.8	3.0	7.0
1976	4,861.3	3,399.9	−1,838.4	113.0	2.5	4.5
1977	6,044.1	3,802.6	−1,889.5	291.0	2.3	4.2
1978	6,459.0	5,346.5	−2,009.4	226.1	7.4	4.4
1979	7,161.1	6,879.2	−2,580.0	38.0	145.0	14.6
1980	7,627.2	9,013.7	−3,407.2	188.5	60.4	9.4
1981	9,188.3	10,513.7	−4,499.7	151.0	75.1	18.1
1982	13,824.9	8,806.2	−4,212.4	177.2	48.0	29.8
1983	17,991.7	2,773.5	−6,577.6	206.9	17.4	35.1
1984	20,586.3	8,807.5	−1,285.2	229.5	136.3	76.8
1985	16,160.3	13,396.4	−3,332.5	241.6	161.4	92.8
1986	17,174.0	15,549.6	−3,565.6	455.3	105.9	84.5
1987	25,034.5	10,799.1	−3,141.2	487.4	40.8	71.9
1988	32,468.5	15,184.8	1,456.0	288.1	454.0	300.7
1989	31,902.6	19,788.2	−1,411.9	195.5	647.1	276.8
1990	39,766.7	15,402.2	−224.4	371.8	467.6	368.3
1991	33,938.1	15,167.0	−6,120.6	287.4	577.6	418.4
1992	36,927.7	8,272.9	−7,269.2	500.6	1,004.5	1,073.5
1993	28,715.1	11,544.1	−10,943.8	−199.5	1,179.4	874.1
1994	33,000.1	16,272.6	−6,399.1	571.8	533.5	944.5
1995	27,758.7	33,323.4	−3,599.7	973.2	663.6	946.0
1996	34,232.5	−95,722.6	−7,807.6	378.0	767.0	499.2
1997	31,107.1	45,005.9	−2,026.1	318.2	914.2	453.0
1998	16,294.9	73,399.7	409.9	623.3	756.7	594.2
1999	11,682.0	−138,597.8	−7,748.0	965.1	613.3	751.0
2000	2,244.9	−144,872.5	−16,381.1	569.6	960.4	756.1
2001	16,298.4	87,533.5	−5,896.0	850.6	453.5	789.8
2002	28,397.6	70,215.1	1,327.4	335.8	672.6	581.2
2003	45,555.8	56,285.1	836.0	923.8	157.3	583.1
2004	66,807.7	66,959.6	8,487.4	926.3	243.8	453.8
2005	94,585.9	73,971.1	24,002.6	767.6	436.3	352.2
2006	71,325.9	154,369.4	41,880.5	1,101.9	144.4	340.0
2007	86,392.3	181,759.3	47,005.9	1,196.8	2,174.4	1,130.6
2008	95,677.8	94,468.0	−18,798.5	728.6	1,382.9	1,024.8
2009	90,185.0	4,825.2	−45,855.1	1,517.1	668.3	1,349.5
2010	259,345.0	−109,976.5	−1,778.4	1,417.4	805.5	652.2
2011	248,780.6	−77,102.7	29,829.2	1,608.0	999.6	894.7

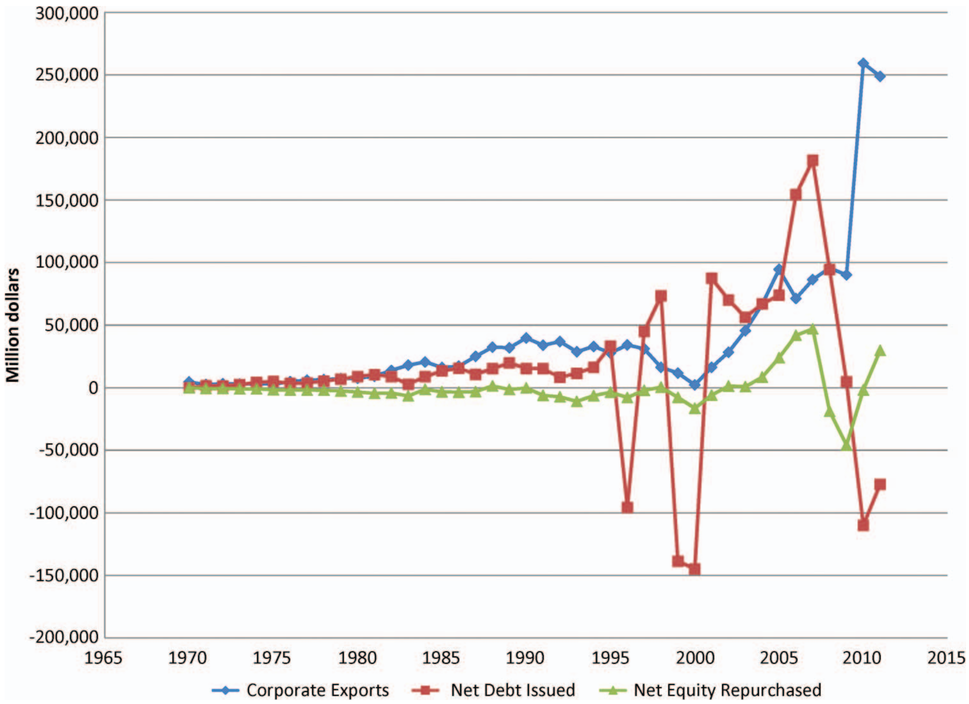

Figure 1

Corporate exports, net debt issued, and net equity repurchased of stocks in the United States in the Wharton Research Data Services (WRDS) database for 1970 to 2011.

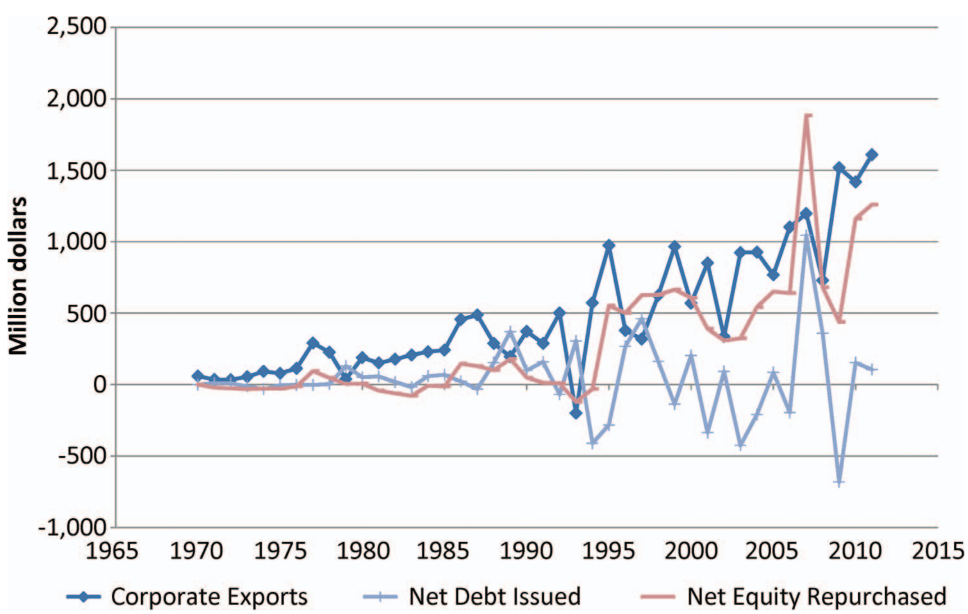

Figure 2

IBM corporate exports, net debt issued, and net equity repurchased during the 1970 to 2011 period. Data is in units of millions of dollars.

Markowitz, and Xu [8] added two variables to the Bloch et al. [26] model. Guerard et al. [8] added a price momentum (PM) variable and an earnings forecasting efficiency variable. The price momentum variable was constructed as the price one month ago divided by the price twelve months ago. The earnings forecasting variable, CTEF (Consensus Temporary Earnings Forecasting), is composed of forecasted earnings yield (FEP), earnings revisions (EREV), and EB (earnings breadth). Earnings breadth represents the net (up minus down) direction of revisions. The EP, BP, CP, SP, PM, and components of earnings forecasts and revisions are continuously examined by security analysts and quantitative specialists in the industry (see Savita Subramanian at Bank of America Merrill Lynch [29] and David Dremen [30]). We estimate a ten-factor stock selection model to use as an input to an optimization analysis. We use the (one month) total stock return, TR, as the independent variable. The monthly stock return is composed of the stock dividend yield plus the stock price appreciation. The stock selection model estimated in this study, denoted as United States Expected Returns (USER) in Guerard, Xu, and Gultekin [7], is

$$\begin{aligned} TR_{t+1} = {} & a_0 + a_1 EP_t + a_2 BP_t + a_3 CP_t + a_4 SP_t \\ & + a_5 REP_t + a_6 RBP_t + a_7 RCP_t + a_8 RSP_t \\ & + a_9 CTEF_t + a_{10} PM_t + e_t \end{aligned} \quad (2)$$

where

EP	[earnings per share]/[price per share] = earnings-price ratio;
BP	[book value per share]/[price per share] = book-price ratio;
CP	[cash flow per share]/[price per share] = cash flow-price ratio;
SP	[net sales per share]/[price per share] = sales-price ratio;
REP	[current EP ratio]/[average EP ratio over the past five years];
RBP	[current BP ratio]/[average BP ratio over the past five years];
RCP	[current CP ratio]/[average CP ratio over the past five years];
RSP	[current SP ratio]/[average SP ratio over the past five years];
CTEF	composed of consensus earnings-per-share I/B/E/S forecast, revisions, and breadth, with equally weighted components;
PM	Price Momentum;
e	randomly distributed error term.

The USER model is estimated monthly, and t is time. The cross sectional regression employ a weighted latent root regression technique to address the problems of outlier and multicollinearity issues in Equation (2). We use the normalized coefficients of the positive and statistically significant variables (10% level) as weights; and we average the variable weights over the past twelve months. Guerard, Xu, and Gultekin [7] and Guerard, Markowitz, and Xu [8] calculated information coefficients, IC, which measures the correlation between the investment strategy and subsequent performance. Higher USER values are preferred, and the IC should be positive. The IC test is referred to as a Level I test. The stock selection model, USER, the earnings efficiency model, CTEF, and the corporate exports model, CE, have positive and statistically significant ICs. The PM, CTEF and USER variable ICs are 0.035, 0.039, and 0.048, respectively, for January 2000 to January 2013 period. The CE variable has an IC of 0.045. The CE variable including cash has an IC of 0.036. An analysis of U.S. stock ICs is presented in Guerard [23]. That is, firms that are identified as being undervalued by the stock selection model, firms having higher earnings forecasting efficiency, and firms that generate higher corporate exports appreciate more than overvalued firms or firms with lesser earnings forecasted growth and firms generating lower corporate exports. Now, the question is how to combine the stock selection model and corporate exports to generate more efficient portfolios.

Constructing mean-variance efficient portfolios

Portfolio construction and management, as formulated in Markowitz [5, 6], seeks to identify the efficient frontier, the point at which the portfolio return is maximized for a given level of risk, or equivalently, portfolio risk is minimized for a given level of portfolio return. The portfolio expected return, denoted as $E(R_P)$, is calculated by taking the sum of the security weights multiplied by their respective expected returns.

$$E(R_P) = \sum_{i=1}^{N} w_i E(R_i), \quad (3)$$

where N is the number of candidate securities, and w_i is the weight for security i. A fully invested portfolio requires that $\sum_{i=1}^{N} w_i = 1$. $E(R_i)$ is the expected return for security i. The portfolio standard deviation σ_P is the square root of portfolio variance, σ_P^2, which is the sum of the weighted securities covariance:

$$\sigma_P^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{ij}, \quad (4)$$

where σ_{ij} is the covariance of returns for security i and security j.

The Markowitz model holds that investors are compensated for bearing the total risk of the portfolio. Implicit in the development of the Capital Asset Pricing Model by Sharpe [31], Lintner [32], and Mossin [33] is that investors are compensated for bearing systematic or market risk, not total risk. Systematic risk is measured by a stock's beta. Beta is the slope of the market model in which the stock return is regressed as a function of the market return. Sharpe [34] proposed what he refers to as the diagonal model to simplify the computations in constructing portfolios.

Multi-Factor Risk Models hold that the total excess return for a multiple-factor model in the Rosenberg methodology for security j may be written as follows:

$$R_j = \sum_{k=1}^{K} \beta_{jk}\widetilde{f}_k + \widetilde{e}_J. \qquad (5)$$

The nonfactor, or asset-specific return $\widetilde{e}_j$ on security j, is the residual risk of the security after removing the estimated impacts of the K factors. The term $\widetilde{f}_k$ is the rate of return on factor k, and β_{jk} is factor beta of security j on factor k. An extensive review of factor risk models can be found in Connor and Korajczyk [35] and Connor, Goldberg, and Korajczyk [36]. Guerard [37] demonstrated the effectiveness of the Blin and Bender APT and Sungard APT systems in portfolio construction and management. The determination of security weights, the ws, in a portfolio are the primary calculation of the Markowitz portfolio management approach.

The security weight is the proportion of the portfolio value that is invested in the individual security j. The portfolio weight of security j, is calculated as

$$w_{(\mathrm{P})j} = \frac{MV_j}{MV_{\mathrm{P}}} \qquad (6)$$

where MV_j is the market value of security j, and MV_P is the market value total portfolio.

The active weight of the security j, $w_{(a)j}$, is calculated by subtracting the security weight in the (index) benchmark b, $w_{(b)j}$, from the security weight in the portfolio:

$$w_{(\mathrm{a})j} = w_{(\mathrm{P})j} - w_{(\mathrm{b})j}. \qquad (7)$$

Blin and Bender created their company, named Advanced Portfolio Technologies, and its *Analytics Guide* [38]. Portfolio volatility can be decomposed into independent variance components, systematic and specific risk.

$$\sigma^2_{\mathrm{P}} = \sigma^2_{\beta\mathrm{P}} + \sigma^2_{\mathrm{SP}}, \qquad (8)$$

where

σ^2_{P} = total portfolio variance;
$\sigma^2_{\beta\mathrm{P}}$ = systematic portfolio volatility;
σ^2_{SP} = specific portfolio volatility.

There are many forms of portfolio optimization and construction techniques. One could test whether the Markowitz [5] mean-variance (MV) optimization technique using the portfolio variance as the relevant risk measure dominates the risk-return trade-off curve using a variation of the mean-variance optimization model that emphasizes systematic (or market) risk, the mean-variance Tracking Error at Risk (MVTar) optimization, and mean-expected tail loss portfolio optimization (see Guerard, Rachev, and Shao [39]). There is no statistically significant difference in the two forms of Mean-Variance analysis. A measure of the trade-off between the portfolio expected return and risk (as measured by the portfolio standard deviation) is typically denoted by the Greek letter lambda (λ). Generally, the higher the lambda, the higher is the ratio of portfolio expected return to portfolio standard deviation. We assume that the portfolio manager seeks to maximize the portfolio geometric mean (GM) and Sharpe ratio as put forth in Latane [40] and Markowitz [5, 6].

Portfolio construction and management of corporate exports

We build Mean-Variance efficient portfolios using all publically traded United States stocks during the January 2000 to January 2013 period. We seek to outperform the Russell 3000 Growth benchmark. We use the Sungard APT World Risk Model composed of 20 betas estimated by principal components analysis with three years of weekly data [38]. Portfolios are created to maximize the portfolio corporate exports variable while minimizing risk with the following constraints: (1) the portfolios are fully invested; that is, security weights sum to one; (2) a 4% maximum weight can be held in any stock; (3) 8% monthly sells (turnover) is maintained; and (4) we use monthly optimization and create an efficient frontier by varying lambda. We use the same portfolio simulation conditions and the APT World 20-factor risk model, as was presented in Guerard, Rachev, and Shao [39]. The portfolio attribution analysis of the corporate exports variable for a lambda value of 500 is shown in **Table 2**. Portfolio active annual return is 9.60%, its Information Ratio is 0.71, and the active return is statistically significant, having a corresponding t value of 2.54. There are no statistically significant style or industry exposures. The corporate exports variable is statistically significant at identifying under-valued stocks. The variable used as an expected returns variable is often referred to as a portfolio tilt variable [23]. The corporate exports variable can be simulated with an additional constraint that the portfolio USER score must exceed 80 and be less than 90. The introduction of a stock selection model enhances returns such that the portfolio Geometric Mean rises from 9.5%, annually in Table 2, to 18.5%, in **Table 3**. Portfolio active annual return is 18.51%, its Information Ratio is 1.56, and the active return is statistically significant, having a corresponding t value of 5.61. The active return is driven by specific risk, 12.2% annual return with a corresponding t value of 6.33, as it should be in a well-diversified portfolio (see Table 3). There are no statistically significant style and industry exposures. Their returns, even though statistically significant, account for slightly more than 2% annual return, whereas

Table 2 Attribution of the corporate exports portfolio simulation, from 2000 to December 2012, using the Axioma World Fundamental Model. (Here, the benchmark is the Russell 3000 Growth Index, and the NoRC [or no risk control] model is used.)

Source of return	*Contribution*	*Contribution*	*Average exposure*	*Risk*	*Information ratio*	*T-statistic*
Portfolio	9.46%			20.09%		
Benchmark	−0.12			22.02		
Active	9.60%			13.57%	0.71	2.54
Factor contribution		2.06				
Style	Exchange rate stability	0.00	0.013	0.37%	0.02	0.07
	Growth	−1.33	−0.567	0.78	−1.70	−6.10
	Leverage	−1.10	0.572	0.69	−1.60	−5.76
	Liquidity	−1.49	−0.594	1.59	−0.93	−3.35
	Medium-term momentum	0.14	−0.239	1.49	0.10	0.34
	Short-term momentum	−0.13	0.011	1.34	−0.10	−0.35
	Size	−0.06	−0.483	3.22	−0.02	−0.06
	Value	2.33	0.846	1.49	1.96	7.04
	Volatility	0.39	0.166	3.52	0.11	0.39
Country	−0.01			7.19	−0.07	−0.26
Industry	2.06			3.97	0.52	1.87
Currency	1.76			4.04	0.43	1.56
Market	−0.60			2.34	−0.26	−0.93
Specific return	7.54			7.31	1.03	3.71

specific stock selection is over 12%. The Markowitz approach to portfolio construction and management is sixty years old and remains an integral tool of investment research.

A further test of data mining corrections

In the practical world of Wall Street, it is conventional wisdom to cut your historical back-tested excess returns in half; that is, if your back-tested excess return (the portfolio geometric mean return less the geometric mean of the benchmark) was 6%, or 600 basis points, an investment manager and/or a client might expect 3% excess returns in the future. Harry Markowitz and Ganlin Xu, the Daiwa Global Research Department mathematician, developed a data mining corrections (DMC) testing methodology that appeared in the *Journal of Portfolio Management* [9]. A secondary question is: could a manager have obtained a similar portfolio return using other models, rather than the model actually employed?

Let y_{it} be the logarithm of one plus the return for the ith portfolio selection model in period t. In DMC Models I and II, y_{it} is assumed to have form

$$y_{it} = \mu_i + z_t + \varepsilon_{it}, \tag{9}$$

where μ_i is the model effect, z_t is the period effect, and ε_{it} is the random deviation. These effects are all assumed to be uncorrelated. Readers are referred back to the original paper for the correlated ε_{it} case. Finally, the appropriate estimate of μ_i is not its sample average return

$$\bar{r}_i = \frac{\sum_{t=1}^{T} y_{it}}{T}, \tag{10}$$

but rather

$$\hat{\mu}_i = \bar{r} + \beta(\bar{r}_i - \bar{r}), \tag{11}$$

where $\bar{r} = \sum_{i=1}^{N} \bar{r}_i / N$ is the grand mean of methods, and $\beta = (\mathrm{Cov}(\bar{r}_i, u))/(\mathrm{Var}(\bar{r}_i))$ is the regression coefficient of μ_i as a function of $\bar{r}_i$ such that $0 < \beta < 1$. In other word, the best estimate of model effect μ_i is its sample estimate regressed back to the average estimate (the grand average). The individual variables tested in this study are as follows:

EP	earnings per share/price per share;
BP	book value per share/price per share;
CP	cash flow per share/price per share;
SP	sales per share/price per share;

Table 3 Attribution of the Corporate Exports Portfolio Simulation with an USER portfolio constraint, 2000 to December 2012, using the Axioma World Fundamental model. (Here, the benchmark is the Russell 3000 Growth Index, and the NoRC model is used.)

Source of return	*Contribution*	*Risk*	*Information ratio*	*T-statistic*
Portfolio	18.39%	18.65%		
Benchmark	-0.12	22.02		
Active	18.51%	11.86%	1.56	5.61
Factor contribution	6.29%	9.62	0.65	2.35
Style	2.07%	5.88	0.35	1.27
Country	0.66%	4.78	0.14	0.50
Industry	2.42%	3.62	0.67	2.40
Currency	1.32%	2.15	0.62	2.22
Market	-0.18%	2.35	-0.08	-0.28
Specific return	12.20%	6.94	1.76	6.33

DP dividends per share/price per share;
PM price momentum as $price_{t-1}/price_{t-12}$;
PM71 price momentum as $price_{t-1}/price_{t-7}$;
FEP1 one-year-ahead forecast earnings per share/price per share;
FEP2 two-year-ahead forecast earnings per share/price per share;
RV1 one-year-ahead forecast earnings per share monthly revision/price per share;
RV2 two-year-ahead forecast earnings per share monthly revision/price per share;
FGR1 one-year-ahead forecast earnings per share monthly breadth;
FGR2 two-year-ahead forecast earnings per share monthly breadth;
FEP1 one-year-ahead forecast earnings per share/last year's reported earnings per share;
FEP2 two-year-ahead forecast earnings per share/last year's reported earnings per share;
EWC equally-weighted EP, BP, CP, SP, REP, RBP, RCP, RSP, CTEF, and PM;
CTEF equally-weighted FEP1, FEP2, BR1, BR2, RV1, and RV2.

As a reminder, PM71 is the price momentum created by the price rising over the past 7 months, ignoring the previous month (prices mean-revert over a 1-month period). PM is the price momentum created by the price rising over the past 12 months, ignoring the previous month.

The Markowitz-Xu DMC test did not use a "holdout period," as holdout tests can be routinely data mined as well. That is, one can vary the estimation and holdout periods to generate the desired conclusion. Alternative portfolio models were created using the factors as tilt factors, such that the real question addressed is whether the model used was statistically better than the average model used to identify mispriced stocks. We use the June 2001 to January 2013 period for the Data Mining Corrections test. We test 17 models including the components of USER and the components of CTEF. The USER variable analysis passes the Data Mining Corrections test criteria for the U.S. market, indicating that the stock selection and portfolio construction methodologies produce superior returns that are not due to chance. The USER variable has a Data Mining Corrections coefficient of 0.57 and is highly statistically significant, having an F value of 2.3. Thus, one could expect 57% of the excess returns of the USER model relative to the average return to be continued. More importantly, the USER model produced a higher geometric mean than did an average model geometric mean which could have been used to manage an equity portfolio in the United States equity market during the June 2001 to December 2012 period. The USER Model passes all three Levels of hypothesis testing: 1) the model and its components have statistically significant information coefficients; 2) the strategy produces excess returns after transactions costs; and 3) the strategy produces a significantly higher geometric mean than the average model that could have been used to manage assets in the universe. The Markowitz-Xu [9] Data Mining Corrections test is a Level III test.

The Morgan Stanley Capital International (MSCI) Barra model is a multi-factor risk model developed by Rosenberg and Marathe [41] in the 1970s. We can create portfolio simulations back to 1980 using the USER model and its

Table 4 Univariate model tilts for simulated portfolios of Wharton Research Data Services (WRDS) stocks in the United States during the 1980 to 2009 period.

Portfolios	*Monthly excess return to S&P500* (%)	*T-statistic*
USER	0.28	1.72
BR1	0.16	1.29
BR2	0.13	1.12
RV1	0.22	1.48
RV2	0.04	0.32
FEP1	0.02	0.09
FEP2	−0.19	−0.87
CTEF	0.27	2.40
EP	0.09	0.50
BP	0.07	0.33
CP	0.16	0.90
SP	0.34	1.81
DP	0.22	1.21
PM71	0.16	0.84
PM	0.16	0.70
EWC	0.14	0.80

components. The longer-run portfolio simulations are shown in **Table 4**. The 1980 to 2009 Barra-simulated portfolios allow the null hypothesis to be rejected with more than 90% confidence. The F statistic equals 1.5, and the Data Mining Corrections test is estimated to be 0.33. The USER model produces a significantly higher geometric mean than the average model that could have been used to manage assets in the WRDS U.S. stock universe during the 1980 to 2009 time period.

Conclusion

The corporate exports variable is the sum of dividends paid, interest paid, and net equity repurchased less net debt issued. Corporate exports result from dividend, debt, and equity decisions. Companies generating larger corporate exports produce higher active returns in portfolios. The corporate exports variable is statistically significant in producing positive active returns in the portfolios. The returns of the corporate exports portfolio can be increased by constraining the portfolio to include stocks identified by a stock selection model as being undervalued. In this paper, we simulated portfolios during the January 2000 to January 2013 period using a multi-factor risk model. We apply the Markowitz-Xu data mining corrections and find no evidence of data mining. The portfolios developed in this paper are statistically different than the average model that could have been used to create portfolios.

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John B. Guerard, Jr. *McKinley Capital Management, LLC, Anchorage, AK 99503 USA (jguerard@mckinleycapital.com).*
Dr. Guerard is Director of Quantitative Research at McKinley Capital Management, in Anchorage, Alaska. He earned his Ph.D. degree in finance from the University of Texas, Austin. He has published several monographs, including *Quantitative Corporate Finance* (Springer, 2007, with Eli Schwartz) and *The Handbook of Portfolio Construction: Contemporary Applications of Markowitz Techniques* (Springer, 2010). John serves an Associate Editor of the *Journal of Investing* and *The International Journal of Forecasting*.

Harry Markowitz *GuidedChoice, San Diego, CA 92122 USA (hmarkowitz@mckinleycapital.com).*
Dr. Markowitz is the Chief Architect at Guidedchoice.com in San Diego, California, and a Quantitative Research Advisor at McKinley Capital Management LLC in Anchorage, Alaska. He is a Noble Laureate, the father of Modern Portfolio Theory, and named "Man of the Century" by *Pensions and Investments* magazine. He is a recipient of the prestigious John von Neumann Theory Prize for his work in portfolio theory, sparse matrix techniques, and the SIMSCRIP programming language. Dr. Markowitz earned his Ph.D. degree from the University of Chicago. He is a quantitative research scientific advisor at McKinley Capital Management LLC in Anchorage, Alaska.

Ganlin Xu *GuidedChoice, San Diego, CA 92122 USA (gxu@mckinleycapital.com).*
Dr. Xu is the Chief Technology Officer of Guidedchoice.com, where he leads a team of finance, economics, and mathematics experts to develop GuidedChoice's financial methodology, software, and systems. Dr. Xu earned his Ph.D. degree from Carnegie Mellon University. His research on portfolio theory has been published in various journals. He is a quantitative research scientific advisor McKinley Capital Management LLC in Anchorage, Alaska.