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LONG-TERM PORTFOLIO SELECTION STRATEGY TO PRODUCE FUTURE ECONOMIC BENEFITS

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RÉSUMÉ

Ce travail explore la sélection de portefeuille sous un angle différent. Il propose une stratégie de sélection à long terme pour construire des portefeuilles dans lesquels la valeur de marché future dépasse un produit synthétique de référence composé de rentes hypothétiques. La stratégie crée des groupes d'actions en fonction de variables telles que le rapport entre la valeur comptable et la valeur de marché, le ratio bénéfices sur cours, le ratio flux de trésorerie sur cours et la croissance des ventes. Il applique ensuite quatre critères de sélection (*safety-first*, moyenne-variance, moyenne-semivariance et l'équipondération) pour constituer des portefeuilles détenus pendant 30 ans tout en investissant mensuellement un capital prédéterminé et en réinvestissant les dividendes. Nous constatons qu'à l'échéance, la plupart des valeurs marchandes des portefeuilles surperforment confortablement l'indice de référence, et tous les portefeuilles les plus performants franchissent la barrière de 1 million de dollars. De plus, nos résultats suggèrent que la stratégie d'investissement à long terme sélectionne des portefeuilles dont les actifs sont évalués de manière rationnelle au fil du temps, par conséquent, les portefeuilles de croissance surperforment systématiquement les portefeuilles de valeur. Nous constatons également que les critères moyenne-variance et moyenne-semivariance produisent des estimations fortement corrélées, le critère *safety-first* est rigide, et la conclusion remarquable est que le critère de l'équipondération sélectionne systématiquement les portefeuilles les plus performants. Nos résultats suggèrent que la stratégie de sélection proposée peut être utilisée par un investisseur à risque modéré comme base d'une pension de retraite synthétique autogérée.

Mots clés : stratégie de sélection de portefeuille, long terme, comptabilité, *safety-first*, moyenne-variance, moyenne-semivariance, équipondération, pension de retraite synthétique autogérée

ABSTRACT

This work explores portfolio selection from a different perspective. It proposes a long-term selection strategy for building portfolios in which the future market value exceeds a benchmark synthetic product comprised of hypothetical perpetual pension payments. The strategy creates groups of stocks based on variables such as book-to-market equity, earnings-price, cash flow-to-price and sales growth. It then applies four selection criteria (safety-first, mean-variance, mean-semivariance, and equal weight) to form portfolios held for 30 years while making monthly investments of predetermined capital and reinvesting dividends. We find that at maturity most of the portfolios' market values comfortably outperform the benchmark, and all the best performing portfolios cross the $1 million barrier. Moreover, our results suggest that the long-term investment strategy selects portfolios whose assets are priced rationally over time, therefore, growth portfolios consistently outperform value portfolios. We also find that the mean-variance and mean-semivariance criteria produce strongly correlated estimates, the safety-first criterion is rigid, and the noteworthy finding is that the "equal weight" criterion systematically selects the best performing portfolios. Our results suggest that the proposed selection strategy can be used by a moderate-risk investor as the basis for a self-managed synthetic pension.

Keywords: portfolio selection strategy, long-term, accounting, safety-first, mean-variance, mean-semivariance, equal weight, self-managed synthetic pension

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ACRONYMS AND ABBREVIATIONS

AMEX	American Stock Exchange
AUM	Asset Under Management
BE	Book Equity
BIS	Bank for International Settlements
CAD	Canadian Dollar
CANSIM	Canadian Socio-Economic Information Management System (Statistics Canada)
CAPM	Capital Asset Pricing Model
CAViaR	Conditional Autoregressive Value-at-Risk Model
CML	Capital Market Line
CPP	Canada Pension Plan
C/P	Cash Flow-to-Price Ratio
E/P	Earnings-to-Price Ratio
EA	Evolutionary Algorithm
ETF	Exchange-Traded Fund
FRED	Federal Reserve Economic Data (Federal Reserve Bank of St. Louis database)
FSD	First Order Stochastic Dominance
GDP	Gross Domestic Product
HML	High Minus Low (Fama and French three-factor model)
ICAPM	Intertemporal Capital Asset Pricing Model
LEL-RM	Limited Expected Losses Risk Management
LPM	Lower Partial Moment

LPV	Lower Partial Variance
LSV	Lakonishok, Shleifer and Vishny (1994)
ME	Market Equity
MOEA	Multi-Objective Evolutionary Algorithm
MPT	Modern Portfolio Theory
MV	Minimum Variance
NASD	National Association of Securities Dealers
NASDAQ	National Association of Securities Dealers Automated Quotations
NBER	National Bureau of Economic Research (U.S.)
NYSE	New York Stock Exchange
P/E	Price-to-Earnings Ratio
PV	Present Value
ROE	Return on Equity
RRSP	Registered Retirement Savings Plan
SEC	Securities and Exchange Commission
SMB	Small Minus Big (Fama and French three-factor model)
SPAN	Standard Portfolio Analysis of Risk
SR	Sales Rank
SSD	Second Order Stochastic Dominance
TSD	Third Order Stochastic Dominance
TSV	Target Semivariance
U.S.	United States
USD	United States Dollar
VaR	Value at Risk
VaR-RM	VaR-based Risk Management

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INTRODUCTION

A fundamental characteristic of people living in a modern capitalist society is that they can accumulate capital over time. At some point in life, important investment decisions will be made, and it is advisable to have a minimum of financial knowledge. Where and how to invest are questions on the minds of a wide range of people, from the asset and wealth management elite to the humblest worker.

When it comes to long-term investment, some relevant questions can be asked: How to manage risks? How to protect and grow a Registered Retirement Savings Plan (RRSP)[1]? How to manage and increase the wealth of thousands of people whose future depends on the performance of a pension fund? These are decisions worth trillions of dollars globally. Some researchers will argue that individuals are rational in decision-making and try to maximize their utility. Other researchers will say that individuals are irrational, conditioned by the environment and they make biased decisions based on their emotions. Regardless of the school of thought considered, members of this society must either acquire investment skills to manage their wealth or hire the services of a financial advisor.

What is the market value of assets under management (AUM)[2]? The Boston Consulting Group[3] finds that global AUM has emerged strongly from the coronavirus pandemic with 11 percent growth in 2020 to USD 103 trillion[4]. Consulting giant PricewaterhouseCoopers released a report[5] that shows a global exchange-traded fund (ETF) market of USD 10 trillion in 2021 and predicts the industry is on track to exceed USD 20 trillion by 2026.

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[1] Registered Retirement Savings Plan is a regulated retirement account offering tax benefits in Canada.
[2] AUM refers to the total market value of assets that financial institutions control on behalf of clients.
[3] See BCG (2021).
[4] North America is the largest asset management region in the world, worth USD 49 trillion in 2020.
[5] See PwC (2022).

The world is experiencing unprecedented economic conditions. Beginning in 2020, the pandemic forced governments around the world to implement economic policy responses that increased debt levels relative to GDP measures. The Canadian housing market recorded a historic price increase of more than 27 percent[6] over two years, from January 2020 to January 2022. In 2022, the Russian invasion of Ukraine created a humanitarian crisis and a shock to energy commodity prices. Moreover, the persistence of high inflation is forcing central banks to revise their interest rates and gradually end a long cycle of rates close to zero[7]. In this context, long-term investment strategies could protect investors from the uncertainties associated with contemporary economic conditions.

When it comes to investment decisions, there is a universally accepted common sense: "Don't put all your eggs in one basket"[8]. It is advisable to distribute the eggs in several baskets to reduce the risk. This is indeed the definition of diversification, which can be achieved through portfolio selection strategies.

In this work, we propose a long-term portfolio selection strategy targeting future economic benefits. First, we create groups of single-sort and double-sort securities in the sense of Lakonishok, Shleifer and Vishny (1994) and Fama and French (1996). Second, we select portfolios by applying a series of criteria, including Markowitz's (1952) mean-variance, Roy's (1952) safety-first, mean-semivariance, and equal weight. Third, we hold these portfolio investments for 30 years while making monthly investments of predetermined capital and reinvesting dividends. Then, at maturity, we evaluate the cross-section of portfolios and retain the sorting (group) that produces portfolios with the highest average market value, controlled for volatility. Finally, we examine the effectiveness of the economic benefit obtained from the proposed long-term portfolio selection strategy by testing whether the average portfolio market value of the retained sorting outperforms the value of a benchmark synthetic product composed of hypothetical perpetual pension payments.

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[6] See "Teranet and National Bank of Canada. House Price Index - Canada Composite" (2022).
[7] See European Central Bank (2022).
[8] This quote was first recorded in the novel 'Don Quixote' by Miguel de Cervantes (1547-1616): "It is the part of a wise man to keep himself today for tomorrow, and not venture all his eggs in one basket.".

CHAPTER I

LITERATURE REVIEW

This chapter is organized as follows: Section 1.1 compares the pioneering work of Harry Markowitz and Andrew Roy on portfolio selection. Section 1.2 and 1.3 discuss expected portfolio returns from the perspectives of the one-factor model, multifactor model, and accounting measures. In Section 1.4, value investing and fundamental analysis are considered for portfolio selection. Downside risk measures are described in Section 1.5.

1.1 Portfolio Selection and Safety First: Pioneering Work on Portfolio Theory

"Uncertainty is a salient feature of security investment."[9] *– Harry Markowitz*

"A man who seeks advice about his actions will not be grateful for the suggestion that he maximize expected utility."[10] *– Andrew D. Roy*

American economist Harry Markowitz laid the foundations of Modern Portfolio Theory (MPT) with his seminal work (Markowitz (1952)) that earned him the Nobel Prize in Economics[11] in 1990. This theory emphasizes diversification and relies on a mathematical framework to construct expected returns-variance (E-V) portfolios. In Figure 1, the "Efficient

[9] See Markowitz (1959, p. 4).
[10] See Roy (1952, p. 433).
[11] See The Nobel Prize (2022).

Frontier" consists of the envelope curve of all attainable E-V portfolios between the global minimum variance portfolio (MV) and the maximum return portfolio.

Portfolios located on this frontier are considered an efficient set because they respect the E-V maxim proposed by Markowitz (1952): these portfolios offer the maximum expected return for a given variance or produce the minimum variance for a given expected return. Variance, or volatility measured as standard deviation, approximates risk in the context of MPT. Markowitz's main insight is that correlations between different assets can reduce overall portfolio variance. Thus, an optimized asset portfolio implies unsystematic risk reduction through diversification.

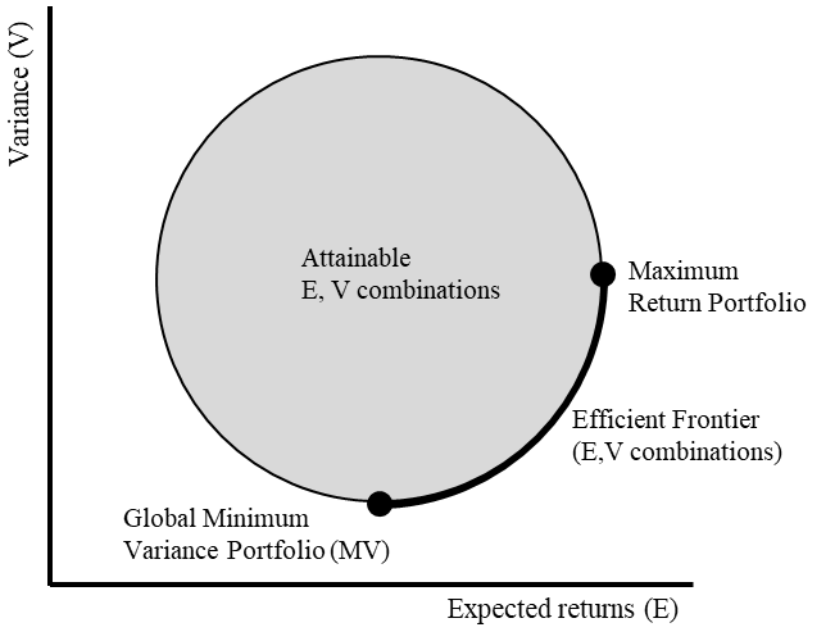

Figure 1 – Efficient Frontier[12]

[12] See Markowitz (1952, p. 82).

The risk (variance) reduction claim is demonstrated by the following formulae. Suppose a portfolio P formed by N securities. Let R_i be the return on the i^{th} security and X_i be the investor's wealth percentage invested in that security. The expected return of the portfolio (R_P) is the weighted average of the expected returns on its securities:

$$\bar{R}_P = \sum_{i=1}^{N} (X_i \bar{R}_i) \quad (1)$$

The variance of portfolio P, denoted by σ_P^2 , is

$$\sigma_P^2 = \sum_{j=1}^{N} \left(X_j^2 \sigma_j^2\right) + \sum_{j=1}^{N} \sum_{\substack{k=1 \\ k \neq j}}^{N} \left(X_j X_k \sigma_{jk}\right) \quad (2)$$

Elton et al. (2014, p. 56) apply some algebraic rearrangements to the portfolio variance equation (2), while considering equal investments in N securities (X_j = 1/N).

The resulting equation of portfolio variance is

$$\sigma_P^2 = \frac{1}{N} \bar{\sigma}_j^2 + \frac{N-1}{N} \bar{\sigma}_{jk} \quad (3)$$

The equation (3) decomposes the contributions of variances and covariances to the overall portfolio variance (σ_P^2). As the number of securities in the portfolio (N) increases significantly, the effects of the variances of the individual securities tend to disappear and portfolio variance approaches the average covariance $\bar{\sigma}_{jk}$.

The E-V maxim can be achieved through portfolio optimization by selecting the weights assigned to each security that makes up the portfolio. These weights respect two mathematical constraints.

The first constraint is that (i) the sum of the weights assigned to the securities must equal unity, and the second constraint is that (ii) no short selling is allowed, so the weights must be positive:

$$\sum_{i=1}^{N} X_i = 1 \tag{4}$$

$$X_i \geq 0 \quad for\ i = 1, 2, 3, \ldots, N \tag{5}$$

Markowitz (1952) proposes a mathematical optimization exercise that takes a system of four equations (1), (2), (4) and (5) to build an "Efficient Frontier" of (E,V) combinations: for a given portfolio expected return E, find the set of weights X_i that minimizes the portfolio variance. Similarly, for a given portfolio variance V, find the set of weights X_i that maximizes the expected return E of the portfolio.

Diversification is an important risk management tool and certainly does not find its *raison d'être* merely in the number of different securities held in the portfolio. Markowitz (1952, p. 89) postulates that: "It is necessary to avoid investing in securities with high covariances among themselves. We should diversify across industries …". His great insight is that diversification is about mastering covariances (correlations) to mitigate unsystematic risk.

Andrew D. Roy was a British economist who made fundamental contribution to portfolio selection research. His best-known work "Safety First" criterion was published in 1952, the same year as Markowitz's "Portfolio Selection". Roy (1952) also proposed selecting securities to form portfolios based on expected returns-variance trade-off, but the main difference from Markowitz (1952) lies in the risk management perspective. By adopting the safety-first approach, investors constantly seek to protect the principal. This means setting a minimum acceptable return and allowing the weights assigned to any security to be positive or negative. If returns are below the minimum target, it implies that a disaster has occurred.

Roy (1952) disagrees with the theory that individuals are always willing to maximize their expected utility (von Neumann and Morgenstern (1944)). In his view, decisions made in practice are less sensitive to marginal increments in utility and are more intended to avoid economic disasters. In the field of investments, a disaster can be one of following future states of the world: (i) net loss, (ii) principal erosion due to inflation or (iii) returns lower than those possibly obtained through riskless investment alternatives. From a different point of view, reducing the probability of disaster can be considered as maximizing expected utility when the utility function produces binary results: a disaster occurs, or it does not occur.

Roy (1952) argues that to achieve the highest level of safety the investor must simply maximize the safety-first ratio:

$$\frac{(m-d)}{\sigma} \qquad (6)$$

where m is the expected return, d is the disastrous return, and σ is the standard deviation of return. This ratio is similar to the two reward-to-variability ratios developed by Sharpe and Treynor, which measure the risk premium per unity of risk taken for an investment.

Baumol (1963) proposes an amendment to Markowitz's portfolio selection approach, notably the way standard deviation is used as a measure of risk. He wrote (p. 174): "An investment with a relatively high standard deviation will be relatively safe if its expected value is sufficiently high.".

Baumol (1963) argues that an alternative efficient portfolio criterion should incorporate a *lower confidence limit* (L), based on standard probability theory:

$$L = E - K\sigma \qquad (7)$$

where E is the expected portfolio return, K is a chosen constant and σ is the standard deviation of return. The alternative (E, L) efficient portfolios are a subset of Markowitz's (E, V) efficient set. An investor expresses her risk preferences by properly selecting a value for K. The proposed efficient set (E, L) tends to the efficient set (E, V) as K becomes large towards infinity.

1.2 Expected Stock Returns: One-Factor CAPM

"Some investments do have higher expected returns than others. Which ones? Well, by and large they're the ones that will do the worst in bad times." [13] *– William F. Sharpe*

The portfolio theory introduced by Markowitz (1952) helps individual investors make asset allocation decisions under conditions of uncertainty and reduce unsystematic risk. However, systematic risk mitigation requires a more elaborate tool: a general equilibrium model that captures aggregate investor behavior and associated stock returns.

A standard general equilibrium model was developed independently by Sharpe (1964), Lintner (1965) and Mossin (1966): capital asset pricing model (CAPM). This model, also known as *one-factor capital asset pricing model*, describes the relationship between systematic risk and expected return of securities or portfolios of securities. It relies on a set of assumptions. While the full set of assumptions is important for the CAPM model, the following three are the most relevant for this review. The first assumption is that investors are expected to make decisions based entirely on expected portfolio returns and variances (E, V) in the sense of Markowitz (1952). The second assumption is that all investors are assumed to have identical expectations regarding expected returns, variance of returns and correlations between all stock pairs. The third assumption is that there is a risk-free security in which investors can borrow or lend unlimited funds at the risk-free rate.

Under CAPM assumptions, in equilibrium, all investors agree on the efficient frontier depicted in Figure 2. The straight line denotes the *capital market line* (CML). It passes through the risk-free (R_F) intercept point and the efficient frontier tangency point (M) representing the market portfolio. All *efficient portfolios* lie along the CML line, so investors will hold portfolios that are combinations of the risk-free (R_F) security (borrow or lend) and the risky market portfolio (M).

[13] See Sharpe (2007).

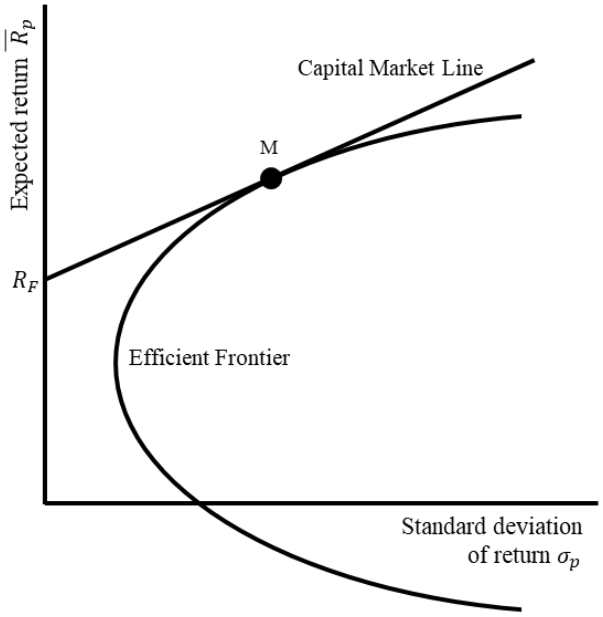

Figure 2 – Efficient Frontier and Capital Market Line[14]

The following equations (8), (9), (10), and (11) are demonstrated by Elton et al. (2014, pp. 293, 296, 297). The CML equation represents the expected return of the efficient portfolio $\bar{R}_e$:

$$\bar{R}_e = R_F + \frac{\bar{R}_M - R_F}{\sigma_M}\sigma_e \quad (8)$$

where R_F is the risk-free rate, $\bar{R}_M$ is the expected market portfolio return, σ_M is the standard deviation of market portfolio return and σ_e is the standard deviation of efficient portfolio return.

The important insight from equation (8) is that excess return $(\bar{R}_e - R_F)$ of the efficient portfolio is basically the market price of risk $[\frac{(\bar{R}_M - R_F)}{\sigma_M}]$ times the amount of portfolio risk σ_e. The price of risk is indeed Roy's "Safety First" ratio.

[14] See Elton et al. (2014, p. 293).

The best-known CAPM equation states that the expected return of i^{th} security or portfolio of securities (whether efficient or not) $\bar{R}_i$ is

$$\bar{R}_i = R_F + \beta_i(\bar{R}_M - R_F) \quad (9)$$

where R_F is the risk-free rate, $\bar{R}_M$ is the expected market portfolio return and β_i is a constant that measures the rate of change in $\bar{R}_i$ given changes in the market portfolio excess return (also known as the beta of the investment).

The β_i is the covariance between the i^{th} security and the market portfolio divided by the market variance:

$$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2} \quad (10)$$

The CAPM equation can be rearranged as a combination of equations (9) and (10):

$$\bar{R}_i = R_F + \left(\frac{\bar{R}_M - R_F}{\sigma_M}\right)\frac{\sigma_{iM}}{\sigma_M} \quad (11)$$

where σ_{iM} is the covariance between the i^{th} security and the market portfolio and σ_M is the standard deviation of market portfolio return.

Like equation (8), equation (11) states that the expected return of any security i, whether efficient or not, $(\bar{R}_i)$ is time value of money R_F plus the market price of risk $[\frac{(\bar{R}_M - R_F)}{\sigma_M}]$ times the amount of risk in the security $[\frac{\sigma_{iM}}{\sigma_M}]$. The price of risk is captured by both reward-to-variability ratios: Sharpe and Treynor.

1.3 Expected Stock Returns: Multifactor Models and Accounting Measures

"In an efficient market, at any point in time, the actual price of a security will be a good estimate of its intrinsic value." [15] *– Eugene Fama*

The capital asset pricing model independently developed by Sharpe (1964), Lintner (1965) and Mossin (1966) enjoyed considerable popularity in the finance field. This is due to its simplicity. The expected return of all securities and portfolios in the market can be determined by one simple measure: the security's beta (β_i), as described in equation (9). There are many criticisms of the CAPM model. It assumes variance of returns as risk measurement, which implies returns normally distributed. The model is also criticized by practitioners and academics for its single-period nature and for the assumptions of constant risk (non time-varying betas).

Merton (1973) proposed the intertemporal capital asset pricing model (ICAPM) as an alternative to the CAPM. He describes consumer-investors who participate in the market for multiple years, therefore its "intertemporal" nature. ICAPM is a consumption-based model that extends CAPM by introducing state variables to account for investors' hedging strategies against changes in the *investment opportunity set* and declining consumption. This intertemporal equilibrium model includes additional factors and k state variables that shift the investment opportunity:

$$\bar{R}_i = R_F + \beta_{iM}(\bar{R}_M - R_F) + \beta_{iH_1}\left(\bar{R}_{H_1} - R_F\right) + \cdots + \beta_{iH_k}(\bar{R}_{H_k} - R_F) \qquad (12)$$

where all $\bar{R}_{H_j}$ are the expected return on the j^{th} hedge (H) portfolio selected by the investor to mitigate against the j^{th} state variable, R_F is the risk-free rate, $\bar{R}_M$ is the expected market portfolio return, β_{iM} is the sensitivity of the i^{th} security to the excess return of the market portfolio and β_{iH_j} is the sensitivity of i^{th} security to the excess return of the j^{th} hedge portfolio.

[15] See Fama (1965, p. 56).

Fama and French (1992) argue that CAPM faces empirical contradictions. They find that the relation between β and average return disappears during 1963-1990 period. Moreover, this simple relation is also weak in the 50-year 1941-1990 period. Their review shows evidence of size and accounting measures helping to explain the average returns on U.S. stocks (NYSE, AMEX and NASDAQ). They analyzed the cross-section of average stock returns, focusing on variables such as market equity ME (the stock's price times shares outstanding), book-to-market equity BE/ME (the ratio of a firm's book value of common equity to its market value), earnings-price ratio E/P (the ratio of a firm's earnings to its market value) and leverage (ratios of the firm's total assets, A, to both its book value and its market value). Fama and French (1992) find that size (ME) and book-to-market equity (BE/ME) capture the cross-sectional variation in average stock returns. For firms of equivalent size, the returns increase as book-to-market equity increases. Conversely, for firms of equivalent book-to-market equity, returns decline as size increases. Thus, the highest return was observed in the combinations of low ME and high BE/ME portfolios.

Lakonishok, Shleifer and Vishny (LSV 1994) suggest that value investing strategies outperform the U.S. stock market (NYSE and AMEX) during 1968-1990 period. A value strategy favors buying stocks with fundamental value, including high book-to-market equity (BE/ME), high earnings-price ratio (E/P) and high dividend yield. LSV use a special name for firms with such characteristics: "value" stocks. However, firms with opposite characteristics are called "glamour"[16] stocks: low book-to-market equity, low earnings-price ratio and low (or non-existent) dividend yield. In addition to the accounting measures (BE/ME and E/P) explored by Fama and French (1992), LSV also evaluated cash flow-to-price (C/P) and 5-year sales growth ranks. They find that value strategies significantly outperform glamour strategies for classifications of firms by a single accounting measure and investment holding period of 5 years.

LSV also investigated two-dimensional classifications (double-sorted portfolios) to differentiate return spreads more accurately. They coupled classifications on sales rank with classifications on BE/ME, E/P, and C/P. These two-dimensional classifications examine the

relation between past performance (information about past growth in sales, earnings, and cash flow) and expected performance (current price to earnings and cash flow ratios).

LSV find that sales growth has significant explanatory power on returns. Additionally, double-sorted value portfolios produce returns 10-11 percent per year higher than glamour double-sorted counterparts. They disagree with the assumption that value stocks are *by definition fundamentally riskier* to explain the higher returns of value stocks. They are, however, unable to reject it. Higher returns from value strategies can be attributed to stocks that are undervalued relative to their risk and return characteristics when individual and institutional investors have high expectations for the future growth of glamour firms.

Fama and French (1996) argue that a multifactor model explains asset price anomalies, notably the average stock return pattern not explained by CAPM. They propose a *three-factor model* to capture these anomalies. The model states that expected return on a portfolio in excess of the risk-free rate is explained by its sensitivity to three-factors: (i) the excess return on a market portfolio, which captures market risk; (ii) the difference between the return on a portfolio of small-capitalization stocks and the return on a portfolio of large-capitalization stocks (SMB, small minus big); and (iii) the difference between the return on a portfolio of high book-to-market stocks and the return on a portfolio of low book-to-market stocks (HML, high minus low). The Fama and French equation for the three-factor model is

$$E(R_i) - R_F = b_i[E(R_M) - R_F] + s_i E(SMB) + h_i E(HML) \quad (13)$$

where $E(R_i)$ is the expected return on i^{th} security, R_F is the risk-free rate, b_i is the sensitivity of the i^{th} security to the excess return of the market, s_i is the sensitivity of the i^{th} security to the expected return of the SMB factor and h_i is the sensitivity of the i^{th} security to the expected return of the HML factor.

[16] "Growth" stock is the term commonly used these days to refer to firms with these characteristics.

Fama and French (1996) apply the three-factor model to LSV's single-sort and double-sort (sales rank combined with BE/ME, E/P and C/P) portfolio formation strategies over the period 1963-1993 in NYSE stock market. They find that the three-factor model describes the returns of both single-sort and double-sort portfolios very well and confirms LSV: distressed portfolios (high BE/ME, E/P, C/P, low sales rank) outperform[17] strong portfolios (low BE/ME, E/P, C/P, high sales rank) in terms of average returns. Moreover, they suggest that (i) strong positive loadings on SMB and HML proxy for relative stock distress and (ii) strong negative loadings on HML proxy for strong stocks.

1.4 Value Investing, Fundamental Analysis, and Intrinsic Value

"You have to understand accounting and you have to understand the nuances of accounting. It's the language of business and it's an imperfect language, but unless you are willing to put in the effort to learn accounting – how to read and interpret financial statements – you really shouldn't select stocks yourself."[18] *– Warren Buffett*

Benjamin Graham was a British-born American investor and researcher. The experiences of the stock market crash of 1929 inspired him to write two pioneering books on value investing: (i) *Security Analysis*[19] and (ii) *The Intelligent Investor*[20]. Value investing is a long-term investment strategy that uses fundamental analysis (the use of publicly available data from financial statements to assess company fundamentals, including earnings, growth, assets, and liabilities) to determine the intrinsic value of the business. In turn, the intrinsic value of a business is the number that represents the present value of all expected future cash flows, discounted at the appropriate discount rate.

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[17] Regressions have strong explanatory power, with most R^2 values above 0.92.
[18] See Buffet & Clark (2008, p. 1).
[19] See Graham and Dodd (1934).
[20] See Graham (1949).

American investor Peter Lynch, the legendary former manager of Fidelity's Magellan Fund and one of the most successful portfolio managers in recent history, wrote: "Although it's easy to forget sometimes, a share of stock is not a lottery ticket. It's part ownership of a business." (Lynch (1989, pp. 161-162)). Markets are very sensitive to news about businesses and the economy. Social media platforms can sometimes strongly influence stock prices by creating narratives in certain online communities that result in coordinated actions on target stocks (meme stocks). Add human behaviors (greed and fear) to news and hype, then the price set by the market may not necessarily reflect the intrinsic value of the underlying business. In the efficient market hypothesis perspective, Shiller (1981, 2015), Summers (1986), Fama and French (1988) suggest that prices will return to the intrinsic value of assets.

In recent years, researchers have attempted to integrate fundamental analysis into the portfolio selection process. Silva, et al. (2015) propose a selection model incorporating fundamental analysis, technical analysis, and optimization by a multi-objective evolutionary algorithm (MOEA). They use this evolutionary algorithm (EA)[21] to analyze three strategies for selecting portfolios of S&P 500 firms for investment holding periods in the 2010-2014 range. The first strategy combines seven fundamental parameters (debt ratio, return on equity (ROE), profit margin, price-to-earnings (P/E), revenue growth, changes in common shares outstanding, net income) with five technical parameters, such as minimum global value (firm valuation), stop loss, profit level to determine investment exit points, simple moving average period of the price to trigger the entry point of the investment, and position size (stock weights). The second strategy builds a portfolio that always keeps a fixed number of assets. It uses the same financial parameters and position size of the first strategy and introduces a parameter for the number of stocks in the portfolio. The third strategy aims to improve the efficiency of the MOEA algorithm. It adds three fundamental parameters (payout ratio, growth in capital expenditure, and growth in cash from operating activities) to the set of financial and technical parameters of the first strategy.

[21] Evolutionary algorithms apply processes of biological evolution (such as natural selection, reproduction, mutation, and recombination) to solve mathematical optimization problems. The Multi-Objective Evolutionary Algorithm is a multi-objective version of EA, solving optimization problems using more than one objective function simultaneously.

Silva, et al. (2015) find that all three strategies produce results that often outperform[22] the S&P 500 index for the periods considered. The first strategy selects conservative portfolios with focus on well-established businesses with monopoly characteristics, focusing on ROE and net income growth. The best performing portfolio in this strategy produces a risk-return[23] ratio of 3.64, while S&P 500 index produces a ratio of 2.02. Silva, et al. (2015) show that the second strategy selects firms with higher profit margins and net income. The best performance yields a risk-return ratio of 7.66, outperforming the 2.36 ratio of the S&P 500 index over the same period. Finally, the third strategy favors ROE, profit margin, capital expenditures, and cash for operating activities, with the best portfolio generating a risk-return ratio of 3.53, while the S&P 500 index produces a ratio of 2.53.

Zhang and Yan (2018) propose a portfolio selection strategy based on fundamental analysis and a continuous-time model, through stochastic processes. They assume that the market price of a risky security can be split into two components: (i) its intrinsic value and (ii) a mispricing component described by a geometric mean-reversion process. Zhang and Yan (2018) follow Treynor and Black (1973) and Sharpe's (1963) Diagonal Model, considering an investor who allocates her wealth to a number of near-independent risky securities and a risk-free asset, then solving an instantaneous mean-variance optimization problem based on quadratic utility. Moreover, they use a set of stochastic differential equations to analytically derive the expected *appraisal ratio* ($E[AR]$) and *information ratio* ($\sqrt{E(AR)}$), used to measure the performance of optimum portfolio selection. The data sample encompasses all common shares of U.S. companies listed on NYSE, AMEX, and NASDAQ for the period 1927-2011. The portfolios contain 90 stocks and are selected according to a wide range of parameters, including mean-reversion speed of mispricing, volatility of the mispricing, volatility of the fundamental, dividend yield, mean-reversion level of the mispricing, the number of investable securities, and the standard deviation of active return.

[22] The investment period of these MOEA strategies is four years (2010-2014). Future work could potentially focus on longer periods (e.g., 1960-2020) to test the strategy's robustness to recessions.
[23] In this context, the risk-return is the ratio between the portfolio (index) return and its standard deviation: R_j/σ_j.

Zhang and Yan (2018) find that for stocks that do not pay dividends, more than 76 percent of the results present information ratios greater than one. This is considered a good performance because only the top 10 percent of active portfolio managers can achieve these results (Grinold and Kahn (1999)). For stocks that pay dividends, they find even higher information ratios, suggesting that dividends make fundamental analysis even more relevant as a portfolio selection strategy.

1.5 Downside Risk Measures: Only Below-Mean Returns Worry Investors

"Don't cross a river if it is four feet deep on average."[24] *– Nassim Nicholas Taleb*

Markowitz's (1952) mean-variance portfolio selection criterion laid the foundations for modern portfolio theory. This theory has come under criticism over the years. Economists and investment practitioners criticize the theory mainly for the following characteristics: (i) it is the optimal selection criterion only if the utility function is quadratic, implying an increasing absolute risk aversion[25], (ii) its assumptions that returns follow a Gaussian distribution, and (iii) to use volatility (stock price changes) as a proxy for risk measures.

Roy's (1952) safety-first is pioneering work on a concept called downside risk, an alternative risk management approach to dealing with non-normal and non-symmetrical return distributions. The safety-first criterion can be thought of as below-target semivariance. Markowitz (1959, p. 194) acknowledges the effectiveness of analysis based on below-mean semivariance when returns are distributed asymmetrically (skewed): "Analyses based on S [semivariance] tend to produce better portfolios then those based on V [variance]. Variance considers extremely high and extremely low returns equally undesirable. An analysis based

[24] See Taleb (2007, p. 161).

[25] Absolute risk aversion changes with wealth. Increasing (constant, decreasing) absolute risk aversion is characterized by investors holding fewer (same amount, more) dollars in a risky asset as her wealth increases. It can be measured by the Arrow-Pratt absolute risk aversion coefficient: $A(w) = -\frac{U''(w)}{U'(w)}$ where $U'(w)$ and $U''(w)$ are the first and second utility function derivatives with respect to wealth (w).

on V seeks to eliminate both extremes. An analysis based on S_E [below-mean semivariance], on the other hand, concentrates on reducing losses.".

The general case of downside risk is called *lower partial moments* (LPM) and was developed by Bawa (1975) and Fishburn (1977). Special cases of LPM are (i) semivariance (measure of the dispersion of returns below mean or target value) and (ii) value at risk (commonly used by banks to measure the risk of potential investment loss, with a given probability, over a specific period of time).

Bawa (1975) proposes a portfolio selection rule based on stochastic dominance[26]. He argues that a third order stochastic dominance (TSD)[27] is the optimal selection rule, given the entire class of distribution functions and a class of *decreasing absolute risk averse utility functions*. This proposal responds to the criticism of the mean-variance quadratic utility function (increasing absolute risk aversion).

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[26] Stochastic dominance is a concept in decision theory that allows the ordering of random variables, referring to situations where one probability distribution can be ranked as superior to another. This requires limited knowledge of individuals' preferences for outcomes (utility).

[27] Stochastic dominance can be classified into: (i) first-order (FSD), (ii) second-order (SSD), and (iii) third-order. Risk-averse investors seeking to maximize expected utility prefer second-order stochastic dominance. For any two cumulative distribution functions F and G, the stochastic dominance relations are:

(a) F FSD G if and only if
$F \neq G$ and $F(x) \leq G(x)$ for all x

(b) F SSD G if and only if
$F \neq G$ and $F_1(x) \leq G_1(x)$ for all x
Equivalently, F SSD G if and only if
$E[u(F)] \geq E[u(G)]$ for all nondecreasing and concave utility functions $u(x)$

(c) F TSD G if and only if
$F \neq G$ and $F_2(x) \leq G_2(x)$ for all x
Equivalently, F TSD G if and only if
$E_F U(x) \geq E_G U(x)$ for all nondecreasing and concave utility functions U that are positively skewed

Bawa (1975) demonstrates that mean-lower partial variance (mean-LPV) rule is a valid approximation to TSD, thus the optimal selection rule. The lower partial variance $LPV_F(x)$ for distribution $F(x)$ is

$$LPV_F(x) \equiv \int_a^x (y-x)^2 dF(y) \qquad (14)$$

which represents the generalization of below-target and below-mean semivariance.

Fishburn (1977) proposes a general mean-risk dominance model for selecting portfolios with uncertain return, in which risk is measured by a probability-weighted function of deviations below a specified target return. The special case of this model is the α-t model[28]:

$$F_\alpha(\mathrm{t}) = \int_{-\infty}^{t} (t-x)^\alpha \, dF(x) \qquad \alpha > 0 \qquad (15)$$

where α is the level of investor risk tolerance and t is the target return.

Fishburn (1977) extends Bawa (1975) by providing a fractional parameter α, allowing a large number of Von Neumann-Morgenstern utility functions. The α-t model deals with the risk associated with the inability to achieve a target return t, shared by a number of investment decision makers. Fishburn (1977) finds that in terms of utility and risk attitude (i) $\alpha < 1$ represents a risk-seeking investor, (ii) $\alpha = 1$ indicates a risk-neutral investor, and (iii) a risk-averse investor is denoted by $\alpha > 1$, where higher values imply higher risk aversion. Moreover, the semivariance is characterized by $\alpha = 2$.

Downside risk measures (safety-first, semivariance and LPM) were not popular in the daily practice of investment firms, banks, and regulators in the late 1980s. The "Black Monday" (October 19, 1987) refers to the famous stock market crash around the world, a domino effect that generated losses in various markets, including the United States (22.68

[28] Fishburn (1977) shows that the efficient set for the α-t model is a subset of: (a) FSD efficient set for all $\alpha \geq 0$; (b) SSD efficient set for all $\alpha \geq 1$, and (c) TSD efficient set for all $\alpha \geq 2$.

percent), Canada (22.50 percent), the United Kingdom (26.45 percent), Hong Kong (45.50 percent), and Australia (41.80 percent). This "black swan"[29] led financial institutions and regulators towards a new approach of risk measurement: value at risk (VaR). VaR is a statistic that measures the value that a given portfolio could lose over a given period, for a given probability.

The Securities and Exchange Commission (SEC)[30] requires registrants to disclose their exposure to market risk and VaR is one of the permitted compliance measures. Furthermore, the Basel Committee on Banking Supervision[31] of the Bank for International Settlements (BIS) includes VaR measures in its risk analysis framework. The BIS requires financial institutions, including banks, credit institutions and investment firms, to comply with liquidity requirements to cover market risks associated with their day-to-day activities.

There are many academic literatures on VaR. Duffie and Pan (1997) focus on VaR measures by analyzing stochastic volatility and probability distributions, as well as their effects on portfolios with or without derivatives. Basak and Shapiro (2001) propose an alternative risk management model (LEL-RM) in which expected losses are limited, an enhancement of Var-based risk management (VaR-RM) that focuses on the probability of a loss. Artzner, et al. (1999) present a set of desirable (coherent) properties for risk measures and apply them to the analysis of three existing risk measurement methods: (i) the "variance-quantile" method of VaR; (ii) the Standard Portfolio Analysis of Risk (SPAN) margin system developed by the Chicago Mercantile Exchange; (iii) SEC's margin rules, which are used by the National Association of Securities Dealers (NASD). Engle and Manganelli (2004) propose a new approach to VaR, namely Conditional Autoregressive Value at Risk (CAViaR) which models the quantile, as opposed to modeling the whole distribution, and assumes that tails are generated by a process different from the process producing the rest of the distribution.

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[29] Metaphor used by Taleb (2007) to describe an outlier event of extreme impact.
[30] See Securities and Exchange Commission (1997).
[31] See Basel Committee on Banking Supervision (2005).

CHAPTER II

METHODOLOGY

The purpose of this work is to assess whether a long-term portfolio selection strategy held for 30 years can produce future economic benefits (portfolio market value) that exceed the value of a benchmark synthetic product comprised of hypothetical perpetual pension payments, evaluated at the end of the last investment year.

The strategy explores a series of selection criteria. It is based on accounting classification groups, monthly investments of predetermined capital and dividend reinvestments. If the strategy outperforms the benchmark synthetic product, we want to determine the characteristics observed at the investment start date of the strategy that produced the best performing portfolios 30 years later. These characteristics include the accounting measures of the classification group and the selection criterion applied: safety-first, mean-variance, mean-semivariance, or equal weight.

All references to currency, including wages, share prices, dividends, and portfolio market value are deemed to be in U.S. dollars and hereafter represented by symbol "$". Canadian dollar is always denoted by the code CAD and all conversions between the U.S. dollar and the Canadian dollar adopt the exchange rate recorded on December 31, 2021, where 1 USD = 1.2678 CAD[32].

[32] See daily exchange rates in Bank of Canada (2022).

2.1 Data

In this work, we consider the universe of stocks listed on NYSE, AMEX, and NASDAQ. Two distinct periods are considered in the implementation of the strategy. First, the *portfolio selection analysis period* begins at least 5 years before the start of the investment in year t and ends at the end of December in year $t-1$. Thus, for a given portfolio, the first year of the selection analysis period will be the oldest for which share price data is available for all the securities in this portfolio, for a minimum of 5 years. Second, the *portfolio investment holding period* is 30 years, from January 1992 (portfolio formation date) to December 2021. The investment holding period experienced three recessions[33]: (i) Dot-com bubble (March 2001–November 2001), (ii) Great Recession (December 2007–June 2009), and (iii) COVID-19 pandemic (February 2020–April 2020).

We use four data sources. First, COMPUSTAT provides data on accounting, dividends, and stock split. Second, Yahoo Finance is the source of share price data. Third, "U.S. federal minimum hourly wage for nonfarm workers" data comes from FRED[34] database. Finally, the U.S. Department of the Treasury[35] is the source of daily treasury par yield curve rates data.

The universe of stocks is formed from the three target stock markets. It includes all sectors and firms that are active (COMPUSTAT) on the portfolio formation date, however the selection criteria only contemplate stocks for which the price data meets two requirements: (i) it is available throughout the portfolio selection analysis period, implying firms that have been in business for 5 years or more, and (ii) it is available throughout the investment holding period. The latter could perhaps produce results blended with a survival or look-ahead bias. Nevertheless, the methodology is constructed in such a way as to potentially mitigate these biases. First, our main goal is to determine the accounting measures of the classification group that produces the best performing portfolios and selection criterion

[33] See U.S. National Bureau of Economic Research (NBER) (2022).
[34] See Federal Reserve Economic Data (FRED) (2022).
[35] See U.S. Department of the Treasury (2022).

applied. It is the characteristics of the group that matter, as opposed to the characteristics of the individual stocks that could eventually fail over the 30-year holding period of the investments. Second, at the portfolio formation date, we select portfolios in the cross-section of all sectors of the three major U.S. stock exchanges. There is no weighting used to balance sectors, nor sectors withdrawn from the study. It should mitigate any asymmetry that a specific sector might cause to the results, should it decline or no longer be needed in the economy during the holding period of the investment.

We use the annual accounting data (COMPUSTAT) for year $t-1$ to calculate the book-to-market, the earnings-price and the cash flow-to-price ratios considered in the strategy for selecting portfolios in which the investment begins in year t. Only firms with positive ratios are retained by the strategy.

Our sales growth metric is the five-year sales ranking documented by Fama and French (1996) and originally proposed by Lakonishok, Shleifer and Vishny (1994). For a given portfolio investment start year t, the sales rank is the weighted average of annual sales growth ranks of the previous five years[36]:

$$5\text{-}Yr\ SR(t) = \sum_{j=1}^{5} (6-j) \times Rank(t-j) \qquad (16)$$

2.2 The Benchmark Synthetic Product

We examine the effectiveness of the economic benefit obtained from the proposed long-term portfolio selection strategy by comparing the mean portfolio market value of the retained sorting (group of stocks) with the value of a benchmark synthetic product. This product consists of a hypothetical perpetuity in which the payments mimic the payments received from a proxy pension. The benchmark value is then the present value of such perpetuity.

[36] Sales *growth* is ranked in descending order: a low (high) sales *rank* means growth (value) stock. The sales *growth* for year $t-j$ is the percentage change in sales between years $t-j-1$ and $t-j$.

Our proxy pension is the Canada Pension Plan (CPP) [37]. It shares similarities with our proposed long-term portfolio selection strategy, including predetermined monthly contributions (investments), no transaction costs or taxes, buy and hold approach, and a long-term investment horizon. CPP is a benefit paid monthly after retirement. Contributions are compulsory for working people aged 18 to 70, and they are divided equally between employees and employers, on annual earnings between the basic exemption amount (CAD 3,500 in 2021) and the maximum annual pensionable earnings (CAD 61,600 in 2021). In 2021, the combined employee and employer CPP contributions amounted to 10.9 percent [38] of the pensionable earnings, for a *maximum* annual total of CAD 6,332.90 ($4,995.19), or CAD 527.74 ($416.27) per month[39]. Moreover, the *maximum* monthly CPP payment to someone starting to receive a pension at standard age of 65 was approximately CAD 1,193 ($941), or CAD 14,316 ($11,292) per year.

The benchmark value is the present value (PV) of our hypothetical perpetuity:

$$PV = \frac{C}{r} \tag{17}$$

where C is the amount of cash payment and r is the interest rate. To calculate the benchmark value, we use equation (17) and set C to the maximum annual CPP payment ($11,292). For the interest rate r, we use the Statistics Canada's CANSIM series[40] "Long-term Government of Canada benchmark bond yield" recorded in December 2021 at 1.76 percent. As of December 2021, the rounded value of our benchmark synthetic product is $642,000.

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[37] See Canada Pension Plan (2022).
[38] Self-employed workers pay the full rate.
[39] We divide the maximum annual CPP contribution by 12 to obtain an equivalent monthly figure, which facilitates the calculations of the long-term strategy's monthly cash investments. Employers may use a different schedule to record CPP contributions.
[40] See Statistics Canada - Data (2022). CANSIM series V122544: "Long-term Government of Canada benchmark bond yield". The Canadian Institute of Actuaries issues a recommendation for calculating the commuted value of pensions, in which V122544 is used to derive the discount interest rate.

2.3 Single-Sort and Double-Sort Stock Groups

Lakonishok, Shleifer and Vishny (LSV 1994) adopt aliases for businesses that share similar accounting measures. “Value” stocks have high ratios of BE/ME, E/P and C/P. In contrast, “glamour” stocks show low ratios of these measures. We recognize that these aliases facilitate cross-sectional interpretation of the results, which is why we adopt in this work similar aliases adjusted to the current stock market metaphors: “value” and “growth”.

LSV suggest stock groups formed on single-sort and double-sort basis to analyze cross-sectional portfolio returns. We follow their proposed method. Our stock universe includes all active stocks (COMPUSTAT) listed on NYSE, AMEX, and NASDAQ at the end of December 1991 (the reference date) for portfolio investments starting in January 1992.

To construct single-sort stock groups, we use the reference date and compute accounting measures for all stocks, then divide the universe into BE/ME deciles, according to breakpoints (see Appendix A). It creates the first set of ten stock groups. Similarly, the universe is divided into E/P deciles, C/P deciles, and 5-year sales rank (SR) deciles to form three additional sets of stock groups, for a total of four sets of ten stock groups. For example, the set BE/ME contains the following stock groups: {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}.

Double-sorted stock groups are intended to mitigate the tendency for correlation between accounting ratios that rely on share prices. These groups represent a combination of SR sorts with sorts on BE/ME, E/P and C/P. In the process of constructing double-sort stock groups, we first compute the accounting measures for all stocks. Next, we separately sort the universe into three groups (low 30 percent, medium 40 percent, and high 30 percent: 1, 2, and 3) according to their BE/ME, E/P, C/P ratios, and the reference date. Low-ratio groups (1) are considered growth stocks and high-ratio groups (3) refer to value stocks, in the sense of LSV. The universe is also divided into three sorted sales rank metric groups: (1) high 30 percent, (2) medium 40 percent, and (3) low 30 percent. Note that firm’s *sales growth* is ranked in descending order. A low *sales rank* metric means growth stock (SR group 3), similarly a high *sales rank* metric means value stock (SR group 1). We then repeat the procedure of sorting

the universe into three groups for the remaining accounting measures. Finally, we form three sets of nine stock groups from the intersections of SR sort and the sorts on BE/ME, E/P and C/P. For instance, the set "C/P and Sales Rank" contains the following stock groups {1-1, 1-2, 1-3, 2-1, 2-2, 2-3, 3-1, 3-2, 3-3} where: (i) the group with the strongest growth characteristics is 1-3, representing low C/P (1) and low sales rank (3), and (ii) the group with the strongest value characteristics is 3-1 for high C/P (3) and high sales rank (1).

2.4 Four Portfolio Selection Criteria

The selection analysis uses monthly data over a period of at least 5 years for a given portfolio. The first observation of price data is the oldest year-month date for which share price data is available for all the securities in that portfolio. The last observation of price data is from December 1991.

We separately apply four criteria to select portfolios with the ultimate goal of determining which strategy yields the greatest economic benefit, translated into portfolios with the highest average market value (controlled for volatility) at the end of the investment holding period, 30 years later. The first criterion is simply portfolios of stocks of equal weight. The second criterion is the mean-variance of Markowitz (1952), using the global minimum variance portfolio on the efficient frontier. The next two criteria adopt the 30-year U.S. Treasury[41] yield recorded on December 31, 1991 (7.41 percent) as the reference rate. The third criterion is Roy's (1952) safety-first: we maximize safety-first ratio first presented in equation (6) and set the disastrous level d to the Treasury yield reference rate. The last criterion is the mean-semivariance, applying a below-target semivariance[42] based on the Treasury yield reference rate (target) to select the global minimum semivariance portfolios.

[41] See U.S. Department of the Treasury (2022).

[42] Below-target semivariance: $TSV = \frac{1}{n}\sum_{for\ all\ X_i<t}^{n}(X_i - t)^2$ where t is the target and n is the total number of sample observations.

2.5 Assumptions Behind the Long-Term Portfolio Selection Strategy

The strategy requires a small set of assumptions inspired by the CAPM model. The first assumption is that portfolios are stock-only. No short selling is permitted and there is no lending or borrowing at the risk-free rate. The second assumption is the existence of fractional shares. The investor can buy or sell any dollar amount of shares of a given firm. The final assumption is that there are no transaction costs or taxes. The strategy never sells securities but makes monthly investments of fixed predetermined capital and annual reinvestment of dividends received during the year. There is no tax on the dividends received, if any.

2.6 The Long-Term Portfolio Selection Strategy

Our long-term portfolio selection strategy is based on portfolios of five stocks. This results in small transaction costs relative to monthly cash investments or portfolio value over time. Therefore, costs can be ignored to meet the no transaction cost assumption.

The strategy works as follows. First, the universe of all active stocks (COMPUSTAT) listed on NYSE, AMEX, and NASDAQ in December 1991 is used to calculate the breakpoints for the respective single-sort and double-sort classifications, creating groups of stocks for which share price data is available for both periods: portfolio selection analysis period and the investment holding period. It produces four sets (BE/ME, E/P, C/P, SR) of ten single-sort stock groups and three sets (intersections of SR sort and the sorts on BE/ME, E/P and C/P) of nine double-sort stock groups. Thus, in total, the universe is sorted into sixty-seven groups of stocks with similar accounting measures. Note that the next steps will consist in forming several series of four portfolios of the same securities weighted according to four different optimization criteria. The aim is to observe the effects produced by these four selection criteria on the average market values of the portfolios at the end of the investment period.

Second, for the first single-sort group (first decile) on BE/ME, we randomly take a set of five stocks and apply different selection criteria: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight. This results in four portfolios of identical securities but weighted according to the optimization criteria. We repeat this step three hundred times to produce 1,200 portfolios of stocks belonging to first BE/ME single-sort group (first decile), then repeat for the remaining nine groups (deciles) to form a total of 12,000 portfolios of single-sort on BE/ME. Separately, this procedure forms 12,000 portfolios for each of the E/P, C/P, and SR metrics, selecting a total of 48,000 single-sort portfolios.

Third, for the first double-sort group on "BE/ME and Sales Rank" (1-1) we randomly produce a set of five stocks and apply the same selection criteria used in the single-sort portfolio selection: safety-first, mean-variance, mean-semivariance, and equal weight. Like single-sort selection, this results in four portfolios of identical securities but individually weighted according to each optimization criterion. We repeat this step three hundred times to produce 1,200 portfolios of stocks from the "BE/ME and Sales Rank" (1-1) group, then repeat for the other eight groups (1-2, 1-3, 2-1, 2-2, 2-3, 3-1, 3-2, 3-3) to create a total of 10,800 double-sort portfolios on "BE/ME and Sales Rank". Independently, this procedure forms 10,800 portfolios for each of the "E/P and Sales Rank" and "C/P and Sales Rank" sorts, selecting 32,400 double-sort portfolios in total.

Fourth, we calculate the strategy's monthly cash investments. They are derived from the FRED's monthly series "Federal minimum hourly wage for nonfarm workers for the United States". The observations in the series are multiplied by a factor of fifty-seven[43] to make the cash investments comparable to the benchmark synthetic product every month. As of December 2021, the last monthly cash investment was $413.25 for the strategy.

[43] The benchmark synthetic product uses the Canada Pension Plan as proxy pension. In 2021, the maximum monthly CPP contribution was $416.27, while the long-term strategy's monthly cash investment was $413.25. This cash investment amount is obtained from a minimum hourly wage of $7.25 (December 2021) and a multiplication factor set to fifty-seven. A constant multiplication factor of fifty-seven is used throughout the holding period of all investments because the minimum wage series (nominal and unadjusted) captures increases over time as the government adjusts to inflation. The monthly cash amount of the long-term strategy automatically benefits from these increases.

Next, we manage investments for all single-sort and double-sort portfolios throughout the 30-year investment period: from January 1992 to December 2021. On a monthly basis, for each portfolio, we apply the stock weights (from the selection criterion) to the monthly investment to calculate the amount of cash to be invested in each security. These cash amounts are then divided by the respective share price to compute the fractional shares added to the portfolio that month. Dividends received over the year, if any, are reinvested each December. Thus, in December, the proceeds of a given firm's dividends over the number of shares in the portfolio are divided by the share price, resulting in additional fractional shares to be added to the portfolio. Each January, stock splits are evaluated. If necessary, the number of shares representing a given firm in the portfolio is adjusted to reflect the effect of the split.

Then, at maturity (December 31, 2021), we calculate statistical estimates of the market value of each group of stocks under single-sort and double-sort classifications. We then evaluate the cross-section of the portfolios and retain the group (classification) that produces the greatest economic benefit in the form of the portfolios with the highest mean market value, controlled for volatility.

Finally, we test whether the mean portfolio market value of the retained group outperforms the value of a benchmark synthetic product: $642,000. If so, we determine the portfolio characteristics observed at the start date of the strategy's investment: (i) the accounting measures of the classification group, and (ii) the selection criterion applied.

2.7 Controlling Portfolio Market Value for Volatility

We use the coefficient of variation (CV) statistic to determine the risk-reward trade-off. It is commonly adopted to compare the degree of variation between different data sets (relative standard deviation):

$$CV = \frac{\sigma}{\mu} \quad (18)$$

where σ is the standard deviation and μ is the mean. Note that volatility is built into the numerator of the coefficient of variation. The lower the CV ratio, the better the risk-reward trade-off.

We assume a moderate risk investor, a plausible assumption for a thirty-year investment horizon. In this regard, the procedure for determining the portfolios with the highest volatility-controlled mean market value works as follows. First, at maturity (December 31, 2021), we calculate statistical estimates of the market value of each group of stocks under single-sort and double-sort classifications. Then, for single-sort BE/ME groups, we assess the individual CVs in the context of all forty coefficients of the four selection criteria on the cross-section of the decile groups. We calculate the empirical 68th percentile of these coefficients and consider it as the moderate risk threshold for these forty groups of portfolios. Finally, the highest mean market value of volatility-controlled BE/ME single-sort portfolios is the highest mean value of portfolios whose CV is at most at the 68th percentile threshold. We repeat this procedure for the remaining single and double-sort groups.

CHAPTER III

EMPIRICAL RESULTS

Lakonishok, Shleifer and Vishny (LSV 1994) analyze the returns on equally weighted portfolios formed from single-sort and double-sort classifications based on BE/ME, E/P, C/P, and sales rank metrics. The portfolios are held for five years and represent groups of stocks from the NYSE and AMEX universe for the period 1968-1989. Fama and French (1996) use a three-factor model to revisit the single-sort and double-sort classifications of LSV and examine portfolio excess returns over the U.S. Treasury rate. Their three-factor model supports LSV results, while using NYSE stocks and monthly portfolio formations for the period 1963-1993.

Our long-term portfolio selection strategy follows LSV's single-sort and double-sort classifications and uses the universe of all NYSE, AMEX, and NASDAQ to construct the classification groups. We focus on selecting portfolios held for thirty years (1992-2021), with predetermined monthly capital investments and dividend reinvestments, which can produce economic benefits at maturity. These benefits translate to a portfolio market value that exceeds the value of a benchmark synthetic product valuated at $642,000 in December 2021. We extend LSV by examining the results of portfolio selections that follow four selection criteria: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight.

This chapter is organized as follows: Sections 3.1 and 3.2 analyze the results obtained by the long-term portfolio selection strategy applied to LSV single-sort and double-sort respectively. Section 3.3 explores the effects of diversification (characterized by moving from 5-stock portfolios to 10-stock portfolios) on strategy performance. In Section 3.4, we examine whether an alternative investment end year, notably the pre-pandemic year 2019, leads to significant changes in the results compared to the main scenario in which the investment period ends in 2021.

3.1 Single-Sort Portfolios

Table 3.1.1 summarizes the mean market value at maturity (December 31, 2021) of the 5-stock single-sort portfolios formed by our long-term portfolio selection strategy. In December 1991, decile breakpoints are calculated, and portfolios are selected according to four criteria. The average portfolio selection analysis period (Ave. SAP) retained by the criteria varies from 5.10 (Sales Rank, decile 9) to 9.58 (C/P, decile 7) years. The universe of stocks (Universe) in the decile groups is between 41 (BE/ME and C/P, decile 1) and 79 (Sales Rank, decile 9). A total of 48,000 portfolios are managed throughout the 30-year holding period, from January 1992 to December 2021.

Table 3.1.1, Panel A presents the market values of the BE/ME (book-to-market equity) strategy. The 30-year long-term investment strategy does not show a strong positive relationship between mean portfolio market value and book-to-market equity, as indicated by LSV in observations of average portfolio return on 5-year investments. Instead, we observe a U-shaped relationship between the mean portfolio market value and BE/ME like the relationship reported by Fama and French (1992) between average return and E/P.

Table 3.1.1, Panel A shows that the four selection criteria produce similar patterns of cross-sectional market value results. For all criteria, the U-shaped relationship has market value troughs in deciles 6 and 7, and peaks in the remaining deciles (1, 2, 3, 4, 5, 8, 9, 10).

Table 3.1.1: Summary Statistics of Market Value on LSV Single-Sort Portfolios of 5 Stocks (in Thousands of U.S. Dollars), by Selection Criteria and Accounting Measures: 1/1992 - 12/2021, 30 Years

The universe of all NYSE, AMEX, and NASDAQ stocks active in December 1991 (COMPUSTAT) is used to individually calculate the decile breakpoints on BE/ME (book-to-market equity), E/P (earnings-price), C/P (cash flow-to-price), and the Sales Rank of the past five years. The universe is then divided into 10-decile groups. For each group, portfolios of five randomly selected stocks are optimized according to selection criteria that evaluate a minimum of five years of available price data: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight. This results in four portfolios of identical securities but weighted according to the optimization criteria. For criteria other than equal weight, the optimized portfolio size is between one and five stocks. This process is repeated three hundred times for each decile group to form portfolios on each criterion. Portfolio duplicates (in terms of stocks and associated weights) are removed from groups. For each portfolio, monthly cash investments of fifty-seven times the data series "Federal minimum hourly wage for nonfarm workers for the United States" are allocated according to the stock weightings (of the selection criterion) and invested in the portfolio throughout the 30-year investment holding period (January 1992 through December 2021). Dividends received during the year, if any, are reinvested each December. Each January, the number of shares representing a given firm in the portfolio is adjusted for stock splits, if necessary. At maturity (December 31, 2021), calculations of portfolio market value estimates take place for each decile group of stocks. Safety-first and semivariance criteria use the 30-year U.S. Treasury yield recorded on December 31, 1991 (7.41 percent) as the reference rate. The alias "Growth" ("Value") refers to a group of stocks with low (high) individual BE/ME, E/P, C/P, and Sales Rank metrics.

For each decile (1 to 10), the table shows the average portfolio selection analysis period (Ave. SAP) in number of years, the universe of stocks (Universe), the number of portfolios selected (P. Count), the mean portfolio market value at maturity (Mean), the coefficient of variation (CV), and the average number of stocks in the portfolios (Ave. Size).

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
Panel A: BE/ME										
Ave. SAP	6.20	6.84	7.03	9.37	7.29	7.99	7.97	7.19	6.52	6.87
Universe	41	62	64	56	59	71	61	53	56	60
P. Count	300	300	300	300	300	300	300	300	300	300
Safety-First										
Mean	1,531	896	1,025	789	966	541	580	1,019	721	1,112
CV	0.65	1.27	0.66	0.88	0.73	0.39	0.43	0.99	0.80	1.26
Ave. Size	2.87	3.46	2.93	3.25	3.19	3.29	2.75	2.50	1.97	1.50
Min. Variance										
Mean	880	1,360	987	685	1,005	586	690	747	733	949
CV	0.47	1.14	0.52	0.51	0.56	0.34	0.39	0.39	0.59	0.57
Ave. Size	4.07	4.20	4.04	4.34	4.13	4.30	4.39	4.55	4.39	4.54
Min. Semivariance										
Mean	947	1,434	966	832	1,004	593	690	744	727	967
CV	0.43	1.12	0.51	1.02	0.54	0.36	0.38	0.39	0.57	0.60
Ave. Size	4.33	4.43	4.33	4.47	4.25	4.39	4.53	4.61	4.40	4.67
Equally Weighted										
Mean	1,230	1,754	1,046	2,357	1,164	670	707	983	888	910
CV	0.46	1.07	0.47	1.94	0.45	0.38	0.39	0.44	0.44	0.56
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.1.1 – *Continued*

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
Panel B: E/P										
Ave. SAP	7.96	6.46	8.38	8.02	8.33	8.67	8.92	7.82	7.25	6.55
Universe	45	52	51	53	60	52	45	49	52	45
P. Count	300	299	300	300	300	300	300	300	300	300
Safety-First										
Mean	1,783	1,555	681	1,251	965	528	592	636	813	1,079
CV	2.30	0.74	0.57	1.44	0.73	0.57	0.36	0.30	0.75	0.94
Ave. Size	2.45	2.43	2.86	3.14	2.94	2.79	3.46	3.06	2.54	2.47
Min. Variance										
Mean	1,098	765	1,150	988	941	700	585	701	639	1,009
CV	0.63	0.46	1.22	0.96	0.57	0.48	0.34	0.32	0.43	0.46
Ave. Size	4.52	4.42	4.39	4.28	4.39	4.35	4.27	4.29	4.09	4.48
Min. Semivariance										
Mean	1,160	834	1,156	1,152	956	696	614	722	650	1,005
CV	0.84	0.44	1.21	0.97	0.54	0.46	0.41	0.31	0.45	0.43
Ave. Size	4.64	4.58	4.49	4.46	4.53	4.43	4.35	4.36	4.21	4.56
Equally Weighted										
Mean	2,746	1,107	1,030	1,573	1,066	740	601	754	787	1,084
CV	1.76	0.43	0.72	1.11	0.43	0.40	0.34	0.32	0.43	0.43
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Panel C: C/P										
Ave. SAP	6.56	7.78	7.72	7.83	7.98	8.41	9.58	6.55	8.93	6.64
Universe	41	47	52	53	51	52	48	44	49	48
P. Count	300	300	300	300	300	300	300	300	300	300
Safety-First										
Mean	1,344	1,264	995	1,325	614	814	664	601	935	1,030
CV	1.18	0.84	0.61	1.52	0.46	0.65	0.52	0.49	1.03	0.95
Ave. Size	2.51	2.91	2.89	3.01	2.89	2.71	3.21	2.86	2.55	2.16
Min. Variance										
Mean	1,461	921	984	1,106	641	832	668	652	796	1,036
CV	1.28	0.58	0.52	0.61	0.36	0.36	0.42	0.28	0.45	0.55
Ave. Size	4.20	4.25	4.35	4.00	4.43	4.28	4.54	4.25	4.48	4.73
Min. Semivariance										
Mean	1,444	938	961	1,283	636	837	683	662	808	1,075
CV	1.23	0.52	0.51	0.76	0.34	0.36	0.41	0.27	0.50	0.50
Ave. Size	4.26	4.49	4.41	4.17	4.68	4.50	4.63	4.23	4.54	4.73
Equally Weighted										
Mean	3,325	1,168	1,076	1,817	754	917	726	788	1,018	1,076
CV	1.57	0.42	0.33	0.99	0.36	0.42	0.38	0.39	0.54	0.43
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.1.1 – *Continued*

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
Panel D: Sales Rank										
Ave. SAP	5.60	6.56	8.34	8.27	8.41	8.75	8.05	8.54	5.10	7.89
Universe	65	73	64	75	63	60	59	64	79	51
P. Count	300	300	300	300	300	300	300	300	300	300
Safety-First										
Mean	1,326	1,163	875	682	867	862	653	727	640	848
CV	0.67	2.07	0.88	0.52	0.73	0.67	0.48	0.56	1.32	0.81
Ave. Size	2.80	3.14	2.83	2.84	3.13	2.84	2.65	2.51	2.18	2.02
Min. Variance										
Mean	902	942	762	732	838	819	775	773	422	1,148
CV	0.48	0.80	0.56	0.48	0.57	0.47	0.41	0.40	0.30	1.21
Ave. Size	4.11	4.27	4.44	4.33	4.40	4.42	4.45	4.53	3.97	4.41
Min. Semivariance										
Mean	982	994	791	749	866	836	748	760	436	1,144
CV	0.46	1.02	0.54	0.48	0.58	0.46	0.38	0.40	0.32	1.17
Ave. Size	4.25	4.47	4.53	4.40	4.52	4.50	4.54	4.56	4.18	4.63
Equally Weighted										
Mean	1,139	1,334	964	778	1,003	989	786	803	547	1,075
CV	0.42	1.14	0.64	0.42	0.49	0.41	0.35	0.37	0.53	0.70
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.1.1, Panel A (BE/ME) also shows that all mean market values of portfolios in the peak deciles exceed the benchmark of $642,000 by at least 12 percent (safety-first, decile 9, $721,000). Safety-first embodies a much stricter criterion, resulting in a lower average number of stocks in portfolios (Ave. Size) between 1.50 and 3.46. Minimum variance and minimum semivariance sizes are about four stocks, and the equally weighted criterion is by definition five stocks. The coefficient of variation (CV) used as a measure of risk-reward varies between 0.34 and 1.94 for all criteria. We observe that portfolios in growth decile 1 can beat portfolios in value decile 10 only on safety-first and "equally weighted" criteria. In the cross-section of decile groups, the four criteria find their highest values in deciles 1, 2 and 4. The best performing criterion controlled for volatility is the "equally weighted" for a mean portfolio market value of $1,230,000 (decile 1, CV=0.46). It outperforms the benchmark by 91.60 percent.

Table 3.1.1, Panel B presents the market values of the E/P (earnings-price) strategy. Like BE/ME, we observe a U-shaped relationship with mean portfolio market value, and the same decile composition of troughs and peaks. Unlike BE/ME, portfolios in growth decile 1 always beat portfolios in value decile 10 by at least 8.82 percent. Compare, for example, the mean portfolio market value of $1,098,000 (min. variance, decile 1) to $1,009,000 (min. variance, decile 10). The first five deciles and decile 10 easily surpass the benchmark for all selection criteria. The coefficients of variation have a significantly wider range (0.3 to 2.3), indicating greater dispersion in the mean portfolio market value. Consequently, decile 1 yields much higher market values (and volatility) than its BE/ME counterpart. For example, the highest mean portfolio market value in the first E/P decile is $2,746,000 (equally weighted, CV=1.76). Compared to the BE/ME equivalent, $1,531,000 (safety-first, decile 1, CV=0.65), this represents a difference of 79.36 percent. Adjusting for volatility, the best performing criterion is “equally weighted”: $1,107,000 (decile 2, CV=0.43), it outperforms the benchmark by 72.43 percent.

Table 3.1.1, Panel C shows the market values of the C/P (cash flow-to-price), repeating the U-shaped relationship seen in BE/ME and E/P. However, C/P has a wider trough region with 4 deciles (5, 6, 7 and 8) and a narrower coefficient of variation range (0.27 to 1.57). Peak deciles (1, 2, 3, 4, 9, and 10) can exceed the benchmark effortlessly. Like E/P, portfolios in growth decile 1 always beat portfolios in value decile 10. Even more impressively, these growth portfolios are at least 30.49 percent better than value portfolios (safety-first, deciles 1 and 10). This is consistent with LSV’s findings that C/P produces the greatest difference in growth-value return among the single-sorts. The C/P sort gives the highest mean portfolio market value of all single-sort classifications: $3,325,000 (equally weighted, decile 1, CV=1.57). Controlling for volatility, the best performing criterion of the C/P strategy is “equally weighted” at $1,168,000 (decile 2, CV=0.42) outperforming the benchmark by 81.93 percent.

Panel D in Table 3.1.1 presents the market values of the Sales Rank strategy of which LSV document the least profitable classification and Fama and French (1996) finds the most difficult classification to explain for the three-factor model. Indeed, we observe a somewhat different relationship where the mean portfolio market value tends towards a V-shaped pattern with a single trough (decile 9). Except for safety-first, all other selection criteria struggle when it comes to growth decile 1 exceeding value decile 10. The Sales Rank sort produces the lowest mean portfolio market value of all single-sort classifications: $422,000 (min. variance, decile 9, CV=0.30). The results support LSV's findings that profitability is reduced by classifications on sales rank alone. The best-performing, volatility-adjusted, criterion for the Sales Rank is "equally weighted" with mean portfolio market value of $1,139,000 (equally weighted, decile 1, CV=0.42). It exceeds the benchmark by 77.41 percent.

The single-sort results summarized in Table 3.1.1 show that strategies based on BE/ME, E/P, C/P and Sales Rank outperform the benchmark synthetic product by at least 72.43 percent. The E/P and C/P classifications select growth portfolios (decile 1) that beat value portfolios (decile 10), while BE/ME is the best performing single-sort classification at 91.60 percent above the benchmark. Over 88 percent (141 out of 160) of single-sort portfolio groups can outperform the benchmark.

In terms of selection criteria, safety-first and "equally weighted" growth portfolios (deciles 1 to 5) consistently perform better than value portfolios (decile 6 to 10). Minimum variance and minimum semivariance produce strongly correlated estimates, and it is uncertain whether these two criteria perform better or worse than safety-first. We observe that Markowitz's minimum variance is geared towards value stocks, being more efficient that safety-first for 60 percent (12 out of 20) of the cross-section of portfolios in the bottom five value deciles. On the other hand, we find that Roy's safety-first creates more value in 70 percent (14 out of 20) of the remaining growth decile portfolios, leaning towards growth stocks. Moreover, safety-first is a rigid criterion that selects the smallest portfolio sizes on average. Finally, the remarkable observation is that "equally weighted" criterion systematically selects the best performing single-sort portfolios, controlled for volatility.

3.2 Double-Sort Portfolios

Table 3.2.1 summarizes the mean market value at maturity (December 31, 2021) of the 5-stock double-sort portfolios formed by our long-term portfolio selection strategy. In December 1991, the breakpoints are calculated, and the universe of stocks is divided separately into three groups (low 30 percent, medium 40 percent, and high 30 percent: 1, 2, and 3) according to their BE/ME, E/P, C/P breakpoints. Next, the universe is divided into three groups (high 30 percent, medium 40 percent, and low 30 percent: 1, 2, and 3) based on the Sales Rank (SR) breakpoints[44] of the past five years. Then three sets of nine stock groups (1-1, 1-2, 1-3, 2-1, 2-2, 2-3, 3-1, 3-2, 3-3) are formed based on the intersections[45] of Sales Rank sort and the sorts on BE/ME, E/P and C/P. Four criteria select the portfolios using an average selection analysis period (Ave. SAP) which varies between 5.78 (C/P, 3-3) and 9.98 (C/P, 1-2) years. The universe of stocks (Universe) in the double-sort groups varies from 14 (BE/ME, 1-1) to 119 (BE/ME, 2-2). In total, up to 32,400 portfolios are managed throughout the 30-year holding period, from January 1992 to December 2021.

Fama and French (1992) argue that size and BE/ME must proxy for risk if asset pricing is rational, implying that higher returns must be associated with higher risk incurred. They find that BE/ME plays an important role in average returns, so the captured risk may be due to a relative distress factor. LSV confirm this relationship between BE/ME and average returns. Furthermore, they find no evidence that value strategies (investing in high BE/ME firms) are *fundamentally riskier*.

Table 3.2.1 presents the market values of combination of Sales Rank sorts with sorts on BE/ME, E/P and C/P.

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[44] Note that sales *growth* is ranked in descending order: a low sales *rank* breakpoint indicates growth stock and, a high sales *rank* breakpoint means value stocks. We follow the group naming convention adopted by LSV. Hence, as indicated in the text, the low 30 percent sales *rank* breakpoint that characterizes the strongest growth stocks is assigned group code "3" to be named "*-3".

[45] There are two high-profile groups derived from the intersections of Sales Rank sort and the sorts on BE/ME, E/P and C/P. The first is the "1-3" group comprising the low values of these accounting measures and better known as "growth". The second is the "3-1" group, better known as "value", which includes high values of these measures.

Table 3.2.1: Summary Statistics of Market Value on LSV Double-Sort Portfolios of 5 Stocks Based on Intersections of Sales Rank Sort and the Sorts on BE/ME, E/P and C/P (in Thousands of U.S. Dollars), by Selection Criteria: 1/1992-12/2021, 30 Years

The universe of all NYSE, AMEX, and NASDAQ stocks active in December 1991 (COMPUSTAT) is used to calculate breakpoints, then separately divide the stocks into three groups (low 30 percent, medium 40 percent, and high 30 percent: 1, 2, and 3) according to their BE/ME, E/P, C/P breakpoints. Next, the universe is divided into three groups (high 30 percent, medium 40 percent, and low 30 percent: 1, 2, and 3) based on breakpoints of Sales Rank of the past five years. Finally, three sets of nine stock groups are formed based on the intersections of Sales Rank sort and the sorts on BE/ME, E/P and C/P. For each group in the sets, portfolios of five randomly selected stocks are optimized according to selection criteria that evaluate a minimum of five years of available price data: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight. This results in four portfolios of identical securities but weighted according to the optimization criteria. For criteria other than equal weight, the optimized portfolio size is between one and five stocks. This process is repeated three hundred times for each group to form portfolios on each criterion. Portfolio duplicates (in terms of stocks and associated weights) are removed from groups. For each portfolio, monthly cash investments of fifty-seven times the data series "Federal minimum hourly wage for nonfarm workers for the United States" are allocated according to the stock weightings (of the selection criterion) and invested in the portfolio throughout the 30-year investment holding period (January 1992 through December 2021). Dividends received during the year, if any, are reinvested each December. Each January, the number of shares representing a given firm in the portfolio is adjusted for stock splits, if necessary. At maturity (December 31, 2021), calculations of portfolio market value estimates take place for each group of stocks. Safety-first and semivariance criteria use the 30-year U.S. Treasury yield recorded on December 31, 1991 (7.41 percent) as the reference rate. The alias "Growth" ("Value") refers to a group of stocks with low (high) individual BE/ME, E/P, C/P, and Sales Rank metrics.

For each group (1-1 to 3-3), the table shows the average portfolio selection analysis period (Ave. SAP) in number of years, the universe of stocks (Universe), the number of portfolios selected (P. Count), the mean portfolio market value at maturity (Mean), the coefficient of variation (CV), and the average number of stocks in the portfolios (Ave. Size).

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel A: BE/ME and Sales Rank									
Ave. SAP	6.42	8.32	6.40	8.83	9.23	6.39	7.01	7.28	6.35
Universe	14	63	88	44	119	80	65	72	31
P. Count	280	300	300	300	300	300	300	300	300
Safety-First									
Mean	460	794	1,164	839	721	704	590	967	1,384
CV	0.68	0.59	0.80	0.56	0.55	0.79	0.82	1.06	0.99
Ave. Size	2.31	3.29	3.13	3.03	3.27	3.11	1.8	2.15	2.29
Min. Variance									
Mean	2,577	921	891	798	692	769	681	943	731
CV	0.93	0.56	0.56	0.44	0.43	0.65	0.48	0.53	0.46
Ave. Size	4.61	4.29	3.96	4.35	4.34	4.24	4.48	4.51	4.62
Min. Semivariance									
Mean	2,451	889	958	783	721	759	673	959	743
CV	0.93	0.55	0.54	0.45	0.44	0.60	0.47	0.55	0.44
Ave. Size	4.6	4.44	4.28	4.47	4.48	4.35	4.55	4.6	4.47
Equally Weighted									
Mean	1,736	818	1,400	871	889	763	788	993	1,090
CV	0.66	0.41	0.83	0.35	0.44	0.50	0.42	0.51	0.48
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.2.1 – *Continued*

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel B: E/P and Sales Rank									
Ave. SAP	7.68	9.22	6.29	8.27	9.79	6.80	8.41	8.41	6.07
Universe	31	54	61	26	109	75	27	62	55
P. Count	299	300	300	299	300	300	300	300	300
Safety-First									
Mean	813	984	1,381	782	710	1,026	589	705	1,123
CV	0.44	0.82	0.69	0.46	0.58	1.65	0.43	0.42	0.87
Ave. Size	2.47	2.57	2.91	2.55	3.33	3.03	2.20	2.97	2.67
Min. Variance									
Mean	1,446	817	792	720	745	944	848	801	640
CV	1.24	0.50	0.45	0.44	0.58	0.66	0.38	0.38	0.44
Ave. Size	4.37	4.58	4.29	4.45	4.50	4.13	4.73	4.35	4.26
Min. Semivariance									
Mean	1,366	830	866	732	754	1,043	849	820	642
CV	1.28	0.54	0.42	0.41	0.54	0.78	0.37	0.38	0.42
Ave. Size	4.55	4.64	4.55	4.52	4.59	4.28	4.74	4.49	4.22
Equally Weighted									
Mean	1,119	1,021	1,048	750	781	1,489	828	913	890
CV	0.77	0.51	0.41	0.42	0.37	1.05	0.32	0.42	0.51
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Panel C: C/P and Sales Rank									
Ave. SAP	8.16	9.98	6.31	8.50	9.07	7.82	8.71	8.80	5.78
Universe	25	50	62	43	95	66	30	67	44
P. Count	296	300	300	300	300	300	300	300	300
Safety-First									
Mean	838	961	1,249	723	669	1,410	749	723	1,085
CV	0.46	0.64	0.69	0.46	0.53	1.44	0.58	0.69	0.94
Ave. Size	2.15	3.01	3.04	2.54	3.06	3.05	1.98	2.93	2.69
Min. Variance									
Mean	1,700	1,015	794	810	704	1,188	856	833	702
CV	1.17	0.57	0.47	0.45	0.40	0.87	0.41	0.46	0.43
Ave. Size	4.52	4.54	3.97	4.39	4.45	4.21	4.56	4.57	4.51
Min. Semivariance									
Mean	1,598	1,001	858	821	716	1,282	883	870	725
CV	1.21	0.57	0.44	0.43	0.37	0.97	0.39	0.45	0.42
Ave. Size	4.52	4.56	4.28	4.53	4.58	4.46	4.75	4.64	4.44
Equally Weighted									
Mean	1,255	1,000	1,195	819	806	1,572	935	1,021	892
CV	0.78	0.41	0.38	0.40	0.39	1.03	0.37	0.48	0.52
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.2.1 (panels A to C) shows that Sales Rank improves the ability of portfolios formed on BE/ME, E/P, and C/P to outperform the $642,000 benchmark. More than 96 percent (104 out of 108) of double-sort portfolio groups can outperform the benchmark (remember that single-sort rate is 88 percent). Additionally, Sales Rank balances the cross-section of market values by significantly reducing their volatility. The CV range (high minus low) drops 55.63 percent from 1.60 for the single-sort BE/ME to 0.71 for double-sort BE/ME-SR.

The minimum variance criterion consistently yields the highest, although more volatile, mean portfolio market values of the three strategies formed at intersections with SR. For example, top mean portfolio market values for Sales Rank sorts on E/P and C/P are respectively $1,446,000 (min. variance, CV=1.24) and $1,700,000 (min. variance, CV=1.17). The four double-sort selection criteria behave as in the single-sort selection: stiff safety-first and strong correlation between variance and semivariance. The “equally weighted” is often the most effective double-sort selection criterion.

Controlling for volatility, the best performing mean portfolio market values are: (i) $1,090,000 (BE/ME-SR, equally weighted, 3-3, CV=0.48), (ii) $1,048,000 (E/P-SR, equally weighted, 1-3, CV=0.41) and (iii) $1,195,000 (C/P-SR, equally weighted, 1-3, CV=0.38). They outperform the benchmark by 69.78 percent, 63.24 percent, and 86.14 percent respectively. Except for C/P with a better marginal return of 2.31 percent (from $1,168,000 to $1,195,000), these volatility-adjusted values underperform their single-sort counterparts. There are two possible reasons for this behavior. First, we recorded a significant reduction in volatility when comparing single-sort and double-sort results. This alone can potentially reduce mean portfolio market value, especially in a volatility-adjusted environment. Second, the sales rank measure built on five years of sales growth before the start of the investment may either attenuate its double-sort explanatory power over the 30-year period or shift that power to the two most prominent groups (growth 1-3, and value 3-1), in a *portfolio purification* process.

Like LSV, we cannot refute that value portfolios are *by definition fundamentally riskier*. We find that for single-sort and double-sort classifications, predominant growth groups (decile 1 for single-sort, and group 1-3 for double-sort) tend to generate higher mean portfolio market values than predominant value groups (decile 10 for single-sort, and group 3-1 for double-sort). Single-sort consistently exhibits this behavior primarily in the E/P and C/P strategies. In double-sort portfolios, this is documented in E/P-SR and BE/ME-SR strategies with significantly wider spread than single-sort strategies. For example, consider BE/ME-SR growth portfolios with market value of $1,400,000 (equally weighted, 1-3, CV=0.83), while the value portfolios are at $788,000 (equally weighted, 3-1, CV=0.42), for a 77.66 percent difference. On the other hand, compare it to 35.16 percent difference between single-sort growth BE/ME decile portfolio market value of $1,230,000 (equally weighted, decile 1, CV=0.46) and the value decile at $910,000 (equally weighted, decile 10, CV=0.56). Observing the wider spread of the double-sorted growth-value groups may indicate a shift in explanatory power toward these two high-profile groups (1-3 growth and 3-1 value).

The double-sort portfolio results indicate some, albeit insufficient, evidence to support the rational asset pricing in our long-term portfolio selection strategy for the 30-year study period.

3.3 Diversification

In this section, we analyze the effects of diversification. We repeat the double-sort investment methodology applied in Section 3.2, but now double the maximum portfolio size from five to ten stocks, for the same 30-year investment period (1992-2021). Table 3.3.1 shows a significant reduction in volatility, compared to 5-stock portfolios. The CV range reduction varies from -30.83 percent (E/P-SR) to -16.90 percent (BE/ME-SR). Like the 5-stock portfolios, we see a high ratio of 10-stock portfolios outperforming the benchmark: over 93 percent (101 out of 108). The minimum variance criterion consistently yields the highest mean portfolio market values of the three strategies formed at intersections with SR.

Table 3.3.1: Summary Statistics of Market Value on LSV Double-Sort Portfolios of 10 Stocks Based on Intersections of Sales Rank Sort and the Sorts on BE/ME, E/P and C/P (in Thousands of U.S. Dollars), by Selection Criteria: 1/1992-12/2021, 30 Years

The universe of all NYSE, AMEX, and NASDAQ stocks active in December 1991 (COMPUSTAT) is used to calculate breakpoints, then separately divide the stocks into three groups (low 30 percent, medium 40 percent, and high 30 percent: 1, 2, and 3) according to their BE/ME, E/P, C/P breakpoints. Next, the universe is divided into three groups (high 30 percent, medium 40 percent, and low 30 percent: 1, 2, and 3) based on breakpoints of Sales Rank of the past five years. Finally, three sets of nine stock groups are formed based on the intersections of Sales Rank sort and the sorts on BE/ME, E/P and C/P. For each group in the sets, portfolios of ten randomly selected stocks are optimized according to selection criteria that evaluate a minimum of five years of available price data: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight. This results in four portfolios of identical securities but weighted according to the optimization criteria. For criteria other than equal weight, the optimized portfolio size is between one and ten stocks. This process is repeated three hundred times for each group to form portfolios on each criterion. Portfolio duplicates (in terms of stocks and associated weights) are removed from groups. For each portfolio, monthly cash investments of fifty-seven times the data series "Federal minimum hourly wage for nonfarm workers for the United States" are allocated according to the stock weightings (of the selection criterion) and invested in the portfolio throughout the 30-year investment holding period (January 1992 through December 2021). Dividends received during the year, if any, are reinvested each December. Each January, the number of shares representing a given firm in the portfolio is adjusted for stock splits, if necessary. At maturity (December 31, 2021), calculations of portfolio market value estimates take place for each group of stocks. Safety-first and semivariance criteria use the 30-year U.S. Treasury yield recorded on December 31, 1991 (7.41 percent) as the reference rate. The alias "Growth" ("Value") refers to a group of stocks with low (high) individual BE/ME, E/P, C/P, and Sales Rank metrics.

For each group (1-1 to 3-3), the table shows the average portfolio selection analysis period (Ave. SAP) in number of years, the universe of stocks (Universe), the number of portfolios selected (P. Count), the mean portfolio market value at maturity (Mean), the coefficient of variation (CV), and the average number of stocks in the portfolios (Ave. Size).

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel A: BE/ME and Sales Rank									
Ave. SAP	5.29	6.55	5.42	7.43	7.73	5.36	5.60	5.86	5.43
Universe	14	63	88	44	119	80	65	72	31
P. Count	258	300	300	300	300	300	300	300	300
Safety-First									
Mean	613	839	1,249	784	645	799	520	830	1,818
CV	0.40	0.61	0.65	0.32	0.36	0.78	0.67	0.70	0.81
Ave. Size	3.83	4.22	4.19	4.43	4.66	4.60	2.51	2.94	3.31
Min. Variance									
Mean	2,552	968	863	764	631	812	672	846	727
CV	0.46	0.52	0.39	0.33	0.29	0.54	0.50	0.39	0.37
Ave. Size	7.64	6.45	5.79	5.91	6.60	5.99	6.77	7.02	7.18
Min. Semivariance									
Mean	2,160	941	913	741	656	801	648	871	720
CV	0.49	0.51	0.35	0.33	0.29	0.50	0.47	0.40	0.33
Ave. Size	8.03	6.44	6.18	6.00	6.71	6.26	6.77	7.11	6.57
Equally Weighted									
Mean	1,662	767	1,595	877	853	772	772	964	1,094
CV	0.32	0.28	0.63	0.22	0.30	0.29	0.31	0.34	0.28
Ave. Size	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Table 3.3.1 – *Continued*

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel B: E/P and Sales Rank									
Ave. SAP	6.68	7.57	5.52	6.57	8.13	5.70	6.78	6.80	5.23
Universe	31	54	61	26	109	75	27	62	55
P. Count	300	300	300	300	300	300	299	300	300
Safety-First									
Mean	787	878	1,412	800	757	785	572	659	1,343
CV	0.41	0.56	0.60	0.30	0.65	0.94	0.28	0.23	0.75
Ave. Size	3.43	3.44	4.02	3.63	4.63	4.29	3.42	4.09	3.94
Min. Variance									
Mean	1,572	777	702	760	793	909	861	807	638
CV	1.01	0.43	0.31	0.32	0.59	0.60	0.32	0.28	0.40
Ave. Size	6.03	7.05	6.38	6.68	6.59	5.94	7.10	6.59	6.22
Min. Semivariance									
Mean	1,398	798	767	754	794	935	847	840	646
CV	1.12	0.45	0.30	0.28	0.55	0.61	0.29	0.27	0.34
Ave. Size	6.42	7.07	6.93	6.53	6.60	6.19	6.99	6.90	6.26
Equally Weighted									
Mean	1,135	998	985	730	783	1,396	840	931	858
CV	0.47	0.35	0.29	0.26	0.28	0.66	0.20	0.28	0.33
Ave. Size	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Panel C: C/P and Sales Rank									
Ave. SAP	6.65	8.78	5.46	6.56	7.71	6.16	7.25	7.21	5.07
Universe	25	50	62	43	95	66	30	67	44
P. Count	300	300	300	300	300	300	300	300	300
Safety-First									
Mean	828	1,057	1,300	717	618	1,402	622	675	1,327
CV	0.39	0.54	0.57	0.36	0.30	1.07	0.45	0.54	0.82
Ave. Size	2.74	4.35	4.24	3.54	4.44	4.11	2.21	4.34	3.97
Min. Variance									
Mean	1,726	1,079	665	840	650	1,036	777	786	695
CV	0.83	0.53	0.36	0.40	0.24	0.55	0.28	0.31	0.31
Ave. Size	6.51	7.00	5.57	6.35	6.49	5.88	6.93	7.07	6.93
Min. Semivariance									
Mean	1,474	1,066	756	850	662	1,095	807	840	738
CV	0.91	0.52	0.36	0.38	0.27	0.58	0.30	0.33	0.30
Ave. Size	6.07	6.84	6.05	6.46	6.74	6.16	7.19	7.08	6.77
Equally Weighted									
Mean	1,221	1,047	1,191	795	793	1,495	921	1,050	897
CV	0.48	0.28	0.26	0.25	0.26	0.73	0.24	0.33	0.31
Ave. Size	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Controlling for volatility, the best performing mean portfolio market values are: (i) $2,552,000 (BE/ME-SR, min. variance, 1-1, CV=0.46), (ii) $1,135,000 (E/P-SR, equally weighted, 1-1, CV=0.47) and (iii) $1,221,000 (C/P-SR, equally weighted, 1-1, CV=0.48). They outperform the benchmark by 297.51 percent, 76.79 percent, and 90.19 percent respectively. These 10-stock volatility-adjusted results beat the 5-stock cohorts by at least 2.18 percent. The main benefit, however, is not the marginal increase in the mean market value of the best performing portfolios, but the decrease in volatility (at least -16.90 percent). This means that the mean market values observed in portfolios of 10 stocks are more likely to be close to the true average values of the population of each classification group.

The impressive rise in BE/ME-SR mean value from $1,090,000 (5-stock portfolios, equally weighted, 3-3, CV=0.48) to $2,552,000 (10-stock portfolios, min. variance, 1-1, CV=0.46) requires additional comments. Back in 5-stock portfolios, BE/ME-SR returned a mean value of $2,577,00 but the CV was 0.93, 55 percent above the 0.60 risk threshold. In the 10-stock portfolios, the reduced volatility brought these portfolios to a CV of 0.46, 8.70 percent below the 10-stock CV threshold of 0.50, adding it to the overall portfolios retained.

The four selection criteria behave as in the 5-stock portfolio: rigid safety-first selecting around four stocks and minimum variance being the most effective selection for BE/ME-SR while keeping a strong correlation with the semivariance criterion. The “equally weighted” is the most effective selection criterion for E/P-SR and C/P-SR.

Table 3.3.1 shows that the 10-stock double-sort portfolios have a wider spread between the growth and value groups, 1-3 and 3-1 respectively. This is recorded for all safety-first and “equally weighted” selections of the three strategies formed at intersections with SR. For example, consider BE/ME-SR growth portfolios with market value of $1,595,000 (equally weighted, 1-3, CV=0.63), while the value portfolios are at $772,000 (equally weighted, 3-1, CV=0.31), for a 106.61 percent difference.

3.4 Alternative Investment End Year

In this section, we look at the timing effect where the 30-year long-term portfolio selection strategy ends in a different year. We repeat the double-sort investment methodology applied in Section 3.2, with maximum portfolio size of five stocks, but we now end the 30-year investment period in 2019, prior to the coronavirus pandemic. The investment holding period is from 1990 to 2019.

Stock markets are known to have plunged and soared in an unprecedented 2020, due to the pandemic. Comparing the last day of December of the year 2019 to the year 2021, the AMEX, S&P 500, and NASDAQ composite indexes surprisingly climbed by 34.27, 47.52 and 74.36 percent respectively. In such a scenario, we expect the mean market values of the 2021 portfolios to be higher than those of the portfolios completed in 2019, but the objective of this section is to analyze the behavior of the selection criteria and to determine whether the portfolios can outperform the benchmark.

Table 3.4.1 (panels A to C) shows that 87 percent of double-sort portfolio groups can outperform the benchmark. The highest mean portfolio market values belong to the 1-1 group. In 2019, the top double-sort portfolios generally generate a similar mean market value across all four selection criteria, while in 2021 the top double-sort portfolios are selected based on the minimum variance criterion. Adjusting for volatility, the best performing mean portfolio market values are: (i) $981,000 (BE/ME-SR, equally weighted, 3-2, CV=0.49), (ii) $950,000 (E/P-SR, equally weighted, 2-2, CV=0.39) and (iii) $965,000 (C/P-SR, equally weighted, 3-2, CV=0.39). Even if the portfolios fail to break through the $1 million barrier, as was the case in the portfolios completed in 2021, they are still able to outperform the benchmark by a comfortable wide margin of respectively 52.80, 47.98, and 50.31 percent.

As in the 2021 single-sort and double-sort 5-stock portfolios previously reported, we find the same selection criteria results in the 2019 portfolios: (i) rigid safety-first, (ii) strong correlation between variance and semivariance, and (iii) “equally weighted” being the most effective selection criterion.

Table 3.4.1: Summary Statistics of Market Value on LSV Double-Sort Portfolios of 5 Stocks Based on Intersections of Sales Rank Sort and the Sorts on BE/ME, E/P and C/P (in Thousands of U.S. Dollars), by Selection Criteria: 1/1990-12/2019, 30 Years

The universe of all NYSE, AMEX, and NASDAQ stocks active in December 1989 (COMPUSTAT) is used to calculate breakpoints, then separately divide the stocks into three groups (low 30 percent, medium 40 percent, and high 30 percent: 1, 2, and 3) according to their BE/ME, E/P, C/P breakpoints. Next, the universe is divided into three groups (high 30 percent, medium 40 percent, and low 30 percent: 1, 2, and 3) based on breakpoints of Sales Rank of the past five years. Finally, three sets of nine stock groups are formed based on the intersections of Sales Rank sort and the sorts on BE/ME, E/P and C/P. For each group in the sets, portfolios of five randomly selected stocks are optimized according to selection criteria that evaluate a minimum of five years of available price data: (i) Roy's (1952) safety-first, (ii) Markowitz's (1952) mean-variance (global minimum variance), (iii) mean-semivariance (global minimum semivariance), and (iv) equal weight. This results in four portfolios of identical securities but weighted according to the optimization criteria. For criteria other than equal weight, the optimized portfolio size is between one and five stocks. This process is repeated three hundred times for each group to form portfolios on each criterion. Portfolio duplicates (in terms of stocks and associated weights) are removed from groups. For each portfolio, monthly cash investments of fifty-seven times the data series "Federal minimum hourly wage for nonfarm workers for the United States" are allocated according to the stock weightings (of the selection criterion) and invested in the portfolio throughout the 30-year investment holding period (January 1990 through December 2019). Dividends received during the year, if any, are reinvested each December. Each January, the number of shares representing a given firm in the portfolio is adjusted for stock splits, if necessary. At maturity (December 31, 2019), calculations of portfolio market value estimates take place for each group of stocks. Safety-first and semivariance criteria use the 30-year U.S. Treasury yield recorded on January 2, 1990 (8.00 percent) as the reference rate. The alias "Growth" ("Value") refers to a group of stocks with low (high) individual BE/ME, E/P, C/P, and Sales Rank metrics.

For each group (1-1 to 3-3), the table shows the average portfolio selection analysis period (Ave. SAP) in number of years, the universe of stocks (Universe), the number of portfolios selected (P. Count), the mean portfolio market value at maturity (Mean), the coefficient of variation (CV), and the average number of stocks in the portfolios (Ave. Size).

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel A: BE/ME and Sales Rank									
Ave. SAP	8.31	8.92	6.52	8.61	8.61	7.85	7.47	8.01	5.81
Universe	21	55	53	50	84	79	45	68	20
P. Count	299	300	300	300	300	284	300	300	300
Safety-First									
Mean	1,134	639	814	676	652	726	679	704	582
CV	0.61	0.57	0.44	0.31	0.39	0.63	0.65	0.82	0.63
Ave. Size	2.27	3.59	3.44	3.14	3.46	3.33	2.10	2.29	2.65
Min. Variance									
Mean	1,354	808	863	743	637	688	640	793	611
CV	0.68	0.80	0.40	0.29	0.28	0.39	0.38	0.44	0.44
Ave. Size	4.66	4.67	4.30	4.83	4.68	4.53	4.51	4.37	4.43
Min. Semivariance									
Mean	1,359	818	871	759	668	663	656	789	632
CV	0.65	0.79	0.38	0.31	0.30	0.36	0.38	0.40	0.48
Ave. Size	4.76	4.76	4.52	4.82	4.76	4.60	4.60	4.57	4.44
Equally Weighted									
Mean	1,307	715	948	837	721	836	745	981	909
CV	0.56	0.48	0.33	0.41	0.35	0.53	0.33	0.49	0.52
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3.4.1 – *Continued*

	Growth						Value		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel B: E/P and Sales Rank									
Ave. SAP	7.38	8.74	6.59	9.44	8.70	7.37	7.98	8.51	7.53
Universe	19	60	40	47	81	71	34	52	33
P. Count	295	300	300	300	300	272	300	300	300
Safety-First									
Mean	734	523	816	681	736	655	888	671	887
CV	0.73	0.49	0.47	0.29	0.51	0.60	0.74	0.45	0.62
Ave. Size	2.25	3.18	3.14	2.94	3.59	3.08	2.51	2.90	3.46
Min. Variance									
Mean	1,137	489	728	650	826	722	668	731	744
CV	0.66	0.36	0.36	0.22	0.62	0.39	0.36	0.38	0.42
Ave. Size	4.16	4.56	4.26	4.65	4.57	4.54	4.52	4.68	4.36
Min. Semivariance									
Mean	1,129	491	715	651	881	717	676	739	733
CV	0.72	0.39	0.33	0.23	0.57	0.38	0.41	0.36	0.42
Ave. Size	4.27	4.65	4.39	4.67	4.71	4.65	4.56	4.80	4.49
Equally Weighted									
Mean	1,105	532	850	652	950	731	742	929	1,131
CV	0.65	0.39	0.34	0.25	0.39	0.39	0.37	0.40	0.54
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Panel C: C/P and Sales Rank									
Ave. SAP	7.82	9.46	6.59	9.08	8.13	7.20	8.86	8.27	6.88
Universe	14	47	46	45	83	59	38	58	23
P. Count	273	300	300	300	300	259	300	300	296
Safety-First									
Mean	1,350	634	774	661	645	704	776	725	1,138
CV	0.89	0.55	0.52	0.32	0.41	0.59	0.55	0.45	0.68
Ave. Size	1.83	3.69	3.27	2.98	3.07	3.21	2.74	2.87	2.82
Min. Variance									
Mean	1,433	800	750	639	723	763	702	789	834
CV	0.66	0.96	0.39	0.28	0.36	0.41	0.23	0.40	0.39
Ave. Size	4.63	4.72	4.26	4.75	4.53	4.55	4.48	4.67	4.65
Min. Semivariance									
Mean	1,465	777	750	630	763	742	724	796	827
CV	0.69	0.97	0.38	0.28	0.37	0.40	0.28	0.37	0.41
Ave. Size	4.79	4.74	4.47	4.73	4.57	4.61	4.62	4.71	4.78
Equally Weighted									
Mean	1,441	642	833	610	909	1,028	796	965	862
CV	0.59	0.54	0.39	0.29	0.53	0.56	0.31	0.39	0.44
Ave. Size	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

CONCLUSION

Time is an excellent protection against current economic conditions. Investors cannot predict movements in inflation and interest rates, nor can they predict wars and pandemics. But they can hedge their wealth using a long investment horizon. Our main result is that a long-term portfolio selection strategy consistently produces future economic benefits, notably a portfolio market value that exceeds a benchmark synthetic product for a 30-year investment holding period (1992- 2021).

We use the single and double classifications recommended by Lakonishok, Shleifer and Vishny (1994) to create stock groups based on accounting measures such as BE/ME (book-to-market equity), E/P (earnings-price), C/P (cash flow-to-price) and sales growth. Portfolios are formed by applying four selection criteria: Roy's (1952) safety-first, Markowitz's (1952) mean-variance, mean-semivariance, and equal weight. For single-sort classification, we find that most of the portfolios created by the strategy outperform the benchmark. The highest portfolio values generally belong to the first two decile groups (growth). C/P yields the highest mean market value of all single-sort portfolios, while BE/ME gives the highest volatility-adjusted mean portfolio market value. Double-sort portfolios also perform well. Sales Rank improves the ability of portfolios formed on BE/ME, E/P, and C/P to outperform the benchmark. Double-sort portfolios are significantly less volatile and outperform the benchmark at a higher rate, compared to single-sort cohorts. Controlling for volatility, "C/P and Sales Rank" selects the best performing mean portfolio market value (growth group "1-3").

Lakonishok, Shleifer and Vishny (1994) and Fama and French (1996) find that accounting measures have significant explanatory power on the average returns of portfolios selected according to single-sort and double-sort classifications strategies with investment horizons ranging from monthly to five years (from the 1960s to the early 1990s). Therefore,

the reasoning why value stocks (high BE/ME, E/P, C/P) outperform growth stocks (low BE/ME, E/P, C/P) in their tests could be either a relative distress factor, or a fundamentally riskier aspect of value securities. Our results do not support these assumptions. Instead, we find that assets are priced rationally for long-term 30-year investment strategies, hence growth portfolios consistently outperform value portfolios for the period 1992-2021.

Should investors really avoid putting all their eggs in one basket? Yes, indeed! We find that doubling the maximum size of double-sorted portfolios from five to ten stocks significantly reduces volatility. In addition, diversification increases the mean portfolio market value of the best performing groups. The best volatility-adjusted mean market value of 10-stock portfolios comes from the "BE/ME and Sales Rank" strategy.

Stock markets experienced high volatility between 2019 and 2021. Therefore, ending the 30-year double-sort investments before the coronavirus pandemic (2019) reveals signs of timing effect. Although the mean values of double-sort portfolios are lower than those of the 2021 counterpart portfolios, they comfortably outperform the benchmark. Even for long-term investments, the last year of investment can determine whether it will result in a good or a great investment.

Lakonishok, Shleifer and Vishny (1994) and Fama and French (1996) use an equally weighted selection criterion. We extend their work by selecting portfolios according to four criteria. We find that minimum variance and minimum semivariance produce strongly correlated estimates, as postulated by Markowitz (1959, p. 194): "If all distributions of returns are symmetric, or have the same degree of asymmetry, V [variance] and S_E [below-mean semivariance] produce the same set of efficient portfolios". The safety-first criterion proved to be stiff and selects the smallest average portfolio sizes. There is a tie in a competition between Markowitz and Roy: minimum variance and safety-first alternate yielding the highest mean portfolio market value (uncontrolled for volatility) of single and double-sorted portfolios.

Which criterion selects the best performing portfolios? The noteworthy finding is that the "equally weighted" criterion systematically selects the best-performing long-term single

and double-sorted portfolios, controlled for volatility. There are three possible reasons for this observation. First, there is enormous uncertainty about which companies will best withstand the 30-year investment period. Thus, portfolios in which stocks have equal weights spread the odds across all securities and better balance excellent performance with suboptimal performance. Second, the efficient set at the investment inception becomes time-invariant once the optimized weights are held constant throughout the long-term investment. Third, the reference rate adopted by certain criteria at the start of the investment changes over time. These last two possible reasons imply a decay in the selection advantage of three criteria compared to the "equally weighted" criterion.

Our results have practical applications for moderate-risk investors concerned with a strategy to build portfolios that produce future economic benefits after 30 years of investing. The strategy could be the basis of a self-managed synthetic pension. At maturity, the investor could either sell all the shares and use the proceeds to purchase a fixed-income product or keep the portfolio and consider the annual dividends received on the shares as his/her pension payment (see Appendix B for the last annual dividend payments received).

The future economic benefit of this long-term portfolio selection strategy is freedom. The freedom to pursue a career from an early age that brings purpose and fulfillment, while allowing genuine talent to flourish. The freedom not to trade job satisfaction for the promise of a retirement benefit in the distant future. The whole of society will benefit. All it takes is a commitment to disciplined, long-term monthly investments. The portfolio will then provide the investor with the peace of mind and the financial support needed at maturity.

APPENDIX A

BREAKPOINTS FOR SINGLE-SORT AND DOUBLE-SORT LSV CLASSIFICATIONS

This appendix presents LSV single-sort and double-sort breakpoints used to build the different stock groups analyzed in this study. Breakpoints are calculated as of December 1991 and include the universe of all active stocks (COMPUSTAT) listed on NYSE, AMEX, and NASDAQ.

Table A.1: Summary Breakpoint Statistics for LSV Single-Sort and Double-Sort Classifications

The reference date for the accounting measures (BE/ME, E/P, C/P, and sales) is December 1991. It is important to note that: (i) the market equity (ME) of a given firm is calculated as the share price multiplied by the shares outstanding, (ii) the earnings (E) exclude extraordinary items, and (iii) cash flow (C) is earnings plus depreciation and amortization. For a given portfolio investment start year t, the Sales Rank is the weighted average of annual sales growth ranks of the previous five years[46]:

$$Sales\ Rank(t) = \sum_{j=1}^{5} (6 - j) \times Rank(t - j)$$

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
BE/ME	0.170	0.277	0.375	0.479	0.570	0.675	0.797	0.959	1.330	10.75
E/P	0.021	0.036	0.044	0.052	0.059	0.070	0.078	0.094	0.121	0.463
C/P	0.040	0.059	0.076	0.089	0.105	0.127	0.144	0.170	0.229	1.439
ln(Sales Rank)	8.175	8.489	8.678	8.813	8.931	9.032	9.129	9.253	9.269	9.520

[46] Sales *growth* is ranked in descending order: a low (high) sales *rank* means growth (value) stock. The sales *growth* for year $t - j$ is the percentage change in sales between years $t - j - 1$ and $t - j$.

APPENDIX B

DIVIDEND PAYMENTS RECEIVED IN THE LAST YEAR OF PORTFOLIO INVESTMENT

Table B.1: Summary Statistics of Dividend Payments Received in December 2021 on 5-Stock Single-Sort LSV Portfolios (In U.S. Dollars), By Selection Criteria and Accounting Measures: 1/1992 - 12/2021, 30 Years

The procedure for selecting 5-stock portfolios (single-sort) and managing investments over a period of 30 years (1992-2021) is described in Table 3.1.1. For each stock group decile (1 to 10), the table shows the mean of the last annual dividend payments received (Mean) and the coefficient of variation (CV).

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
Panel A: BE/ME										
Safety-First										
Mean	19,257	10,666	15,982	14,945	15,012	12,110	12,615	11,892	15,702	9,616
CV	0.63	0.64	0.77	0.43	0.61	0.44	0.55	0.68	1.33	1.49
Min. Variance										
Mean	22,919	15,976	17,520	16,623	16,196	14,516	13,902	11,577	19,981	19,572
CV	0.90	0.79	0.69	0.36	0.45	0.35	0.33	0.48	1.03	1.09
Min. Semivariance										
Mean	25,710	15,668	17,502	16,423	15,632	14,169	13,676	11,387	18,673	19,165
CV	0.95	0.80	0.70	0.38	0.44	0.38	0.32	0.43	0.98	1.09
Equally Weighted										
Mean	26,357	14,333	14,116	13,497	13,325	12,839	11,957	12,481	18,272	12,520
CV	1.06	0.72	0.49	0.31	0.39	0.43	0.39	0.37	0.78	0.72
Panel B: E/P										
Safety-First										
Mean	12,930	16,495	10,451	16,094	13,936	14,103	15,202	15,224	12,182	16,875
CV	0.67	0.82	0.43	0.71	0.68	0.44	0.41	0.49	0.63	1.06
Min. Variance										
Mean	11,509	14,819	15,092	24,586	15,320	14,118	15,054	16,019	12,570	28,956
CV	0.57	0.81	0.81	0.84	0.66	0.35	0.30	0.35	0.57	0.80
Min. Semivariance										
Mean	10,275	14,558	15,163	25,904	15,398	13,807	14,934	16,176	11,895	28,368
CV	0.57	0.81	0.80	0.83	0.66	0.33	0.31	0.34	0.58	0.79
Equally Weighted										
Mean	9,557	13,072	12,232	27,040	14,474	13,053	13,056	14,323	10,851	20,485
CV	0.52	0.57	0.60	0.97	0.59	0.32	0.36	0.30	0.42	0.55

Table B.1 – *Continued*

	Growth									Value
	1	2	3	4	5	6	7	8	9	10
Panel C: C/P										
Safety-First										
Mean	16,617	10,269	15,636	16,702	10,943	13,088	14,214	14,768	12,186	9,880
CV	0.60	0.73	0.68	0.72	0.65	0.70	0.37	0.51	0.81	0.75
Min. Variance										
Mean	17,869	13,546	19,008	19,394	12,490	17,139	15,514	20,699	12,063	15,918
CV	0.89	0.87	0.57	0.91	0.53	0.71	0.29	0.77	0.54	0.66
Min. Semivariance										
Mean	17,733	13,769	18,739	19,426	12,105	16,721	14,740	21,111	12,023	15,461
CV	0.84	1.13	0.56	0.80	0.57	0.67	0.29	0.82	0.54	0.61
Equally Weighted										
Mean	15,080	17,528	17,808	18,739	9,423	14,805	11,851	17,315	11,451	12,320
CV	0.59	1.28	0.53	0.66	0.46	0.50	0.36	0.57	0.57	0.54
Panel D: Sales Rank										
Safety-First										
Mean	12,971	14,106	14,371	12,859	18,404	16,346	15,891	13,477	21,929	11,596
CV	0.68	0.88	0.87	0.56	0.84	0.47	0.50	0.72	0.70	1.18
Min. Variance										
Mean	11,904	12,526	16,161	13,502	16,757	18,233	18,608	16,435	20,667	18,933
CV	0.63	0.58	0.68	0.42	0.65	0.40	0.57	0.62	0.46	1.15
Min. Semivariance										
Mean	12,583	12,271	16,688	13,503	16,949	18,310	17,685	15,852	20,037	19,043
CV	0.61	0.57	0.84	0.43	0.65	0.40	0.51	0.64	0.43	1.18
Equally Weighted										
Mean	10,997	12,411	17,274	11,764	15,400	18,629	17,670	13,226	20,552	13,012
CV	0.48	0.64	1.17	0.40	0.50	0.53	0.63	0.49	0.39	0.77

Table B.2: Summary Statistics of Dividend Payments Received in December 2021 on 5-Stock Double-Sort LSV Portfolios on Intersections of Sales Rank Sort and Sorts on BE/ME, E/P and C/P (In U.S. Dollars), By Selection Criteria: 1/1992-12/2021, 30 Years

The procedure for selecting 5-stock portfolios (double-sort) and managing investments over a period of 30 years (1992-2021) is described in Table 3.2.1. For each group of stocks (1-1 to 3-3), the table shows the mean of the last annual dividend payments received (Mean) and the coefficient of variation (CV).

	Growth					Value			
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3
Panel A: BE/ME and Sales Rank									
Safety-First									
Mean	20,526	14,744	14,665	14,504	16,749	9,682	10,498	16,238	11,109
CV	1.19	0.87	0.61	0.43	0.43	0.83	1.40	1.20	0.88
Min. Variance									
Mean	38,615	15,956	15,191	15,574	15,886	11,758	14,483	20,909	12,569
CV	0.67	0.70	0.69	0.34	0.34	0.69	1.21	0.94	0.74
Min. Semivariance									
Mean	36,859	15,769	15,577	14,787	15,919	11,441	14,815	19,408	11,795
CV	0.66	0.70	0.72	0.35	0.33	0.69	1.19	0.86	0.73
Equally Weighted									
Mean	20,567	13,385	16,781	12,860	15,126	10,124	13,067	17,041	11,722
CV	0.58	0.52	1.01	0.37	0.35	0.57	0.62	0.74	0.58
Panel B: E/P and Sales Rank									
Safety-First									
Mean	9,765	16,237	15,161	15,009	16,255	13,901	14,401	15,674	12,976
CV	0.76	1.17	0.62	0.48	0.51	0.85	1.01	0.57	0.55
Min. Variance									
Mean	15,476	15,259	11,717	14,467	17,127	16,248	26,539	18,039	11,571
CV	1.01	0.79	0.35	0.43	0.53	0.82	0.76	0.42	0.55
Min. Semivariance									
Mean	13,779	15,093	11,986	13,711	16,904	18,300	27,322	17,897	10,875
CV	1.10	0.82	0.35	0.43	0.50	0.95	0.76	0.39	0.50
Equally Weighted									
Mean	12,974	12,898	10,986	8,962	16,398	20,490	21,821	16,821	11,047
CV	0.65	0.61	0.40	0.40	0.49	1.13	0.52	0.43	0.43
Panel C: C/P and Sales Rank									
Safety-First									
Mean	13,383	16,289	14,754	14,096	15,437	14,407	18,043	14,650	10,620
CV	0.66	0.62	0.66	0.76	0.53	0.83	1.18	0.51	0.86
Min. Variance									
Mean	18,616	18,644	14,657	15,156	17,234	14,685	23,769	14,795	10,383
CV	0.93	0.58	0.71	0.75	0.57	0.66	0.84	0.39	0.92
Min. Semivariance									
Mean	17,388	18,484	16,719	14,252	16,745	14,888	24,525	14,437	9,762
CV	0.98	0.58	1.01	0.77	0.53	0.66	0.87	0.36	0.82
Equally Weighted									
Mean	17,222	16,675	18,336	9,129	15,595	14,360	17,818	12,833	9,413
CV	0.55	0.52	1.15	0.60	0.58	0.65	0.56	0.42	0.68

APPENDIX C

DISTRIBUTION OF COMPANIES BY LSV SINGLE-SORT AND DOUBLE-SORT CLASSIFICATIONS

This appendix includes a series of tables that show the distribution of companies by single-sort and double-sort LSV stock groups. These groups are the basis of the long-term portfolio selection strategy which builds portfolios held for a 30-year investment period: from January 1992 to December 2021. The universe of all NYSE, AMEX, and NASDAQ stocks active in December 1991 (COMPUSTAT) is used to calculate the breakpoints for the respective single-sort and double-sort classifications.

For single-sort classifications, the universe is split into ten stock groups based on decile breakpoints for BE/ME (book-to-market equity), E/P (earnings-price), C/P (cash flow-to-price), and the sales rank of the past five years. For each of these accounting metrics, the single-sort decile groups are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. The double-sort classifications form three independent sets (intersections of Sales Rank sort and the sorts on BE/ME, E/P and C/P) in which the universe is divided into nine stock groups: 1-1, 1-2, 1-3, 2-1, 2-2, 2-3, 3-1, 3-2, 3-3.

Table C.1: Distribution of Companies on BE/ME by LSV Single-Sort Decile Breakpoints, as of December 1991

1
Adobe Inc, Altria Group Inc, Amgen Inc, Anixa Biosciences Inc, Bridgford Foods Corp, Bristol-Myers Squibb Co, Cedar Fair, Cintas Corp, Coca-Cola Co, Comcast Corp, Cooper Cos Inc (The), Cracker Barrel Old Ctry Stor, Fastenal Co, Franklin Resources Inc, General Mills Inc, Heron Therapeutics Inc, Hf Sinclair Corp, Home Depot Inc, Intergroup Corp, Johnson & Johnson, Kellogg Co, Merck & Co, Meridian Bioscience Inc, Mesabi Trust, Microsoft Corp, Newmont Corp, North European Oil Rty Tr, Permian Basin Royalty Trust, Psychemedics Corp, Rocky Mountain Choc Fact Inc, Rollins Inc, Sabine Royalty Trust, Stryker Corp, Taro Pharmaceuticl Inds Ltd, Tat Technologies Ltd, Tejon Ranch Co, The Shyft Group Inc, U S Lime & Minerals, United-Guardian Inc, Unitedhealth Group Inc, Walmart Inc
2
American Software, Apple Inc, Autodesk Inc, Barnwell Industries, Barrick Gold Corp, Block H & R Inc, Brown & Brown Inc, Cadence Design Systems Inc, Church & Dwight Inc, Colgate-Palmolive Co, Conmed Corp, Corning Inc, Cyberoptics Corp, Daily Journal Corp, Deluxe Corp, Disney (Walt) Co, Emerson Electric Co, Ennis Inc, Equifax Inc, Federal Signal Corp, Fmc Corp, Franklin Electric Co Inc, Gap Inc, Hanger Inc, Heartland Express Inc, Henry (Jack) & Associates, Hni Corp, Interpublic Group Of Cos, Intl Flavors & Fragrances, Invacare Corp, Jacobs Engineering Group Inc, Lilly (Eli) & Co, Marsh & Mclennan Cos, Mattel Inc, Mccormick & Co Inc, Medtronic Plc, Middleby Corp, Newell Brands Inc, Nordson Corp, Oceaneering International, Paychex Inc, Pepsico Inc, Pfizer Inc, Plexus Corp, Price (T. Rowe) Group, Procter & Gamble Co, Range Resources Corp, Rcm Technologies Inc, Research Frontiers Inc, Schlumberger Ltd, Schwab (Charles) Corp, Sei Investments Co, Sensient Technologies Corp, Sysco Corp, Texas Pacific Land Corp, Tootsie Roll Industries Inc, Umh Properties Inc, Unilever Plc, Viatris Inc, Walgreens Boots Alliance Inc, Washington Reit, Wd-40 Co
3
3M Co, Alico Inc, Ametek Inc, Arthur J Gallagher & Co, Balchem Corp, British Amer Tobacco Plc, Brown Forman Corp, Calamp Corp, Campbell Soup Co, Carnival Corporation & Plc, Clorox Co, Conagra Brands Inc, Cto Realty Growth Inc, Distribution Solutio Gro Inc, Ecolab Inc, Encompass Health Corp, Expeditors Intl Wash Inc, Fifth Third Bancorp, Fiserv Inc, General Electric Co, Gentex Corp, Genuine Parts Co, Glatfelter Corp, Globe Life Inc, Grainger Inc, Harley-Davidson Inc, Healthpeak Properties Inc, Hershey Co, Hormel Foods Corp, Host Hotels & Resorts Inc, Hubbell Inc, Hunt (Jb) Transprt Svcs Inc, Icad Inc, Illinois Tool Works, Kelly Services Inc, Kimberly-Clark Corp, Lancaster Colony Corp, Lee Enterprises Inc, Lumen Technologies Inc, Mcdonald's Corp, Newmarket Corp, Nike Inc, Nucor Corp, Oracle Corp, Owens & Minor Inc, Pennsylvania Re Invs Trust, Perkinelmer Inc, Pitney Bowes Inc, Polaris Inc, Powell Industries Inc, Pro-Dex Inc/Co, Progressive Corp-Ohio, S&P Global Inc, Sherwin-Williams Co, State Street Corp, Superior Industries Intl, Teva Pharmaceuticals, Tjx Cos Inc (The), Toll Brothers Inc, Tyson Foods Inc, Universal Corp/Va, Watts Water Technologies Inc, Williams-Sonoma Inc, Xoma Corp
4
Advanced Micro Devices, Aflac Inc, Agnico Eagle Mines Ltd, Air Products & Chemicals Inc, Apogee Enterprises Inc, Archer-Daniels-Midland Co, AT&T Inc, Black Hills Corp, Conocophillips, Crane Holdings Co, Crown Holdings Inc, Cvs Health Corp, Dillards Inc, Donaldson Co Inc, Exxon Mobil Corp, Fair Isaac Corp, Federal Realty Investment Tr, Flowserve Corp, Fuller (H. B.) Co, Griffon Corp, Hasbro Inc, Healthcare Services Group, Hecla Mining Co, Intel Corp, Kirby Corp, Mesa Royalty Trust, Monster Beverage Corp, National Presto Inds Inc, Nordstrom Inc, Northern Trust Corp, Oil Dri Corp America, Omnicom Group Inc, Otter Tail Corp, Pldt Inc, Pvh Corp, Rada Electronic Industries, Raymond James Financial Inc, Rpm International Inc, San Juan Basin Royalty Tr, Service Corp International, Snap-On Inc, Sonoco Products Co, Southwest Airlines, Stanley Black & Decker Inc, Sturm Ruger & Co Inc, Teleflex Inc, Tennant Co, Thermo Fisher Scientific Inc, Thor Industries Inc, Unifirst Corp, Union Pacific Corp, Verizon Communications Inc, Vf Corp, Washington Federal Inc, Wells Fargo & Co, Worthington Industries

Table C.1 – *Continued*

5
Abiomed Inc, Adams Resources & Energy Inc, Allete Inc, Alliant Energy Corp, American International Group, American Shared Hsptl Serv, Applied Materials Inc, Arrow Electronics Inc, Atrion Corp, Avery Dennison Corp, Ball Corp, Becton Dickinson & Co, Boeing Co, Brady Corp, Cardinal Health Inc, Chemed Corp, Clean Harbors Inc, Csx Corp, Danaher Corp, Dentsply Sirona Inc, Destination Xl Group Inc, Dte Energy Co, Eaton Corp Plc, Edison International, Gorman-Rupp Co, Graco Inc, Honeywell International Inc, Johnson Outdoors Inc, Kb Home, Keycorp, Leggett & Platt Inc, Masco Corp, Mcgrath Rentcorp, Mge Energy Inc, Nextera Energy Inc, Norfolk Southern Corp, Novo Nordisk, Oge Energy Corp, Old National Bancorp, Oppenheimer Holdings Inc, Pg&E Corp, Ppg Industries Inc, Quaker Houghton, Rite Aid Corp, Southwestern Energy Co, Superior Group Of Cos Inc, Target Corp, Team Inc, Terex Corp, Texas Instruments Inc, Udr Inc, Unisys Corp, Unum Group, Valero Energy Corp, Value Line Inc, Vulcan Materials Co, Wec Energy Group Inc, West Pharmaceutical Svsc Inc, Whirlpool Corp
6
Abm Industries Inc, Albany Intl Corp, American Electric Power Co, American Vanguard Corp, Apa Corp, Ascent Industries Co, Astronova Inc, Atmos Energy Corp, Avista Corp, Bank Of America Corp, Bank Of Hawaii Corp, Barnes Group Inc, Bio-Rad Laboratories Inc, Bp Plc, Brunswick Corp, Caci Intl Inc, Canon Inc, Carlisle Cos Inc, Centerpoint Energy Inc, Central Pacific Financial Cp, Chevron Corp, Cleveland-Cliffs Inc, Comerica Inc, Cummins Inc, Devon Energy Corp, Diebold Nixdorf Inc, Dominion Energy Inc, Equity Commonwealth, Evergy Inc, Eversource Energy, First Finl Bancorp Inc, First Horizon Corp, Foot Locker Inc, Getty Realty Corp, Harsco Corp, Hawaiian Electric Inds, Hawkins Inc, Idacorp Inc, J & J Snack Foods Corp, Mays (J.W.) Inc, Mbia Inc, Mdu Resources Group Inc, Mercury General Corp, Myers Industries Inc, New Jersey Resources Corp, New York Times Co, Northwest Natural Hldng Co, Paccar Inc, Parker-Hannifin Corp, Photronics Inc, Pnc Financial Svcs Group Inc, Ppl Corp, Pultegroup Inc, Regal Rexnord Corporation, Regions Financial Corp, Robert Half Intl Inc, Rockwell Automation, Rpc Inc, Standex International Corp, Stepan Co, Teradyne Inc, Tidewater Inc, Ugi Corp, Watsco Inc, Weis Markets Inc, Welltower Inc, Werner Enterprises Inc, Weyerhaeuser Co, Williams Cos Inc, Xcel Energy Inc, Yellow Corp
7
American Express Co, American States Water Co, Analog Devices Inc, Aon Plc, Associated Banc-Corp, Azz Inc, Banco Santander Sa, Berkley (W R) Corp, Big Lots Inc, Cabot Corp, California Water Service Gp, Chesapeake Utilities Corp, Citigroup Inc, Cms Energy Corp, Coca-Cola Europacific Partne, Consolidated Edison Inc, Deere & Co, Entergy Corp, Essential Utilities Inc, Fulton Financial Corp, Gatx Corp, Goodyear Tire & Rubber Co, Halliburton Co, Huntington Bancshares, Hurco Cos Inc, Intl Business Machines Corp, Intl Paper Co, Kaspien Holdings Inc, La-Z-Boy Inc, Lci Industries, Lennar Corp, Liveramp Holdings Inc, Loews Corp, Louisiana-Pacific Corp, Lowe's Cos Inc, M & T Bank Corp, Markel Corp, Materion Corp, Middlesex Water Co, Millerknoll Inc, Modine Manufacturing Co, Murphy Oil Corp, National Fuel Gas Co, National Healthcare Corp, Nextgen Healthcare Inc, Pilgrim's Pride Corp, Public Service Entrp Grp Inc, Servotronics Inc, Sony Group Corporation, South Jersey Industries Inc, Spire Inc, Starrett (L.S.) Co, Telefonaktiebolaget Lm Erics, Truist Financial Corp, Umb Financial Corp, Unitil Corp, Universal Health Rlty Income, Us Bancorp, Vishay Intertechnology Inc, Wiley (John) & Sons, Zions Bancorporation Na
8
1St Source Corp, Acme United Corp, Air T Inc, Alexander's Inc, Argo Group Intl Holdings Ltd, Ark Restaurants Corp, Asa Gold And Precious Metals, Astec Industries Inc, Avnet Inc, Barclays Plc, Bassett Furniture Inds, Caleres Inc, Caterpillar Inc, Cincinnati Financial Corp, Cna Financial Corp, Coca Cola Consolidated Inc, Coeur Mining Inc, Coherent Inc, Commerce Bancshares Inc, Commercial Metals, Comtech Telecommun, Csp Inc, Curtiss-Wright Corp, Cvb Financial Corp, Escalade Inc, Fedex Corp, General Dynamics Corp, Hess Corp, Honda Motor Co Ltd, Jefferies Financial Grp Inc, Lockheed Martin Corp, Mesa Laboratories Inc, National Retail Properties, Northrop Grumman Corp, Occidental Petroleum Corp, Oshkosh Corp, Pinnacle West Capital Corp, Potlatchdeltic Corp, Power Reit, Primeenergy Resources Corp, Richardson Electronics Ltd, Ross Stores Inc, Ryder System Inc, Sanderson Farms Inc, Sjw Group, Textron Inc, Toro Co, Toyota Motor Corp, Trustco Bank Corp/Ny, United Bankshares Inc/Wv, Valmont Industries Inc, Westamerica Bancorporation

Table C.1 – *Continued*

9
Aar Corp, Aegon Nv, Agilysys Inc, Alaska Air Group Inc, Alleghany Corp, American Financial Group Inc, America's Car-Mart Inc, Applied Industrial Tech Inc, Badger Meter Inc, Bank Of New York Mellon Corp, Best Buy Co Inc, Bk Technologies Corp, Cadence Bank, Chicago Rivet & Machine Co, Cohu Inc, Community Trust Bancorp Inc, Computer Task Group Inc, Cts Corp, Cullen/Frost Bankers Inc, Daxor Corp, Diodes Inc, Eastern Co, Electro-Sensors Inc, Espey Mfg & Electronics Corp, First Citizens Bancsh, Friedman Industries Inc, Frp Holdings Inc, Helmerich & Payne, Immucell Corp, Ingles Markets Inc, Interface Inc, Investors Title Co, Koninklijke Philips Nv, L3Harris Technologies Inc, Lincoln National Corp, Marcus Corp, Marten Transport Ltd, Msa Safety Inc, New England Realty Assc, Old Republic Intl Corp, Park Aerospace Corp, Popular Inc, Rli Corp, Rogers Corp, Safeguard Scientifics Inc, Selective Ins Group Inc, Standard Motor Prods, Stifel Financial Corp, Telefonica Sa, Transcat Inc, Trustmark Corp, Universal Health Svcs Inc, Wendy's Co, Wesbanco Inc, Weyco Group Inc, White Mtns Ins Group Ltd
10
American Realty Investors, American Woodmark Corp, Ampco-Pittsburgh Corp, Blackstone Mortgage Tr Inc, Brandywine Realty Trust, Brt Apartments Corp, Caseys General Stores Inc, Cato Corp, Cedar Realty Trust Inc, Cigna Corp, Corecard Corporation, Dixie Group Inc, Duke Realty Corp, Eastgroup Properties, Educational Development Corp, Ford Motor Co, Foster (Lb) Co, Frequency Electronics Inc, Genesco Inc, Haverty Furniture, Helen Of Troy Ltd, Hexcel Corp, Icahn Enterprises Lp, Income Opportunity Rlty Invs, Innsuites Hospitality Tr, Jpmorgan Chase & Co, Kaman Corp, Kewaunee Scientific Corp, Kinross Gold Corp, Lakeland Industries Inc, Mdc Holdings Inc, Molson Coors Beverage Co, Moog Inc, Ofg Bancorp, One Liberty Properties Inc, Oxford Industries Inc, P & F Industries, P.A.M. Transportation Svcs, Par Technology Corp, Park Ohio Holdings Corp, Patrick Industries Inc, Pnm Resources Inc, Public Storage, Seaboard Corp, Semtech Corp, Smith (A.O.), Southwest Gas Holdings Inc, Spectrum Brnd Hldg Inc, Stewart Information Services, Taylor Devices Inc, Transcontinental Rlty Invs, Tsr Inc, Tutor Perini Corp, Tyler Technologies Inc, Universal Security Instrumnt, Village Super Market, Virco Mfg. Corp, Vista Gold Corp, Vse Corp, Wolverine World Wide

Table C.2: Distribution of Companies on E/P by LSV Single-Sort Decile Breakpoints, as of December 1991

1
Alaska Air Group Inc, American Shared Hsptl Serv, Amgen Inc, Analog Devices Inc, Arrow Electronics Inc, Bank Of America Corp, Coca Cola Consolidated Inc, Coherent Inc, Colgate-Palmolive Co, Computer Task Group Inc, Conocophillips, Cracker Barrel Old Ctry Stor, Cullen/Frost Bankers Inc, Daily Journal Corp, Educational Development Corp, Federal Realty Investment Tr, Fedex Corp, Foster (Lb) Co, Genesco Inc, Gentex Corp, Goodyear Tire & Rubber Co, Halliburton Co, Jpmorgan Chase & Co, Kewaunee Scientific Corp, L3Harris Technologies Inc, Masco Corp, Mays (J.W.) Inc, Meridian Bioscience Inc, Monster Beverage Corp, Norfolk Southern Corp, Oshkosh Corp, Rada Electronic Industries, Range Resources Corp, Smith (A.O.), Southwest Airlines, Spectrum Brnd Hldg Inc, Stryker Corp, Taro Pharmaceuticl Inds Ltd, Tejon Ranch Co, Thor Industries Inc, Toll Brothers Inc, Tyler Technologies Inc, Udr Inc, Union Pacific Corp, United-Guardian Inc
2
Adobe Inc, Albany Intl Corp, Alleghany Corp, American Vanguard Corp, Applied Industrial Tech Inc, Asa Gold And Precious Metals, Astec Industries Inc, Barrick Gold Corp, Big Lots Inc, Bp Plc, Bridgford Foods Corp, Caci Intl Inc, Carlisle Cos Inc, Cintas Corp, Clean Harbors Inc, Clorox Co/De, Coca-Cola Co, Conmed Corp, Cto Realty Growth Inc, Cyberoptics Corp, Danaher Corp, Eaton Corp Plc, Encompass Health Corp, Fastenal Co, Fiserv Inc, Hasbro Inc, Hess Corp, Home Depot Inc, Jacobs Engineering Group Inc, Keycorp, Kinross Gold Corp, Louisiana-Pacific Corp, Merck & Co, Microsoft Corp, Millerknoll Inc, Molson Coors Beverage Co, New York Times Co, Newmont Corp, Northwest Natural Hldng Co, Nucor Corp, Paccar Inc, Pfizer Inc, Pnm Resources Inc, Progressive Corp-Ohio, Robert Half Intl Inc, Stewart Information Services, Sysco Corp, Team Inc, Tutor Perini Corp, Unitedhealth Group Inc, Wiley (John) & Sons, Yellow Corp

Table C.2 – *Continued*

3
Alico Inc, Avery Dennison Corp, Bank Of New York Mellon Corp, Barclays Plc, Cardinal Health Inc, Cedar Realty Trust Inc, Chemed Corp, Church & Dwight Inc, Corning Inc, Cts Corp, Disney (Walt) Co, Equifax Inc, Haverty Furniture, Hunt (Jb) Transprt Svcs Inc, Hurco Cos Inc, Interface Inc, Interpublic Group Of Cos, Intl Flavors & Fragrances, Invacare Corp, J & J Snack Foods Corp, Johnson & Johnson, Kellogg Co, Kelly Services Inc, Lumen Technologies Inc, Mccormick & Co Inc, New Jersey Resources Corp, Newell Brands Inc, Nordson Corp, Owens & Minor Inc, Parker-Hannifin Corp, Paychex Inc, Pepsico Inc, Ppg Industries Inc, Regal Rexnord Corporation, Rpc Inc, Ryder System Inc, Schwab (Charles) Corp, Sealed Air Corp, Telefonaktiebolaget Lm Erics, Teradyne Inc, Texas Pacific Land Corp, The Shyft Group Inc, Thermo Fisher Scientific Inc, Tootsie Roll Industries Inc, Transcat Inc, Umh Properties Inc, Viatris Inc, Vulcan Materials Co, Walgreens Boots Alliance Inc, Walmart Inc, Washington Reit
4
American Financial Group Inc, American Software, Apa Corp, Apple Inc, Applied Materials Inc, Archer-Daniels-Midland Co, Atmos Energy Corp, Autodesk Inc, Bristol-Myers Squibb Co, British Amer Tobacco Plc, Canon Inc, Commercial Metals, Crown Holdings Inc, Csp Inc, Diodes Inc, Distribution Solutio Gro Inc, Emerson Electric Co, Fair Isaac Corp, Federal Signal Corp, Fifth Third Bancorp, Franklin Resources Inc, Frp Holdings Inc, Fuller (H. B.) Co, Graco Inc, Grainger (W W) Inc, Harley-Davidson Inc, Healthpeak Properties Inc, Heartland Express Inc, Helmerich & Payne, Hf Sinclair Corp, Host Hotels & Resorts Inc, Illinois Tool Works, Intl Paper Co, Kb Home, Kirby Corp, Lancaster Colony Corp, Medtronic Plc, Mesabi Trust, Novo Nordisk A/S, Oil Dri Corp America, Park Aerospace Corp, Plexus Corp, Potlatchdeltic Corp, Price (T. Rowe) Group, Rollins Inc, Standard Motor Prods, Taylor Devices Inc, Teva Pharmaceuticals, Ugi Corp, Universal Corp/Va, Watts Water Technologies Inc, Wolverine World Wide, Worthington Industries
5
3M Co, Acme United Corp, Altria Group Inc, Balchem Corp, Ball Corp, Bio-Rad Laboratories Inc, Bk Technologies Corp, Cabot Corp, Chevron Corp, Conagra Brands Inc, Deluxe Corp, Dentsply Sirona Inc, Destination Xl Group Inc, Diebold Nixdorf Inc, Dillards Inc, Ecolab Inc, Equity Commonwealth, Expeditors Intl Wash Inc, General Mills Inc, Genuine Parts Co, Henry (Jack) & Associates, Hershey Co, Hexcel Corp, Hni Corp, Honda Motor Co Ltd, Hormel Foods Corp, Hubbell Inc, Idacorp Inc, Investors Title Co, Johnson Outdoors Inc, Kroger Co, Lee Enterprises Inc, Leggett & Platt Inc, Lennar Corp, Lilly (Eli) & Co, Marsh & Mclennan Cos, Mattel Inc, Perkinelmer Inc, Pitney Bowes Inc, Powell Industries Inc, Procter & Gamble Co, Pro-Dex Inc/Co, Quaker Houghton, Rpm International Inc, S&P Global Inc, Schlumberger Ltd, Sensient Technologies Corp, Service Corp International, Sherwin-Williams Co, Snap-On Inc, Sony Group Corporation, Stanley Black & Decker Inc, State Street Corp, Superior Industries Intl, Teleflex Inc, Toro Co, Tyson Foods Inc, Unifirst Corp, Watsco Inc, Williams-Sonoma Inc
6
Aflac Inc, Air Products & Chemicals Inc, Ametek Inc, Arthur J Gallagher & Co, AT&T Inc, Avnet Inc, Azz Inc, Badger Meter Inc, Barnwell Industries, Black Hills Corp, Block H & R Inc, Brady Corp, Carnival Corporation & Plc, Chesapeake Utilities Corp, Chicago Rivet & Machine Co, Crane Holdings Co, Donaldson Co Inc, Edison International, Evergy Inc, Flowserve Corp, Friedman Industries Inc, Gap Inc, General Electric Co, Glatfelter Corp, Hawaiian Electric Inds, Kimberly-Clark Corp, Liveramp Holdings Inc, Mcdonald's Corp, Msa Safety Inc, National Fuel Gas Co, Newmarket Corp, Nextera Energy Inc, Nordstrom Inc, Occidental Petroleum Corp, Oceaneering International, Ofg Bancorp, Omnicom Group Inc, Pennsylvania Re Invs Trust, Pg&E Corp, Rite Aid Corp, Sei Investments Co, Sonoco Products Co, South Jersey Industries Inc, Starrett (L.S.) Co, Tennant Co, Unitil Corp, Verizon Communications Inc, Vf Corp, Wd-40 Co, Whirlpool Corp, Williams Cos Inc, Xcel Energy Inc

Table C.2 – *Continued*

7
Abm Industries Inc, Allete Inc, Alliant Energy Corp, American Express Co, American International Group, Apogee Enterprises Inc, Avista Corp, Barnes Group Inc, Bassett Furniture Inds, Becton Dickinson & Co, Brown & Brown Inc, Brown Forman Corp, Campbell Soup Co, Centerpoint Energy Inc, Cvs Health Corp, Dominion Energy Inc, Exxon Mobil Corp, Gorman-Rupp Co, La-Z-Boy Inc, Mbia Inc, Mesa Royalty Trust, Mge Energy Inc, Northern Trust Corp, Oge Energy Corp, Old National Bancorp, Otter Tail Corp, Par Technology Corp, Pnc Financial Svcs Group Inc, Ppl Corp, Pultegroup Inc, Rocky Mountain Choc Fact Inc, Southwestern Energy Co, Spire Inc, Sturm Ruger & Co Inc, Superior Group Of Cos Inc, Tat Technologies Ltd, Tidewater Inc, Toyota Motor Corp, Umb Financial Corp, Unum Group, Valero Energy Corp, Vishay Intertechnology Inc, Wec Energy Group Inc, Weis Markets Inc, Welltower Inc
8
Aar Corp, Advanced Micro Devices, American Electric Power Co, Astronova Inc, Bank Of Hawaii Corp, Berkley (W R) Corp, Caleres Inc, California Water Service Gp, Cedar Fair, Cincinnati Financial Corp, Comerica Inc, Consolidated Edison Inc, Entergy Corp, Essential Utilities Inc, Eversource Energy, Foot Locker Inc, Franklin Electric Co Inc, Globe Life Inc, Hawkins Inc, Intel Corp, Lincoln National Corp, Lowe's Cos Inc, Marten Transport Ltd, Mcgrath Rentcorp, Mdu Resources Group Inc, Middlesex Water Co, Myers Industries Inc, National Presto Inds Inc, National Retail Properties, Oxford Industries Inc, Pilgrim's Pride Corp, Power Reit, Primeenergy Resources Corp, Public Service Entrp Grp Inc, Regions Financial Corp, San Juan Basin Royalty Tr, Sanderson Farms Inc, Stepan Co, Telefonica Sa, Textron Inc, Unilever Plc, Universal Health Rlty Income, Universal Security Instrumnt, Us Bancorp, Village Super Market , Washington Federal Inc, Wells Fargo & Co, Werner Enterprises Inc, Weyco Group Inc
9
Aegon Nv, Aon Plc, Ark Restaurants Corp, Ascent Industries Co, Associated Banc-Corp, Best Buy Co Inc, Boeing Co, Cigna Corp, Citigroup Inc, Cna Financial Corp, Cohu Inc, Commerce Bancshares Inc, Dte Energy Co, Electro-Sensors Inc, Ennis Inc, Espey Mfg & Electronics Corp, First Citizens Bancsh, First Horizon Corp, Fmc Corp, Fulton Financial Corp, Griffon Corp, Harsco Corp, Helen Of Troy Ltd, Huntington Bancshares, Ingles Markets Inc, Kaman Corp, Koninklijke Philips Nv, Lockheed Martin Corp, M & T Bank Corp, Modine Manufacturing Co, Nike Inc, North European Oil Rty Tr, Oppenheimer Holdings Inc, Photronics Inc, Pldt Inc, Polaris Inc, Popular Inc, Public Storage, Raymond James Financial Inc, Rockwell Automation, Semtech Corp, Servotronics Inc, Sjw Group, Standex International Corp, Target Corp, Tjx Cos Inc (The), Truist Financial Corp, Trustmark Corp, Universal Health Svcs Inc, Westamerica Bancorporation, White Mtns Ins Group Ltd, Zions Bancorporation Na
10
Adams Resources & Energy Inc, Agilysys Inc, Air T Inc, American States Water Co, Argo Group Intl Holdings Ltd, Atrion Corp, Banco Santander Sa, Caseys General Stores Inc, Cleveland-Cliffs Inc, Comtech Telecommun, Curtiss-Wright Corp, Cvb Financial Corp, Ducommun Inc, Eastern Co, Eastgroup Properties, Gatx Corp, General Dynamics Corp, Icahn Enterprises Lp, Innsuites Hospitality Tr, Jefferies Financial Grp Inc, Kaspien Holdings Inc, Lci Industries, Loews Corp, Marcus Corp, Markel Corp, Mercury General Corp, Mesa Laboratories Inc, Moog Inc, National Healthcare Corp, New England Realty Assc, Northrop Grumman Corp, Old Republic Intl Corp, One Liberty Properties Inc, P & F Industries, Permian Basin Royalty Trust, Pvh Corp, Rli Corp, Ross Stores Inc, Sabine Royalty Trust, Safeguard Scientifics Inc, Seaboard Corp, Selective Ins Group Inc, Value Line Inc, Virco Mfg. Corp, Wpp Plc

Table C.3: Distribution of Companies on C/P by LSV Single-Sort Decile Breakpoints, as of December 1991

1
Alexander's Inc, Amgen Inc, Ampco-Pittsburgh Corp, Asa Gold And Precious Metals, Barrick Gold Corp, Bridgford Foods Corp, Cadence Design Systems Inc, Cedar Realty Trust Inc, Cms Energy Corp, Coca-Cola Co, Colgate-Palmolive Co, Comcast Corp, Cracker Barrel Old Ctry Stor, Encompass Health Corp, Fastenal Co, Gentex Corp, Hanger Inc, Healthcare Services Group, Hecla Mining Co, Honeywell International Inc, Materion Corp, Mays (J.W.) Inc, Merck & Co, Meridian Bioscience Inc, Microsoft Corp, Monster Beverage Corp, Nl Industries, Oracle Corp, Park Ohio Holdings Corp, Pfizer Inc, Rada Electronic Industries, Stryker Corp, Taro Pharmaceuticl Inds Ltd, Tejon Ranch Co, Texas Pacific Land Corp, Thor Industries Inc, Toll Brothers Inc, Udr Inc, United-Guardian Inc, Unitedhealth Group Inc, Valmont Industries Inc
2
Adobe Inc, Arrow Electronics Inc, Autodesk Inc, Bristol-Myers Squibb Co, Cardinal Health Inc, Caterpillar Inc, Church & Dwight Inc, Cintas Corp, Clorox Co/De, Conmed Corp, Cyberoptics Corp, Deere & Co, Distribution Solutio Gro Inc, Educational Development Corp, Equity Commonwealth, Franklin Resources Inc, Getty Realty Corp, Grainger (W W) Inc, Hasbro Inc, Home Depot Inc, Intergroup Corp, Intl Flavors & Fragrances, Invacare Corp, Jacobs Engineering Group Inc, Johnson & Johnson, Kb Home, Kellogg Co, Kelly Services Inc, Masco Corp, Mccormick & Co Inc, Mesabi Trust, Newell Brands Inc, Nordson Corp, Norfolk Southern Corp, Owens & Minor Inc, Paccar Inc, Price (T. Rowe) Group, Rollins Inc, Sysco Corp, Texas Instruments Inc, The Shyft Group Inc, Thermo Fisher Scientific Inc, Tootsie Roll Industries Inc, Viatris Inc, Walmart Inc, Washington Reit, West Pharmaceutical Svsc Inc
3
Alico Inc, Altria Group Inc, American Software, Block H & R Inc, British Amer Tobacco Plc, Chemed Corp, Coherent Inc, Corning Inc, Csp Inc, Csx Corp, Cto Realty Growth Inc, Cummins Inc, Danaher Corp, Emerson Electric Co, Equifax Inc, Expeditors Intl Wash Inc, Fair Isaac Corp, Federal Signal Corp, Fiserv Inc, Genuine Parts Co, Harley-Davidson Inc, Hershey Co, Hf Sinclair Corp, Hni Corp, Hormel Foods Corp, Hubbell Inc, Interpublic Group Of Cos, Investors Title Co, Lilly (Eli) & Co, Marsh & Mclennan Cos, Medtronic Plc, Mesa Royalty Trust, New York Times Co, Newmont Corp, Oshkosh Corp, Paychex Inc, Pennsylvania Re Invs Trust, Plexus Corp, Powell Industries Inc, Regal Rexnord Corporation, Sealed Air Corp, Service Corp International, Snap-On Inc, Teva Pharmaceuticals, Union Pacific Corp, Universal Corp/Va, Vse Corp, Walgreens Boots Alliance Inc, Watts Water Technologies Inc, Wd-40 Co, Welltower Inc, Weyerhaeuser Co
4
Alleghany Corp, American Financial Group Inc, Apple Inc, Applied Materials Inc, Archer-Daniels-Midland Co, Arthur J Gallagher & Co, Balchem Corp, Brunswick Corp, Carlisle Cos Inc, Carnival Corporation & Plc, Coca-Cola Europacific Partne, Deluxe Corp, Diebold Nixdorf Inc, Dillards Inc, Friedman Industries Inc, Fuller (H. B.) Co, Gap Inc, General Mills Inc, Glatfelter Corp, Graco Inc, Halliburton Co, Heartland Express Inc, Henry (Jack) & Associates, Hurco Cos Inc, Illinois Tool Works, J & J Snack Foods Corp, Lancaster Colony Corp, Lennar Corp, Mattel Inc, National Presto Inds Inc, Novo Nordisk A/S, Nucor Corp, Oceaneering International, Oil Dri Corp America, Pepsico Inc, Perkinelmer Inc, Power Reit, Procter & Gamble Co, Quaker Houghton, Robert Half Intl Inc, Rpc Inc, Rpm International Inc, S&P Global Inc, San Juan Basin Royalty Tr, Schwab (Charles) Corp, Sensient Technologies Corp, Sherwin-Williams Co, Southwest Airlines, Stanley Black & Decker Inc, Teleflex Inc, Universal Health Rlty Income, Williams-Sonoma Inc, Worthington Industries
5
3M Co, Avery Dennison Corp, Avnet Inc, Azz Inc, Bassett Furniture Inds, Black Hills Corp, Brady Corp, Brown Forman Corp, Caci Intl Inc, Chicago Rivet & Machine Co, Clean Harbors Inc, Computer Task Group Inc, Conagra Brands Inc, Corecard Corporation, Crane Holdings Co, Crown Holdings Inc, Cvs Health Corp, Dentsply Sirona Inc, Disney (Walt) Co, Donaldson Co Inc, Eaton Corp Plc, Ecolab Inc, Flowserve Corp, Foster (Lb) Co, Gorman-Rupp Co, Intl Business Machines Corp, Johnson Outdoors Inc, Kimberly-Clark Corp, Kirby Corp, Lee Enterprises Inc, Lumen Technologies Inc, Mcdonald's Corp, Millerknoll Inc, Newmarket Corp

Table C.3 – *Continued*

5 – *Continued*
North European Oil Rty Tr, Pitney Bowes Inc, Ppg Industries Inc, Pro-Dex Inc/Co, Rocky Mountain Choc Fact Inc, Schlumberger Ltd, Starrett (L.S.) Co, Sturm Ruger & Co Inc, Superior Group Of Cos Inc, Superior Industries Intl, Tat Technologies Ltd, Teradyne Inc, Transcat Inc, Tsr Inc, Tyson Foods Inc, Universal Security Instrumnt, Weis Markets Inc
6
Aar Corp, Abm Industries Inc, Acme United Corp, Allete Inc, Ametek Inc, Applied Industrial Tech Inc, Astronova Inc, Becton Dickinson & Co, Big Lots Inc, Bio-Rad Laboratories Inc, Campbell Soup Co, Cedar Fair, Daily Journal Corp, Diodes Inc, Electro-Sensors Inc, Ennis Inc, General Electric Co, Haverty Furniture, Hawkins Inc, Idacorp Inc, Intel Corp, La-Z-Boy Inc, Leggett & Platt Inc, Middlesex Water Co, Murphy Oil Corp, New Jersey Resources Corp, Nike Inc, Nordstrom Inc, Ofg Bancorp, Omnicom Group Inc, Oppenheimer Holdings Inc, Otter Tail Corp, Parker-Hannifin Corp, Permian Basin Royalty Trust, Range Resources Corp, Raymond James Financial Inc, Sabine Royalty Trust, Sei Investments Co, Sonoco Products Co, Standard Motor Prods, Taylor Devices Inc, Team Inc, Tennant Co, Ugi Corp, Unifirst Corp, Valero Energy Corp, Vf Corp, Vulcan Materials Co, Watsco Inc, Wec Energy Group Inc, Weyco Group Inc, Wolverine World Wide
7
Air Products & Chemicals Inc, Albany Intl Corp, Alliant Energy Corp, American Woodmark Corp, Analog Devices Inc, Apogee Enterprises Inc, Ascent Industries Co, Atmos Energy Corp, Avista Corp, Ball Corp, Brown & Brown Inc, Canon Inc, Cleveland-Cliffs Inc, Cohu Inc, Consolidated Edison Inc, Edison International, Espey Mfg & Electronics Corp, Essential Utilities Inc, Exxon Mobil Corp, Foot Locker Inc, Franklin Electric Co Inc, Frp Holdings Inc, Genesco Inc, Goodyear Tire & Rubber Co, Hawaiian Electric Inds, Helmerich & Payne, Innsuites Hospitality Tr, Intl Paper Co, Loews Corp, Louisiana-Pacific Corp, Lowe's Cos Inc, Mge Energy Inc, Msa Safety Inc, Myers Industries Inc, National Fuel Gas Co, Nextera Energy Inc, Northwest Natural Hldng Co, Oge Energy Corp, Potlatchdeltic Corp, Ppl Corp, Rite Aid Corp, Servotronics Inc, South Jersey Industries Inc, Southwestern Energy Co, Spire Inc, Stewart Information Services, Telefonaktiebolaget Lm Erics, Value Line Inc
8
American Electric Power Co, American Vanguard Corp, Astec Industries Inc, AT&T Inc, Barnes Group Inc, Bk Technologies Corp, Boeing Co, Caleres Inc, California Water Service Gp, Centerpoint Energy Inc, Chesapeake Utilities Corp, Chevron Corp, Commercial Metals, Destination Xl Group Inc, Dominion Energy Inc, Entergy Corp, Escalade Inc, Evergy Inc, Eversource Energy, Griffon Corp, Hunt (Jb) Transprt Svcs Inc, Icahn Enterprises Lp, Interface Inc, Kewaunee Scientific Corp, Mcgrath Rentcorp, Mdu Resources Group Inc, Pg&E Corp, Photronics Inc, Pldt Inc, Polaris Inc, Public Service Entrp Grp Inc, Sanderson Farms Inc, Sony Group Corporation, Standex International Corp, Textron Inc, Tidewater Inc, Tjx Cos Inc (The), Toro Co, Toyota Motor Corp, Umh Properties Inc, Unitil Corp, Whirlpool Corp, Williams Cos Inc, Xcel Energy Inc
9
Adams Resources & Energy Inc, Advanced Micro Devices, American States Water Co, Apa Corp, Ark Restaurants Corp, Badger Meter Inc, Barnwell Industries, Bp Plc, Cabot Corp, Coca Cola Consolidated Inc, Conocophillips, Cts Corp, Curtiss-Wright Corp, Dte Energy Co, Eastgroup Properties, Harsco Corp, Helen Of Troy Ltd, Honda Motor Co Ltd, Host Hotels & Resorts Inc, Kaman Corp, Kaspien Holdings Inc, Kroger Co, L3Harris Technologies Inc, Lci Industries, Liveramp Holdings Inc, Lockheed Martin Corp, Modine Manufacturing Co, Molson Coors Beverage Co, Occidental Petroleum Corp, Oxford Industries Inc, Par Technology Corp, Park Aerospace Corp, Pilgrim's Pride Corp, Pnm Resources Inc, Pvh Corp, Rockwell Automation, Rogers Corp, Ross Stores Inc, Sjw Group, Southwest Gas Holdings Inc, Stepan Co, Target Corp, Tutor Perini Corp, Tyler Technologies Inc, U S Lime & Minerals, Verizon Communications Inc, Vishay Intertechnology Inc, Wiley (John) & Sons, Yellow Corp

Table C.3 – *Continued*

10
Agilysys Inc, Air T Inc, Alaska Air Group Inc, American Shared Hsptl Serv, Atrion Corp, Best Buy Co Inc, Caseys General Stores Inc, Comtech Telecommun, Ducommun Inc, Eastern Co, Fedex Corp, Fmc Corp, Ford Motor Co, Gatx Corp, General Dynamics Corp, Hess Corp, Hexcel Corp, Ingles Markets Inc, Jefferies Financial Grp Inc, Kinross Gold Corp, Koninklijke Philips Nv, Lsb Industries Inc, Marcus Corp, Markel Corp, Marten Transport Ltd, Mesa Laboratories Inc, Moog Inc, National Healthcare Corp, New England Realty Assc, Northrop Grumman Corp, One Liberty Properties Inc, P & F Industries, P.A.M. Transportation Svcs, Patrick Industries Inc, Primeenergy Resources Corp, Ryder System Inc, Safeguard Scientifics Inc, Seaboard Corp, Semtech Corp, Smith (A.O.), Spectrum Brnd Hldg Inc, Telefonica Sa, Universal Health Svcs Inc, Village Super Market, Virco Mfg. Corp, Wendy's Co, Werner Enterprises Inc, Wpp Plc

Table C.4: Distribution of Companies on Sales Rank by LSV Single-Sort Decile Breakpoints, as of December 1991

1
Adobe Inc, American Software, America's Car-Mart Inc, Amgen Inc, Apa Corp, Applied Materials Inc, Astronova Inc, Autodesk Inc, Banco Santander Sa, Bank Of America Corp, Barrick Gold Corp, Cadence Design Systems Inc, Cardinal Health Inc, Cintas Corp, Comcast Corp, Conagra Brands Inc, Conmed Corp, Cracker Barrel Old Ctry Stor, Cyberoptics Corp, Daily Journal Corp, Dentsply Sirona Inc, Destination Xl Group Inc, Dillards Inc, Encompass Health Corp, Equity Commonwealth, Fastenal Co, Fedex Corp, Fiserv Inc, Gap Inc, Healthcare Services Group, Healthpeak Properties Inc, Heartland Express Inc, Home Depot Inc, Hunt (Jb) Transprt Svcs Inc, Intel Corp, Interdigital Inc, Invacare Corp, J & J Snack Foods Corp, Kaspien Holdings Inc, Keycorp, Kirby Corp, Liveramp Holdings Inc, M & T Bank Corp, Medtronic Plc, Mesa Laboratories Inc, Microsoft Corp, Nike Inc, Nordson Corp, Oracle Corp, Paychex Inc, Photronics Inc, Psychemedics Corp, Safeguard Scientifics Inc, Sony Group Corporation, Stryker Corp, Team Inc, Telefonica Sa, The Shyft Group Inc, Thermo Fisher Scientific Inc, Udr Inc, Walmart Inc, Watsco Inc, Watts Water Technologies Inc, Werner Enterprises Inc, Williams-Sonoma Inc
2
Adams Resources & Energy Inc, Aegon Nv, Aflac Inc, Air T Inc, Altria Group Inc, Apogee Enterprises Inc, Apple Inc, Arthur J Gallagher & Co, Balchem Corp, Bank Of Hawaii Corp, Best Buy Co Inc, Bio-Rad Laboratories Inc, Block H & R Inc, Boeing Co, Brady Corp, Bridgford Foods Corp, Bristol-Myers Squibb Co, Calamp Corp, Canon Inc, Carnival Corporation & Plc, Caseys General Stores Inc, Corning Inc, Crown Holdings Inc, Cvs Health Corp, Disney (Walt) Co, Educational Development Corp, Expeditors Intl Wash Inc, Fair Isaac Corp, Fifth Third Bancorp, First Citizens Bancsh, Franklin Resources Inc, Gatx Corp, Hawaiian Electric Inds, Hawkins Inc, Henry (Jack) & Associates, Interpublic Group Of Cos, Jacobs Engineering Group Inc, Kinross Gold Corp, Markel Corp, Mbia Inc, Mcgrath Rentcorp, Merck & Co, Meridian Bioscience Inc, National Healthcare Corp, Nordstrom Inc, Novo Nordisk A/S, Oil Dri Corp America, Oppenheimer Holdings Inc, Pepsico Inc, Perkinelmer Inc, Pilgrim's Pride Corp, Pldt Inc, Plexus Corp, Polaris Inc, Popular Inc, Powell Industries Inc, Primeenergy Resources Corp, Procter & Gamble Co, Rada Electronic Industries, Raymond James Financial Inc, Rite Aid Corp, Ross Stores Inc, Rpm International Inc, Schwab (Charles) Corp, Seaboard Corp, Southwest Airlines, State Street Corp, Sysco Corp, Teleflex Inc, Teva Pharmaceuticals, Tyson Foods Inc, Walgreens Boots Alliance Inc, Wpp Plc
3
Aar Corp, Agilysys Inc, Alaska Air Group Inc, American International Group, American Shared Hsptl Serv, American Vanguard Corp, Applied Industrial Tech Inc, Ark Restaurants Corp, Azz Inc, Ball Corp, Church & Dwight Inc, Citigroup Inc, Clorox Co/De, Cna Financial Corp, Coca-Cola Co, Cohu Inc, Computer Task Group Inc, Equifax Inc, Federal Realty Investment Tr, Foot Locker Inc, Fulton Financial Corp, General Mills Inc, Grainger (W W) Inc, Griffon Corp, Halliburton Co, Harsco Corp, Helen Of Troy Ltd, Illinois Tool Works

Table C.4 – *Continued*

3 – *Continued*
Ingles Markets Inc, Johnson & Johnson, Johnson Outdoors Inc, Kellogg Co, Lee Enterprises Inc, Light & Wonder Inc, Lilly (Eli) & Co, Loews Corp, Lumen Technologies Inc, Marten Transport Ltd, Mattel Inc, Mesabi Trust, Middleby Corp, Omnicom Group Inc, Park Aerospace Corp, Price (T. Rowe) Group, Public Storage, Pvh Corp, Regions Financial Corp, Sei Investments Co, Sherwin-Williams Co, Standard Motor Prods, Superior Industries Intl, Target Corp, Telefonaktiebolaget Lm Erics, Terex Corp, Tidewater Inc, Tootsie Roll Industries Inc, Toyota Motor Corp, Truist Financial Corp, Ugi Corp, Unifirst Corp, Unilever Plc, Unitedhealth Group Inc, Washington Reit, Wells Fargo & Co
4
3M Co, Abm Industries Inc, Acme United Corp, Agnico Eagle Mines Ltd, Ametek Inc, Analog Devices Inc, Aon Plc, Avery Dennison Corp, Barclays Plc, Barnwell Industries, Becton Dickinson & Co, Big Lots Inc, British Amer Tobacco Plc, Brown & Brown Inc, Coca Cola Consolidated Inc, Colgate-Palmolive Co, Comerica Inc, Cto Realty Growth Inc, Cvb Financial Corp, Deluxe Corp, Donaldson Co Inc, Duke Realty Corp, Eversource Energy, Federal Signal Corp, Flowserve Corp, Fuller (H. B.) Co, General Electric Co, Gentex Corp, Gorman-Rupp Co, Harley-Davidson Inc, Hasbro Inc, Hershey Co, Hf Sinclair Corp, Icad Inc, Interface Inc, Intl Flavors & Fragrances, Intl Paper Co, Jefferies Financial Grp Inc, Jpmorgan Chase & Co, Kimberly-Clark Corp, La-Z-Boy Inc, Leggett & Platt Inc, Lincoln National Corp, Mcdonald's Corp, Mesa Royalty Trust, Middlesex Water Co, Millerknoll Inc, Modine Manufacturing Co, National Presto Inds Inc, Nucor Corp, Old National Bancorp, Owens & Minor Inc, P & F Industries, Pfizer Inc, Pitney Bowes Inc, Range Resources Corp, Research Frontiers Inc, Richardson Electronics Ltd, Rollins Inc, San Juan Basin Royalty Tr, Schlumberger Ltd, Sealed Air Corp, Semtech Corp, Service Corp International, Servotronics Inc, Southwestern Energy Co, Stepan Co, Tjx Cos Inc (The), Transcat Inc, Trustmark Corp, Umh Properties Inc, Universal Health Svcs Inc, Vishay Intertechnology Inc, Whirlpool Corp, Xoma Corp
5
Air Products & Chemicals Inc, Albany Intl Corp, Alico Inc, Alleghany Corp, Archer-Daniels-Midland Co, Arrow Electronics Inc, Ascent Industries Co, Campbell Soup Co, Cedar Fair, Centerpoint Energy Inc, Cincinnati Financial Corp, Clean Harbors Inc, Coherent Inc, Comtech Telecommun, Csp Inc, Danaher Corp, Deere & Co, Edison International, Escalade Inc, Exxon Mobil Corp, First Horizon Corp, Fmc Corp, Frp Holdings Inc, Genuine Parts Co, Getty Realty Corp, Helmerich & Payne, Hess Corp, Honda Motor Co Ltd, Hormel Foods Corp, Host Hotels & Resorts Inc, Hubbell Inc, Huntington Bancshares, Kb Home, Lowe's Cos Inc, Marsh & Mclennan Cos, Masco Corp, Mccormick & Co Inc, Molson Coors Beverage Co, Msa Safety Inc, Newell Brands Inc, Nextgen Healthcare Inc, Northern Trust Corp, Old Republic Intl Corp, Pg&E Corp, Progressive Corp-Ohio, Robert Half Intl Inc, Rocky Mountain Choc Fact Inc, Selective Ins Group Inc, Sjw Group, Stewart Information Services, Sturm Ruger & Co Inc, Teradyne Inc, Toro Co, Tyler Technologies Inc, Unitil Corp, Universal Corp/Va, Universal Health Rlty Income, Unum Group, Us Bancorp, Valero Energy Corp, Valmont Industries Inc, Vf Corp, Yellow Corp
6
Advanced Micro Devices, American Express Co, American States Water Co, Associated Banc-Corp, Avista Corp, Badger Meter Inc, Black Hills Corp, Bp Plc, Caleres Inc, Cato Corp, Chemed Corp, Chevron Corp, Cigna Corp, Coca-Cola Europacific Partne, Coeur Mining Inc, Commercial Metals, Csx Corp, Diebold Nixdorf Inc, Dominion Energy Inc, Dte Energy Co, Eastgroup Properties, Essential Utilities Inc, Franklin Electric Co Inc, Globe Life Inc, Graco Inc, Hecla Mining Co, Hurco Cos Inc, Investors Title Co, Koninklijke Philips Nv, Kroger Co, L3Harris Technologies Inc, Lakeland Industries Inc, Lci Industries, Marcus Corp, Myers Industries Inc, New Jersey Resources Corp, Newmarket Corp, Newmont Corp, North European Oil Rty Tr, Oceaneering International, Oge Energy Corp, Pnc Financial Svcs Group Inc, Ppl Corp, Quaker Houghton, Rcm Technologies Inc, Rogers Corp, Sonoco Products Co, Standex International Corp, Starrett (L.S.) Co, Texas Instruments Inc, Tutor Perini Corp, Umb Financial Corp, Vector Group Ltd, Village Super Market, Vista Gold Corp, Welltower Inc, West Pharmaceutical Svsc Inc, Williams Cos Inc, Xcel Energy Inc, Zions Bancorporation Na

Table C.4 – *Continued*

7
Allete Inc, Alliant Energy Corp, American Financial Group Inc, American Woodmark Corp, Argo Group Intl Holdings Ltd, AT&T Inc, Atmos Energy Corp, Bank Of New York Mellon Corp, Barnes Group Inc, Brandywine Realty Trust, Brown Forman Corp, California Water Service Gp, Chesapeake Utilities Corp, Commerce Bancshares Inc, Conocophillips, Consolidated Edison Inc, Distribution Solutio Gro Inc, Ducommun Inc, Ecolab Inc, Emerson Electric Co, Entergy Corp, Espey Mfg & Electronics Corp, Glatfelter Corp, Haverty Furniture, Heron Therapeutics Inc, Hexcel Corp, Hni Corp, Idacorp Inc, Immucell Corp, Intergroup Corp, Intl Business Machines Corp, Kelly Services Inc, Kewaunee Scientific Corp, Lancaster Colony Corp, Mge Energy Inc, Moog Inc, Murphy Oil Corp, New England Realty Assc, P.A.M. Transportation Svcs, Parker-Hannifin Corp, Pnm Resources Inc, Potlatchdeltic Corp, Public Service Entrp Grp Inc, Pultegroup Inc, Regal Rexnord Corporation, Rli Corp, S&P Global Inc, Sanderson Farms Inc, Sensient Technologies Corp, Snap-On Inc, South Jersey Industries Inc, Southwest Gas Holdings Inc, Tennant Co, Textron Inc, Union Pacific Corp, Verizon Communications Inc, Wd-40 Co, Weis Markets Inc, Weyco Group Inc
8
American Electric Power Co, Atrion Corp, Avnet Inc, Berkley (W R) Corp, Brt Apartments Corp, Cabot Corp, Caci Intl Inc, Carlisle Cos Inc, Caterpillar Inc, Cedar Realty Trust Inc, Cleveland-Cliffs Inc, Cummins Inc, Curtiss-Wright Corp, Electro-Sensors Inc, Ennis Inc, Evergy Inc, Ford Motor Co, Frequency Electronics Inc, Friedman Industries Inc, Genesco Inc, Goodyear Tire & Rubber Co, Kaman Corp, Lennar Corp, Lsb Industries Inc, Mays (J.W.) Inc, Mdu Resources Group Inc, National Fuel Gas Co, National Retail Properties, New York Times Co, Nextera Energy Inc, Norfolk Southern Corp, Northrop Grumman Corp, Northwest Natural Hldng Co, Occidental Petroleum Corp, One Liberty Properties Inc, Oshkosh Corp, Otter Tail Corp, Paccar Inc, Par Technology Corp, Patrick Industries Inc, Permian Basin Royalty Trust, Pinnacle West Capital Corp, Ppg Industries Inc, Pro-Dex Inc/Co, Rpc Inc, Ryder System Inc, Sabine Royalty Trust, Spectrum Brnd Hldg Inc, Stanley Black & Decker Inc, Stifel Financial Corp, Superior Group Of Cos Inc, Tat Technologies Ltd, Toll Brothers Inc, U S Lime & Minerals, Value Line Inc, Viatris Inc, Virco Mfg. Corp, Vulcan Materials Co, Wec Energy Group Inc, Wendy's Co, Westamerica Bancorporation, Weyerhaeuser Co, Wiley (John) & Sons, Worthington Industries
9
1St Source Corp, Abrdn Asia Pacific Income Fd, Abrdn Australia Equity Fund, Adams Diversified Equity Fd, Adams Natural Resources Fund, America First Multifamily, Ameriserv Financial Inc/Pa, Anixa Biosciences Inc, Arrow Financial Corp, Astec Industries Inc, Bancroft Fund Ltd, Bank South Carolina Corp, Barings Corporate Investors, Bny Mellon Strategic Muns In, Cadence Bank, Central Pacific Financial Cp, Central Securities Corp, Citizens Inc, City Holding Co, Cms Energy Corp, Community Bank System Inc, Community Trust Bancorp Inc, Cornerstone Total Return Fd, Credit Suisse Asst Income Fd, Dnp Select Income Fund Inc, Ellsworth Grwth Incm Fd Ltd, European Equity Fund Inc, F N B Corp/Fl, First Bancorp P R, First Bancorp/Nc, First Finl Bancorp Inc/Oh, First Long Island Corp, Gabelli Equity Trust, General American Investors, Glacier Bancorp Inc, Hancock (John) Income Sec, High Income Securities Fund, Honeywell International Inc, Independent Bank Corp/Ma, Independent Bank Corp/Mi, Insight Select Income Fd, Invesco Bond Fund, John Hancock Investors Trust, Liberty All-Star Equity, Liberty All-Star Growth Fund, Mfs Gvt Mkts Income Tr, Mfs High Yield Municipal Tr, Mfs Multimarket Income Tr, Mfs Municipal Inc Tr, National Western Life Group, Northeast Bank, Nuveen California Mun Val Fd, Nuveen Muni Value Fund Inc, Nuveen N Y Muni Value Fund, Ofg Bancorp, Peoples Bancorp Nc Inc, Rand Capital Corp, Royce Value Trust, Seacoast Banking Corp/Fl, Security Natl Finl Cp, Simmons First Natl Cp, Srh Total Return Fund Inc, Svb Financial Group, Swiss Helvetia Fund, Taiwan Fund Inc, Tcw Strategic Income Fund, Tekla Healthcare Investors, Templeton Emerging Mkts Fund, Tompkins Financial Corp, Tri-Continental Corp, Trustco Bank Corp/Ny, United Bankshares Inc/Wv, United Fire Group Inc, United-Guardian Inc, Washington Tr Bancorp Inc, Webster Financial Corp, Wesbanco Inc, Western Asst Inv Grd Incm Fd, Wsfs Financial Corp

Table C.4 – *Continued*

10
Abiomed Inc, Alexander's Inc, American Realty Investors, Ampco-Pittsburgh Corp, Asa Gold And Precious Metals, Bassett Furniture Inds, Bk Technologies Corp, Brunswick Corp, Ceco Environmental Corp, Chicago Rivet & Machine Co, Cooper Cos Inc (The), Corecard Corporation, Crane Holdings Co, Cts Corp, Cullen/Frost Bankers Inc, Daxor Corp, Diodes Inc, Dixie Group Inc, Eastern Co, Eaton Corp Plc, Flanigans Enterprises Inc, Foster (Lb) Co, General Dynamics Corp, Icahn Enterprises Lp, Income Opportunity Rlty Invs, Innsuites Hospitality Tr, Lockheed Martin Corp, Louisiana-Pacific Corp, Materion Corp, Mcewen Mining Inc, Mdc Holdings Inc, Mexico Fund Inc, Nl Industries, Oxford Industries Inc, Park Ohio Holdings Corp, Pennsylvania Re Invs Trust, Power Reit, Rockwell Automation, Smith (A.O.), Spire Inc, Taylor Devices Inc, Tejon Ranch Co, Texas Pacific Land Corp, Thor Industries Inc, Transcontinental Rlty Invs, Tsr Inc, Unisys Corp, Universal Security Instrumnt, Vse Corp, White Mtns Ins Group Ltd, Wolverine World Wide

Table C.5: Distribution of Companies on Intersections of Sales Rank and BE/ME by LSV Double-Sort Breakpoints, as of December 1991

1-1
Anixa Biosciences Inc, Cooper Cos Inc (The), Ennis Inc, Pennsylvania Re Invs Trust, Permian Basin Royalty Trust, Pro-Dex Inc/Co, Sabine Royalty Trust, Tat Technologies Ltd, Tejon Ranch Co, Texas Pacific Land Corp, Toll Brothers Inc, U S Lime & Minerals, United-Guardian Inc, Viatris Inc
1-2
3M Co, Alico Inc, Ametek Inc, Barnwell Industries, British Amer Tobacco Plc, Brown & Brown Inc, Brown Forman Corp, Campbell Soup Co, Cedar Fair, Colgate-Palmolive Co, Cto Realty Growth Inc, Deluxe Corp, Distribution Solutio Gro Inc, Ecolab Inc, Emerson Electric Co, Federal Signal Corp, Fmc Corp, Franklin Electric Co Inc, General Electric Co, Gentex Corp, Genuine Parts Co, Glatfelter Corp, Globe Life Inc, Harley-Davidson Inc, Heron Therapeutics Inc, Hershey Co, Hf Sinclair Corp, Hni Corp, Hormel Foods Corp, Host Hotels & Resorts Inc, Hubbell Inc, Icad Inc, Intergroup Corp, Intl Flavors & Fragrances, Kelly Services Inc, Kimberly-Clark Corp, Lancaster Colony Corp, Marsh & Mclennan Cos, Mccormick & Co Inc, Mcdonald's Corp, Newell Brands Inc, Newmarket Corp, Newmont Corp, North European Oil Rty Tr, Nucor Corp, Oceaneering International, Owens & Minor Inc, Pfizer Inc, Pitney Bowes Inc, Progressive Corp-Ohio, Range Resources Corp, Rcm Technologies Inc, Research Frontiers Inc, Rocky Mountain Choc Fact Inc, Rollins Inc, S&P Global Inc, Schlumberger Ltd, Sensient Technologies Corp, Tjx Cos Inc (The), Umh Properties Inc, Universal Corp/Va, Wd-40 Co, Xoma Corp
1-3
Adobe Inc, Altria Group Inc, American Software, Amgen Inc, Apple Inc, Arthur J Gallagher & Co, Autodesk Inc, Balchem Corp, Barrick Gold Corp, Block H & R Inc, Bridgford Foods Corp, Bristol-Myers Squibb Co, Cadence Design Systems Inc, Calamp Corp, Carnival Corporation & Plc, Church & Dwight Inc, Cintas Corp, Clorox Co/De, Coca-Cola Co, Comcast Corp, Conagra Brands Inc, Conmed Corp, Corning Inc, Cracker Barrel Old Ctry Stor, Cyberoptics Corp, Daily Journal Corp, Disney (Walt) Co, Encompass Health Corp, Equifax Inc, Expeditors Intl Wash Inc, Fastenal Co, Fifth Third Bancorp, Fiserv Inc, Franklin Resources Inc, Gap Inc, General Mills Inc, Grainger (W W) Inc, Healthpeak Properties Inc, Heartland Express Inc, Henry (Jack) & Associates, Home Depot Inc, Hunt (Jb) Transprt Svcs Inc, Illinois Tool Works, Interpublic Group Of Cos, Invacare Corp

Table C.5 – *Continued*

1-3 – *Continued*
Jacobs Engineering Group Inc, Johnson & Johnson, Kellogg Co, Lee Enterprises Inc, Lilly (Eli) & Co, Lumen Technologies Inc, Mattel Inc, Medtronic Plc, Merck & Co, Meridian Bioscience Inc, Mesabi Trust, Microsoft Corp, Middleby Corp, Nike Inc, Nordson Corp, Oracle Corp, Paychex Inc, Pepsico Inc, Perkinelmer Inc, Plexus Corp, Polaris Inc, Powell Industries Inc, Price (T. Rowe) Group, Procter & Gamble Co, Psychemedics Corp, Schwab (Charles) Corp, Sei Investments Co, Sherwin-Williams Co, State Street Corp, Stryker Corp, Superior Industries Intl, Sysco Corp, Teva Pharmaceuticals, The Shyft Group Inc, Tootsie Roll Industries Inc, Tyson Foods Inc, Unilever Plc, Unitedhealth Group Inc, Walgreens Boots Alliance Inc, Walmart Inc, Washington Reit, Watts Water Technologies Inc, Williams-Sonoma Inc
2-1
Abiomed Inc, American Electric Power Co, Atrion Corp, Berkley (W R) Corp, Brunswick Corp, Cabot Corp, Caci Intl Inc, Carlisle Cos Inc, Central Pacific Financial Cp, Cleveland-Cliffs Inc, Cms Energy Corp, Crane Holdings Co, Cummins Inc, Eaton Corp Plc, Evergy Inc, First Finl Bancorp Inc/Oh, Goodyear Tire & Rubber Co, Honeywell International Inc, Lennar Corp, Louisiana-Pacific Corp, Materion Corp, Mays (J.W.) Inc, Mdu Resources Group Inc, National Fuel Gas Co, New York Times Co, Nextera Energy Inc, Norfolk Southern Corp, Northwest Natural Hldng Co, Otter Tail Corp, Paccar Inc, Ppg Industries Inc, Rockwell Automation, Rpc Inc, Spire Inc, Stanley Black & Decker Inc, Superior Group Of Cos Inc, Thor Industries Inc, Unisys Corp, Value Line Inc, Vulcan Materials Co, Wec Energy Group Inc, Weyerhaeuser Co, Wiley (John) & Sons, Worthington Industries
2-2
Abm Industries Inc, Advanced Micro Devices, Agnico Eagle Mines Ltd, Air Products & Chemicals Inc, Albany Intl Corp, Allete Inc, Alliant Energy Corp, American Express Co, American States Water Co, Analog Devices Inc, Aon Plc, Archer-Daniels-Midland Co, Arrow Electronics Inc, Ascent Industries Co, Associated Banc-Corp, AT&T Inc, Atmos Energy Corp, Avery Dennison Corp, Avista Corp, Barnes Group Inc, Becton Dickinson & Co, Big Lots Inc, Black Hills Corp, Bp Plc, California Water Service Gp, Centerpoint Energy Inc, Chemed Corp, Chesapeake Utilities Corp, Chevron Corp, Clean Harbors Inc, Coca-Cola Europacific Partne, Comerica Inc, Conocophillips, Consolidated Edison Inc, Csx Corp, Danaher Corp, Deere & Co, Diebold Nixdorf Inc, Dominion Energy Inc, Donaldson Co Inc, Dte Energy Co, Edison International, Entergy Corp, Essential Utilities Inc, Eversource Energy, Exxon Mobil Corp, First Horizon Corp, Flowserve Corp, Fuller (H. B.) Co, Getty Realty Corp, Gorman-Rupp Co, Graco Inc, Hasbro Inc, Hecla Mining Co, Huntington Bancshares, Hurco Cos Inc, Idacorp Inc, Intl Business Machines Corp, Intl Paper Co, Kb Home, La-Z-Boy Inc, Lci Industries, Leggett & Platt Inc, Lowe's Cos Inc, Masco Corp, Mesa Royalty Trust, Mge Energy Inc, Middlesex Water Co, Millerknoll Inc, Modine Manufacturing Co, Murphy Oil Corp, Myers Industries Inc, National Presto Inds Inc, New Jersey Resources Corp, Nextgen Healthcare Inc, Northern Trust Corp, Oge Energy Corp, Old National Bancorp, Parker-Hannifin Corp, Pg&E Corp, Pnc Financial Svcs Group Inc, Ppl Corp, Public Service Entrp Grp Inc, Pultegroup Inc, Quaker Houghton, Regal Rexnord Corporation, Robert Half Intl Inc, San Juan Basin Royalty Tr, Service Corp International, Servotronics Inc, Snap-On Inc, Sonoco Products Co, South Jersey Industries Inc, Southwestern Energy Co, Standex International Corp, Starrett (L.S.) Co, Stepan Co, Sturm Ruger & Co Inc, Tennant Co, Teradyne Inc, Texas Instruments Inc, Umb Financial Corp, Union Pacific Corp, Unitil Corp, Universal Health Rlty Income, Unum Group, Us Bancorp, Valero Energy Corp, Verizon Communications Inc, Vf Corp, Vishay Intertechnology Inc, Weis Markets Inc, Welltower Inc, West Pharmaceutical Svsc Inc, Whirlpool Corp, Williams Cos Inc, Xcel Energy Inc, Yellow Corp, Zions Bancorporation Na
2-3
Adams Resources & Energy Inc, Aflac Inc, American International Group, American Shared Hsptl Serv, American Vanguard Corp, Apa Corp, Apogee Enterprises Inc, Applied Materials Inc, Astronova Inc, Azz Inc, Ball Corp, Banco Santander Sa, Bank Of America Corp, Bank Of Hawaii Corp, Bio-Rad Laboratories Inc, Boeing Co, Brady Corp, Canon Inc, Cardinal Health Inc, Citigroup Inc, Crown Holdings Inc, Cvs Health Corp

Table C.5 – *Continued*

2-3 – *Continued*
Dentsply Sirona Inc, Destination Xl Group Inc, Dillards Inc, Equity Commonwealth, Fair Isaac Corp, Federal Realty Investment Tr, Foot Locker Inc, Fulton Financial Corp, Gatx Corp, Griffon Corp, Halliburton Co, Harsco Corp, Hawaiian Electric Inds, Hawkins Inc, Healthcare Services Group, Intel Corp, J & J Snack Foods Corp, Johnson Outdoors Inc, Kaspien Holdings Inc, Keycorp, Kirby Corp, Liveramp Holdings Inc, Loews Corp, M & T Bank Corp, Markel Corp, Mbia Inc, Mcgrath Rentcorp, National Healthcare Corp, Nordstrom Inc, Novo Nordisk A/S, Oil Dri Corp America, Omnicom Group Inc, Oppenheimer Holdings Inc, Photronics Inc, Pilgrim's Pride Corp, Pldt Inc, Pvh Corp, Rada Electronic Industries, Raymond James Financial Inc, Regions Financial Corp, Rite Aid Corp, Rpm International Inc, Sony Group Corporation, Southwest Airlines, Target Corp, Team Inc, Teleflex Inc, Telefonaktiebolaget Lm Erics, Terex Corp, Thermo Fisher Scientific Inc, Tidewater Inc, Truist Financial Corp, Udr Inc, Ugi Corp, Unifirst Corp, Watsco Inc, Wells Fargo & Co, Werner Enterprises Inc
3-1
1St Source Corp, Alexander's Inc, American Realty Investors, Ampco-Pittsburgh Corp, Asa Gold And Precious Metals, Astec Industries Inc, Avnet Inc, Bassett Furniture Inds, Bk Technologies Corp, Brt Apartments Corp, Cadence Bank, Caterpillar Inc, Cedar Realty Trust Inc, Chicago Rivet & Machine Co, Community Trust Bancorp Inc, Corecard Corporation, Cts Corp, Cullen/Frost Bankers Inc, Curtiss-Wright Corp, Daxor Corp, Diodes Inc, Dixie Group Inc, Eastern Co, Electro-Sensors Inc, Ford Motor Co, Foster (Lb) Co, Frequency Electronics Inc, Friedman Industries Inc, General Dynamics Corp, Genesco Inc, Icahn Enterprises Lp, Income Opportunity Rlty Invs, Innsuites Hospitality Tr, Kaman Corp, Lockheed Martin Corp, Mdc Holdings Inc, National Retail Properties, Northrop Grumman Corp, Occidental Petroleum Corp, Ofg Bancorp, One Liberty Properties Inc, Oshkosh Corp, Oxford Industries Inc, Par Technology Corp, Park Ohio Holdings Corp, Patrick Industries Inc, Pinnacle West Capital Corp, Power Reit, Ryder System Inc, Smith (A.O.), Spectrum Brnd Hldg Inc, Stifel Financial Corp, Taylor Devices Inc, Transcontinental Rlty Invs, Trustco Bank Corp/Ny, Tsr Inc, United Bankshares Inc/Wv, Universal Security Instrumnt, Virco Mfg. Corp, Vse Corp, Wendy's Co, Wesbanco Inc, Westamerica Bancorporation, White Mtns Ins Group Ltd, Wolverine World Wide
3-2
Acme United Corp, Alleghany Corp, American Financial Group Inc, American Woodmark Corp, Argo Group Intl Holdings Ltd, Badger Meter Inc, Bank Of New York Mellon Corp, Barclays Plc, Brandywine Realty Trust, Caleres Inc, Cato Corp, Cigna Corp, Cincinnati Financial Corp, Coca Cola Consolidated Inc, Coeur Mining Inc, Coherent Inc, Commerce Bancshares Inc, Commercial Metals, Comtech Telecommun, Csp Inc, Cvb Financial Corp, Duke Realty Corp, Eastgroup Properties, Escalade Inc, Espey Mfg & Electronics Corp, Frp Holdings Inc, Haverty Furniture, Helmerich & Payne, Hess Corp, Hexcel Corp, Honda Motor Co Ltd, Immucell Corp, Interface Inc, Investors Title Co, Jefferies Financial Grp Inc, Jpmorgan Chase & Co, Kewaunee Scientific Corp, Koninklijke Philips Nv, L3Harris Technologies Inc, Lakeland Industries Inc, Lincoln National Corp, Marcus Corp, Molson Coors Beverage Co, Moog Inc, Msa Safety Inc, New England Realty Assc, Old Republic Intl Corp, P & F Industries, P.A.M. Transportation Svcs, Pnm Resources Inc, Potlatchdeltic Corp, Richardson Electronics Ltd, Rli Corp, Rogers Corp, Sanderson Farms Inc, Selective Ins Group Inc, Semtech Corp, Sjw Group, Southwest Gas Holdings Inc, Stewart Information Services, Textron Inc, Toro Co, Transcat Inc, Trustmark Corp, Tutor Perini Corp, Tyler Technologies Inc, Universal Health Svcs Inc, Valmont Industries Inc, Village Super Market, Vista Gold Corp, Weyco Group Inc
3-3
Aar Corp, Aegon Nv, Agilysys Inc, Air T Inc, Alaska Air Group Inc, America's Car-Mart Inc, Applied Industrial Tech Inc, Ark Restaurants Corp, Best Buy Co Inc, Caseys General Stores Inc, Cna Financial Corp, Cohu Inc, Computer Task Group Inc, Educational Development Corp, Fedex Corp, First Citizens Bancsh, Helen Of Troy Ltd, Ingles Markets Inc, Kinross Gold Corp, Marten Transport Ltd, Mesa Laboratories Inc, Park Aerospace Corp, Popular Inc, Primeenergy Resources Corp, Public Storage, Ross Stores Inc, Safeguard Scientifics Inc, Seaboard Corp, Standard Motor Prods, Telefonica Sa, Toyota Motor Corp

Table C.6: Distribution of Companies on Intersections of Sales Rank and E/P by LSV Double-Sort Breakpoints, as of December 1991

1-1
Asa Gold And Precious Metals, Astec Industries Inc, Caci Intl Inc, Carlisle Cos Inc, Cedar Realty Trust Inc, Cts Corp, Cullen/Frost Bankers Inc, Eaton Corp Plc, Foster (Lb) Co, Genesco Inc, Goodyear Tire & Rubber Co, Louisiana-Pacific Corp, Mays (J.W.) Inc, New York Times Co, Norfolk Southern Corp, Northwest Natural Hldng Co, Oshkosh Corp, Paccar Inc, Ppg Industries Inc, Rpc Inc, Ryder System Inc, Smith (A.O.), Spectrum Brnd Hldg Inc, Tejon Ranch Co, Texas Pacific Land Corp, Thor Industries Inc, Toll Brothers Inc, United-Guardian Inc, Viatris Inc, Vulcan Materials Co, Wiley (John) & Sons
1-2
Albany Intl Corp, Alico Inc, Alleghany Corp, Analog Devices Inc, Arrow Electronics Inc, Avery Dennison Corp, Bank Of New York Mellon Corp, Barclays Plc, Big Lots Inc, Bp Plc, Chemed Corp, Clean Harbors Inc, Coca Cola Consolidated Inc, Coherent Inc, Colgate-Palmolive Co, Conocophillips, Cto Realty Growth Inc, Danaher Corp, Gentex Corp, Hasbro Inc, Haverty Furniture, Hess Corp, Hurco Cos Inc, Interface Inc, Intl Flavors & Fragrances, Jpmorgan Chase & Co, Kelly Services Inc, Kewaunee Scientific Corp, L3Harris Technologies Inc, Masco Corp, Mccormick & Co Inc, Millerknoll Inc, Molson Coors Beverage Co, New Jersey Resources Corp, Newell Brands Inc, Newmont Corp, Nucor Corp, Owens & Minor Inc, Parker-Hannifin Corp, Pfizer Inc, Pnm Resources Inc, Progressive Corp-Ohio, Range Resources Corp, Regal Rexnord Corporation, Robert Half Intl Inc, Sealed Air Corp, Stewart Information Services, Teradyne Inc, Transcat Inc, Tutor Perini Corp, Tyler Technologies Inc, Umh Properties Inc, Union Pacific Corp, Yellow Corp
1-3
Adobe Inc, Alaska Air Group Inc, American Shared Hsptl Serv, American Vanguard Corp, Amgen Inc, Applied Industrial Tech Inc, Bank Of America Corp, Barrick Gold Corp, Bridgford Foods Corp, Cardinal Health Inc, Church & Dwight Inc, Cintas Corp, Clorox Co/De, Coca-Cola Co, Computer Task Group Inc, Conmed Corp, Corning Inc, Cracker Barrel Old Ctry Stor, Cyberoptics Corp, Daily Journal Corp, Disney (Walt) Co, Educational Development Corp, Encompass Health Corp, Equifax Inc, Fastenal Co, Federal Realty Investment Tr, Fedex Corp, Fiserv Inc, Halliburton Co, Home Depot Inc, Hunt (Jb) Transprt Svcs Inc, Interpublic Group Of Cos, Invacare Corp, J & J Snack Foods Corp, Jacobs Engineering Group Inc, Johnson & Johnson, Kellogg Co, Keycorp, Kinross Gold Corp, Lumen Technologies Inc, Merck & Co, Meridian Bioscience Inc, Microsoft Corp, Nordson Corp, Paychex Inc, Pepsico Inc, Rada Electronic Industries, Schwab (Charles) Corp, Southwest Airlines, Stryker Corp, Sysco Corp, Team Inc, Telefonaktiebolaget Lm Erics, The Shyft Group Inc, Thermo Fisher Scientific Inc, Tootsie Roll Industries Inc, Udr Inc, Unitedhealth Group Inc, Walgreens Boots Alliance Inc, Walmart Inc, Washington Reit
2-1
Avnet Inc, Bassett Furniture Inds, Bk Technologies Corp, Cabot Corp, Chicago Rivet & Machine Co, Crane Holdings Co, Diodes Inc, Evergy Inc, Friedman Industries Inc, Lennar Corp, National Fuel Gas Co, Nextera Energy Inc, Occidental Petroleum Corp, Ofg Bancorp, Otter Tail Corp, Par Technology Corp, Pennsylvania Re Invs Trust, Pro-Dex Inc/Co, Spire Inc, Stanley Black & Decker Inc, Superior Group Of Cos Inc, Tat Technologies Ltd, Taylor Devices Inc, Wec Energy Group Inc, Wolverine World Wide, Worthington Industries
2-2
3M Co, Abm Industries Inc, Acme United Corp, Air Products & Chemicals Inc, Allete Inc, Alliant Energy Corp, American Express Co, American Financial Group Inc, Ametek Inc, Archer-Daniels-Midland Co, AT&T Inc, Atmos Energy Corp, Avista Corp, Badger Meter Inc, Barnes Group Inc, Barnwell Industries, Becton Dickinson & Co, Black Hills Corp, British Amer Tobacco Plc, Brown & Brown Inc, Brown Forman Corp, Campbell Soup Co, Centerpoint Energy Inc, Chesapeake Utilities Corp, Chevron Corp, Commercial Metals, Csp Inc, Deluxe Corp, Diebold Nixdorf Inc, Distribution Solutio Gro Inc, Dominion Energy Inc, Donaldson Co Inc, Ecolab Inc

Table C.6 – *Continued*

2-2 – *Continued*
Edison International, Emerson Electric Co, Exxon Mobil Corp, Federal Signal Corp, Flowserve Corp, Frp Holdings Inc, Fuller (H. B.) Co, General Electric Co, Genuine Parts Co, Glatfelter Corp, Gorman-Rupp Co, Graco Inc, Harley-Davidson Inc, Helmerich & Payne, Hershey Co, Hexcel Corp, Hf Sinclair Corp, Hni Corp, Honda Motor Co Ltd, Hormel Foods Corp, Host Hotels & Resorts Inc, Hubbell Inc, Idacorp Inc, Intl Paper Co, Investors Title Co, Kb Home, Kimberly-Clark Corp, Kroger Co, Lancaster Colony Corp, La-Z-Boy Inc, Leggett & Platt Inc, Marsh & Mclennan Cos, Mcdonald's Corp, Mesa Royalty Trust, Mge Energy Inc, Msa Safety Inc, Newmarket Corp, Northern Trust Corp, Oceaneering International, Oge Energy Corp, Old National Bancorp, Pg&E Corp, Pitney Bowes Inc, Pnc Financial Svcs Group Inc, Potlatchdeltic Corp, Ppl Corp, Pultegroup Inc, Quaker Houghton, Rocky Mountain Choc Fact Inc, Rollins Inc, S&P Global Inc, Schlumberger Ltd, Sensient Technologies Corp, Service Corp International, Snap-On Inc, Sonoco Products Co, South Jersey Industries Inc, Southwestern Energy Co, Starrett (L.S.) Co, Sturm Ruger & Co Inc, Tennant Co, Toro Co, Umb Financial Corp, Unitil Corp, Universal Corp/Va, Unum Group, Valero Energy Corp, Verizon Communications Inc, Vf Corp, Vishay Intertechnology Inc, Wd-40 Co, Weis Markets Inc, Welltower Inc, Whirlpool Corp, Williams Cos Inc, Xcel Energy Inc
2-3
Aflac Inc, Altria Group Inc, American International Group, American Software, Apa Corp, Apogee Enterprises Inc, Apple Inc, Applied Materials Inc, Arthur J Gallagher & Co, Autodesk Inc, Azz Inc, Balchem Corp, Ball Corp, Bio-Rad Laboratories Inc, Block H & R Inc, Brady Corp, Bristol-Myers Squibb Co, Canon Inc, Carnival Corporation & Plc, Conagra Brands Inc, Crown Holdings Inc, Cvs Health Corp, Dentsply Sirona Inc, Destination Xl Group Inc, Dillards Inc, Equity Commonwealth, Expeditors Intl Wash Inc, Fair Isaac Corp, Fifth Third Bancorp, Franklin Resources Inc, Gap Inc, General Mills Inc, Grainger (W W) Inc, Hawaiian Electric Inds, Healthpeak Properties Inc, Heartland Express Inc, Henry (Jack) & Associates, Illinois Tool Works, Johnson Outdoors Inc, Kirby Corp, Lee Enterprises Inc, Lilly (Eli) & Co, Liveramp Holdings Inc, Mattel Inc, Mbia Inc, Medtronic Plc, Mesabi Trust, Nordstrom Inc, Novo Nordisk A/S, Oil Dri Corp America, Omnicom Group Inc, Park Aerospace Corp, Perkinelmer Inc, Plexus Corp, Powell Industries Inc, Price (T. Rowe) Group, Procter & Gamble Co, Rite Aid Corp, Rpm International Inc, Sei Investments Co, Sherwin-Williams Co, Sony Group Corporation, Standard Motor Prods, State Street Corp, Superior Industries Intl, Teleflex Inc, Teva Pharmaceuticals, Tidewater Inc, Toyota Motor Corp, Tyson Foods Inc, Ugi Corp, Unifirst Corp, Watsco Inc, Watts Water Technologies Inc, Williams-Sonoma Inc
3-1
American Electric Power Co, Atrion Corp, Berkley (W R) Corp, Cleveland-Cliffs Inc, Curtiss-Wright Corp, Eastern Co, Electro-Sensors Inc, Ennis Inc, General Dynamics Corp, Icahn Enterprises Lp, Innsuites Hospitality Tr, Kaman Corp, Lockheed Martin Corp, Mdu Resources Group Inc, National Retail Properties, Northrop Grumman Corp, One Liberty Properties Inc, Oxford Industries Inc, Permian Basin Royalty Trust, Power Reit, Rockwell Automation, Sabine Royalty Trust, Universal Security Instrumnt, Value Line Inc, Virco Mfg. Corp, Westamerica Bancorporation, White Mtns Ins Group Ltd
3-2
Advanced Micro Devices, American States Water Co, Aon Plc, Argo Group Intl Holdings Ltd, Ascent Industries Co, Associated Banc-Corp, Caleres Inc, California Water Service Gp, Cedar Fair, Cigna Corp, Cincinnati Financial Corp, Comerica Inc, Commerce Bancshares Inc, Comtech Telecommun, Consolidated Edison Inc, Cvb Financial Corp, Dte Energy Co, Ducommun Inc, Eastgroup Properties, Entergy Corp, Espey Mfg & Electronics Corp, Essential Utilities Inc, Eversource Energy, First Horizon Corp, Fmc Corp, Franklin Electric Co Inc, Globe Life Inc, Huntington Bancshares, Jefferies Financial Grp Inc, Koninklijke Philips Nv, Lci Industries, Lincoln National Corp, Lowe's Cos Inc, Marcus Corp, Middlesex Water Co, Modine Manufacturing Co, Moog Inc

Table C.6 – *Continued*

3-2 – *Continued*
Myers Industries Inc, National Presto Inds Inc, New England Realty Assc, North European Oil Rty Tr, Old Republic Intl Corp, P & F Industries, Public Service Entrp Grp Inc, Rli Corp, San Juan Basin Royalty Tr, Sanderson Farms Inc, Selective Ins Group Inc, Semtech Corp, Servotronics Inc, Sjw Group, Standex International Corp, Stepan Co, Textron Inc, Tjx Cos Inc (The), Trustmark Corp, Universal Health Rlty Income, Universal Health Svcs Inc, Us Bancorp, Village Super Market, Weyco Group Inc, Zions Bancorporation Na
3-3
Aar Corp, Adams Resources & Energy Inc, Aegon Nv, Agilysys Inc, Air T Inc, Ark Restaurants Corp, Astronova Inc, Banco Santander Sa, Bank Of Hawaii Corp, Best Buy Co Inc, Boeing Co, Caseys General Stores Inc, Citigroup Inc, Cna Financial Corp, Cohu Inc, First Citizens Bancsh, Foot Locker Inc, Fulton Financial Corp, Gatx Corp, Griffon Corp, Harsco Corp, Hawkins Inc, Helen Of Troy Ltd, Ingles Markets Inc, Intel Corp, Kaspien Holdings Inc, Loews Corp, M & T Bank Corp, Markel Corp, Marten Transport Ltd, Mcgrath Rentcorp, Mesa Laboratories Inc, National Healthcare Corp, Nike Inc, Oppenheimer Holdings Inc, Photronics Inc, Pilgrim's Pride Corp, Pldt Inc, Polaris Inc, Popular Inc, Primeenergy Resources Corp, Public Storage, Pvh Corp, Raymond James Financial Inc, Regions Financial Corp, Ross Stores Inc, Safeguard Scientifics Inc, Seaboard Corp, Target Corp, Telefonica Sa, Truist Financial Corp, Unilever Plc, Wells Fargo & Co, Werner Enterprises Inc, Wpp Plc

Table C.7: Distribution of Companies on Intersections of Sales Rank and C/P by LSV Double-Sort Breakpoints, as of December 1991

1-1
Alexander's Inc, Ampco-Pittsburgh Corp, Asa Gold And Precious Metals, Caterpillar Inc, Cedar Realty Trust Inc, Cms Energy Corp, Cummins Inc, Honeywell International Inc, Materion Corp, Mays (J.W.) Inc, New York Times Co, Nl Industries, Norfolk Southern Corp, Oshkosh Corp, Paccar Inc, Park Ohio Holdings Corp, Pennsylvania Re Invs Trust, Tejon Ranch Co, Texas Pacific Land Corp, Thor Industries Inc, Toll Brothers Inc, United-Guardian Inc, Viatris Inc, Vse Corp, Weyerhaeuser Co
1-2
Alico Inc, Arrow Electronics Inc, British Amer Tobacco Plc, Chemed Corp, Coherent Inc, Colgate-Palmolive Co, Csp Inc, Csx Corp, Cto Realty Growth Inc, Danaher Corp, Deere & Co, Distribution Solutio Gro Inc, Emerson Electric Co, Federal Signal Corp, Gentex Corp, Genuine Parts Co, Getty Realty Corp, Harley-Davidson Inc, Hasbro Inc, Hecla Mining Co, Hershey Co, Hf Sinclair Corp, Hni Corp, Hormel Foods Corp, Hubbell Inc, Intergroup Corp, Intl Flavors & Fragrances, Investors Title Co, Kb Home, Kelly Services Inc, Marsh & Mclennan Cos, Masco Corp, Mccormick & Co Inc, Mesa Royalty Trust, Newell Brands Inc, Newmont Corp, Owens & Minor Inc, Pfizer Inc, Regal Rexnord Corporation, Rollins Inc, Sealed Air Corp, Service Corp International, Snap-On Inc, Texas Instruments Inc, Union Pacific Corp, Universal Corp/Va, Valmont Industries Inc, Wd-40 Co, Welltower Inc, West Pharmaceutical Svsc Inc
1-3
Adobe Inc, Altria Group Inc, American Software, Amgen Inc, Autodesk Inc, Barrick Gold Corp, Block H & R Inc, Bridgford Foods Corp, Bristol-Myers Squibb Co, Cadence Design Systems Inc, Cardinal Health Inc, Church & Dwight Inc, Cintas Corp, Clorox Co/De, Coca-Cola Co, Comcast Corp, Conmed Corp, Corning Inc, Cracker Barrel Old Ctry Stor, Cyberoptics Corp, Educational Development Corp, Encompass Health Corp, Equifax Inc, Equity Commonwealth, Expeditors Intl Wash Inc, Fair Isaac Corp, Fastenal Co, Fiserv Inc, Franklin Resources Inc, Grainger (W W) Inc, Healthcare Services Group, Home Depot Inc, Interpublic Group Of Cos

Table C.7 – *Continued*

1-3 – *Continued*
Invacare Corp, Jacobs Engineering Group Inc, Johnson & Johnson, Kellogg Co, Lilly (Eli) & Co, Medtronic Plc, Merck & Co, Meridian Bioscience Inc, Mesabi Trust, Microsoft Corp, Nordson Corp, Oracle Corp, Paychex Inc, Plexus Corp, Powell Industries Inc, Price (T. Rowe) Group, Rada Electronic Industries, Stryker Corp, Sysco Corp, Teva Pharmaceuticals, The Shyft Group Inc, Thermo Fisher Scientific Inc, Tootsie Roll Industries Inc, Udr Inc, Unitedhealth Group Inc, Walgreens Boots Alliance Inc, Walmart Inc, Washington Reit, Watts Water Technologies Inc
2-1
Avnet Inc, Bassett Furniture Inds, Brunswick Corp, Caci Intl Inc, Carlisle Cos Inc, Chicago Rivet & Machine Co, Cleveland-Cliffs Inc, Corecard Corporation, Crane Holdings Co, Diodes Inc, Eaton Corp Plc, Electro-Sensors Inc, Ennis Inc, Foster (Lb) Co, Friedman Industries Inc, Genesco Inc, Goodyear Tire & Rubber Co, Innsuites Hospitality Tr, Lennar Corp, Louisiana-Pacific Corp, National Fuel Gas Co, Nextera Energy Inc, Northwest Natural Hldng Co, Ofg Bancorp, Otter Tail Corp, Permian Basin Royalty Trust, Power Reit, Ppg Industries Inc, Pro-Dex Inc/Co, Rpc Inc, Sabine Royalty Trust, Spire Inc, Stanley Black & Decker Inc, Superior Group Of Cos Inc, Tat Technologies Ltd, Taylor Devices Inc, Tsr Inc, Universal Security Instrumnt, Value Line Inc, Vulcan Materials Co, Wec Energy Group Inc, Wolverine World Wide, Worthington Industries
2-2
3M Co, Abm Industries Inc, Acme United Corp, Air Products & Chemicals Inc, Albany Intl Corp, Alleghany Corp, Allete Inc, Alliant Energy Corp, American Financial Group Inc, American Woodmark Corp, Ametek Inc, Analog Devices Inc, Archer-Daniels-Midland Co, Ascent Industries Co, Atmos Energy Corp, Avery Dennison Corp, Avista Corp, Becton Dickinson & Co, Big Lots Inc, Black Hills Corp, Brown & Brown Inc, Brown Forman Corp, Campbell Soup Co, Cedar Fair, Clean Harbors Inc, Coca-Cola Europacific Partne, Consolidated Edison Inc, Deluxe Corp, Diebold Nixdorf Inc, Donaldson Co Inc, Ecolab Inc, Edison International, Espey Mfg & Electronics Corp, Essential Utilities Inc, Exxon Mobil Corp, Flowserve Corp, Franklin Electric Co Inc, Frp Holdings Inc, Fuller (H. B.) Co, General Electric Co, Glatfelter Corp, Gorman-Rupp Co, Graco Inc, Haverty Furniture, Helmerich & Payne, Hurco Cos Inc, Idacorp Inc, Intl Business Machines Corp, Intl Paper Co, Kimberly-Clark Corp, Lancaster Colony Corp, La-Z-Boy Inc, Leggett & Platt Inc, Lowe's Cos Inc, Mcdonald's Corp, Mge Energy Inc, Middlesex Water Co, Millerknoll Inc, Msa Safety Inc, Murphy Oil Corp, Myers Industries Inc, National Presto Inds Inc, New Jersey Resources Corp, Newmarket Corp, North European Oil Rty Tr, Nucor Corp, Oceaneering International, Oge Energy Corp, Parker-Hannifin Corp, Pitney Bowes Inc, Potlatchdeltic Corp, Ppl Corp, Quaker Houghton, Range Resources Corp, Robert Half Intl Inc, Rocky Mountain Choc Fact Inc, S&P Global Inc, San Juan Basin Royalty Tr, Schlumberger Ltd, Sensient Technologies Corp, Servotronics Inc, Sonoco Products Co, South Jersey Industries Inc, Southwestern Energy Co, Starrett (L.S.) Co, Stewart Information Services, Sturm Ruger & Co Inc, Tennant Co, Teradyne Inc, Transcat Inc, Universal Health Rlty Income, Valero Energy Corp, Vf Corp, Weis Markets Inc, Weyco Group Inc
2-3
Aar Corp, Apogee Enterprises Inc, Apple Inc, Applied Industrial Tech Inc, Applied Materials Inc, Arthur J Gallagher & Co, Astronova Inc, Azz Inc, Balchem Corp, Ball Corp, Bio-Rad Laboratories Inc, Brady Corp, Canon Inc, Carnival Corporation & Plc, Cohu Inc, Computer Task Group Inc, Conagra Brands Inc, Crown Holdings Inc, Cvs Health Corp, Daily Journal Corp, Dentsply Sirona Inc, Dillards Inc, Disney (Walt) Co, Foot Locker Inc, Gap Inc, General Mills Inc, Halliburton Co, Hawaiian Electric Inds, Hawkins Inc, Heartland Express Inc, Henry (Jack) & Associates, Illinois Tool Works, Intel Corp, J & J Snack Foods Corp, Johnson Outdoors Inc, Kirby Corp, Lee Enterprises Inc, Loews Corp, Lumen Technologies Inc, Mattel Inc, Nike Inc, Nordstrom Inc, Novo Nordisk A/S, Oil Dri Corp America, Omnicom Group Inc, Oppenheimer Holdings Inc, Pepsico Inc, Perkinelmer Inc, Procter & Gamble Co, Raymond James Financial Inc, Rite Aid Corp, Rpm International Inc, Schwab (Charles) Corp, Sei Investments Co, Sherwin-Williams Co, Southwest Airlines, Standard Motor Prods, Superior Industries Intl, Team Inc, Teleflex Inc, Telefonaktiebolaget Lm Erics, Tyson Foods Inc, Ugi Corp, Unifirst Corp, Watsco Inc, Williams-Sonoma Inc

Table C.7 – *Continued*

3-1
American Electric Power Co, Astec Industries Inc, Atrion Corp, Bk Technologies Corp, Cabot Corp, Cts Corp, Curtiss-Wright Corp, Eastern Co, Evergy Inc, Ford Motor Co, General Dynamics Corp, Icahn Enterprises Lp, Kaman Corp, Lockheed Martin Corp, Lsb Industries Inc, Mdu Resources Group Inc, Northrop Grumman Corp, Occidental Petroleum Corp, One Liberty Properties Inc, Oxford Industries Inc, Par Technology Corp, Patrick Industries Inc, Rockwell Automation, Ryder System Inc, Smith (A.O.), Spectrum Brnd Hldg Inc, U S Lime & Minerals, Virco Mfg. Corp, Wendy's Co, Wiley (John) & Sons
3-2
Advanced Micro Devices, American States Water Co, AT&T Inc, Badger Meter Inc, Barnes Group Inc, Barnwell Industries, Bp Plc, Caleres Inc, California Water Service Gp, Centerpoint Energy Inc, Chesapeake Utilities Corp, Chevron Corp, Coca Cola Consolidated Inc, Commercial Metals, Comtech Telecommun, Conocophillips, Dominion Energy Inc, Dte Energy Co, Ducommun Inc, Eastgroup Properties, Entergy Corp, Escalade Inc, Eversource Energy, Fmc Corp, Hess Corp, Hexcel Corp, Honda Motor Co Ltd, Host Hotels & Resorts Inc, Interface Inc, Jefferies Financial Grp Inc, Kewaunee Scientific Corp, Koninklijke Philips Nv, Kroger Co, L3Harris Technologies Inc, Lci Industries, Marcus Corp, Modine Manufacturing Co, Molson Coors Beverage Co, Moog Inc, New England Realty Assc, P & F Industries, P.A.M. Transportation Svcs, Pg&E Corp, Pnm Resources Inc, Public Service Entrp Grp Inc, Rogers Corp, Sanderson Farms Inc, Semtech Corp, Sjw Group, Southwest Gas Holdings Inc, Standex International Corp, Stepan Co, Textron Inc, Tjx Cos Inc (The), Toro Co, Tutor Perini Corp, Tyler Technologies Inc, Umh Properties Inc, Unitil Corp, Universal Health Svcs Inc, Verizon Communications Inc, Village Super Market, Vishay Intertechnology Inc, Whirlpool Corp, Williams Cos Inc, Xcel Energy Inc, Yellow Corp
3-3
Adams Resources & Energy Inc, Agilysys Inc, Air T Inc, Alaska Air Group Inc, American Shared Hsptl Serv, American Vanguard Corp, Apa Corp, Ark Restaurants Corp, Best Buy Co Inc, Boeing Co, Caseys General Stores Inc, Destination Xl Group Inc, Fedex Corp, Gatx Corp, Griffon Corp, Harsco Corp, Helen Of Troy Ltd, Hunt (Jb) Transprt Svcs Inc, Ingles Markets Inc, Kaspien Holdings Inc, Kinross Gold Corp, Liveramp Holdings Inc, Markel Corp, Marten Transport Ltd, Mcgrath Rentcorp, Mesa Laboratories Inc, National Healthcare Corp, Park Aerospace Corp, Photronics Inc, Pilgrim's Pride Corp, Pldt Inc, Polaris Inc, Primeenergy Resources Corp, Pvh Corp, Ross Stores Inc, Safeguard Scientifics Inc, Seaboard Corp, Sony Group Corporation, Target Corp, Telefonica Sa, Tidewater Inc, Toyota Motor Corp, Werner Enterprises Inc, Wpp Plc

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