Market Efficiency and Diversification: An Experiential Approach Using the *Wall Street Journal*'s Dartboard Portfolio

John C. Adams and Ken B. Cyree

The concepts of market efficiency and portfolio diversification are easy to understand, but it is difficult for some to comprehend the relation of risk and return. A good way to teach these concepts uses the Wall Street Journal's dartboard contest, where dart throws and professionals pick only four stocks per period. Undergraduate students can use the contest to form portfolios; calculate returns, wealth changes, and risk measures; and compare results to unmanaged indexes over time. Doctoral students can use the contest to estimate a market model to calculate abnormal returns and announcement effects, and adjust for time series issues. Dart picks beat the pros over the 1990-2001 period on both on a cumulative wealth and risk-adjusted basis. Neither dart nor pro picks beat the S&P 500 or the DJIA on a raw return basis, and both fall well behind on a risk-adjusted basis. Analysis like this can enhance student understanding of the basic issues in market efficiency, diversification, and portfolio theory. [G110, G140]

■For advanced undergraduate and MBA students, the concepts of market efficiency and portfolio diversification seem easy to understand. Many students grasp the broad effects of a lack of diversification, but cannot comprehend how a lack of diversification can impact stock returns and risk in a portfolio. Similarly, many students think that markets are efficient to some degree, but believe that: 1) professional money managers can on average beat the market, and 2) research and analysis can identify undervalued securities, technical trends, momentum, or other factors that can create consistent abnormal performance.

We can all cite research to support the claims of market efficiency. Literally thousands of studies investigate market efficiency. In the May 2001 version of EconLit, we find over 3800 articles including the words "market" and either "efficiency" or "efficient" in the text or title. For example, a professor may cite early work by Fama (1970) as evidence that markets are efficient. Fama (1998) indicates findings of anomalies or inefficiency are typically because of measurement problems or risk differentials. Then there are other results that question the efficiency of stock markets, such as Haugen and Baker (1996).

Grinblatt and Titman (1992) and Elton, Gruber, and Blake (1996) provide evidence that mutual fund returns are somewhat persistent, and that managers have momentum or "hot hands." Carhart (1997) finds that mutual fund performance results in these studies are due mostly to common factors such as size and book-to-market valuation instead of performance persistence. Authors test many anomalies that seem to refute market efficiency ranging from the January effect to the "Dogs of the Dow."

The common thread in all this work for students seems to be irresolution. The ambiguity in market efficiency and mutual fund performance research confuses students. For many, authors seem to argue more about statistical problems of various types and survivorship bias than the core issues of market efficiency, performance, or diversification. A better way to illustrate the effects of market efficiency and the performance of market professionals is through a project that aids comprehension. Students might track performance of publicly available professional recommendations against unmanaged indexes.

An alternative to teach students about stock market

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We wish to thank Scott Hein, Jeff Mercer, and participants at the Texas Tech Research Seminar for helpful comments. Insightful comments were provided by David Lange, Betty Simkins, Gary Porter, Greg Kuhlemeyer, and other participants at the 2003 Financial Management Association meeting in Denver. This paper was initiated while both authors were at Texas Tech University.

investing is an investing simulation game. Investment games requiring students to manage a hypothetical portfolio suffer from academic term time limitations. McClatchey and Kuhlemeyer (2000) report typical survey responses from investment professors: "Trading games are too short to get a feel for managing portfolios….The methods that you use to do well in a 3-month game are not the methods that you would employ over a 5-10 year holding horizon…. No matter how realistic the trading, the investment horizon is too short to be educationally valuable." And: "I think these games have useful but also harmful impacts. Students do not learn to invest, they learn to trade."

Elan and Sanderson (1991) argue a multi-semester approach is needed if students are to fully benefit from an investment game, but this approach may be difficult to accomplish at many institutions. The *Wall Street Journal*'s dartboard contest is an alternative that avoids the problems associated with time limitations.

Stephenson (1997) proposes using the dartboard contest to discuss market efficiency in an introductory investments class. Students can compare the performance of professionals to performance of a broader market index. We agree the contest can illuminate the effects of efficiency and performance. We extend the dartboard exercise and encourage calculation of returns and risk measures by undergraduate students, and exploration of more advanced topics by doctoral students.

Most of the reporting in the *WSJ* and in research concerning the dartboard contest focuses either on return for an individual six-month period, or on the number of times the pros beat the darts, or whether either group beats the Dow Jones Industrial Average (DJIA). The concept of returns often seems more relevant if students can calculate the cumulative change in wealth over some time period.

In one application, students invest a hypothetical dollar amount in the historical pro picks, dart picks, S&P 500, and DJIA. Comparison data can come from the Center for Research in Security Prices (CRSP) or public websites such as Yahoo Finance. All that is required to obtain returns from most websites is the ticker symbol and Internet access.

Another variation is that the students throw darts themselves to pick the stocks. Dart picks can be for each period, such as three months of the current semester, with stocks tracked until the next period begins and another student's throws are used. Individual students can throw the darts, or one student can throw them for the whole class or group. A dartboard project could also be a directed independent study.

Tracking dart portfolios does not eliminate the time limitation problem unless the contest carries on across semesters and portfolios are "passed on" to another group in another semester, which may be impractical.[1]

I. Methods and Data

The *Wall Street Journal* dartboard contest, which originated in 1988, was prompted by the Burton Malkiel book, "*A Random Walk Down Wall Street,*" (the most recent edition is the 8th). Malkiel notes that, if market efficiency were valid, we would do as well throwing darts at the pages of the *WSJ* as to rely on selections of professional money managers. A more telling comparison would be whether manager recommendations can beat unmanaged index returns over the same investment period.

There are four professional stock pickers (pros). Each chooses one investment and four darts are thrown to select the dartboard portfolio. The picks are allowed to perform for six months, and then the contest is repeated. The most successful pro stock picker is often asked to participate in the next contest, so pros with the greatest expertise tend to remain in the contest, which we might see as managers with "hot hands."

The game is somewhat stacked against the professionals and the darts as compared to an index, because such a small number of stocks create exposure to unsystematic risk that cannot be diversified away, but it is in the nature of the selection that we find useful teaching opportunities. That is, the small selection of stocks teaches students that even the pros need to be diversified, and markets are efficient if the picks cannot outperform an unmanaged index over a long time. Of course, the strongest evidence of market efficiency in this setting would be if the dart picks outperformed the pro picks.

Students could perform the initial research beginning with finding the recommendations, and then track the stock picks and calculate the results.[2] An analysis as to the relative performance of the dartboard portfolio and some index allows students to see the benefits of diversification and benchmark the results. Students must also consider risk and return, whether standard deviations of returns or measures such as Sharpe ratios or Jensen's alphas.

The easiest way to calculate the cumulative effect is to use the reported results by the *WSJ* and allow the student to calculate changes in wealth in an equally weighted portfolio. In the next period, the student cashes out the portfolio and reinvests equally in the

[1]Many universities handle this time limitation problem using student managed investment funds (SMIFs) that calls for students to invest real money in stocks and then pass the fund to new students in the next semester.

[2]The tracking of results would teach students to adjust for stock splits and dividends, as well as shorted stocks over a time period.

picks for the upcoming period. Problems in this approach are that there is no explicit risk calculation, and the *Journal*'s returns do not include dividends (see Metcalf and Malkiel (1994) for a discussion).

One way to calculate returns and track wealth changes is to use daily or monthly price or return information and ask students to calculate cumulative effects. The data could come from the *Wall Street Journal*, but students must be aware they need to account for dividends. Or, the data could come from a financial website providing pricing data or from another commercial data source, such as the Center for Research in Security Prices (CRSP) database. In this case, students can more easily calculate risk measures including standard deviations, betas, Sharpe ratios, and so forth. Students can also track the daily changes in the pro and dart portfolios and graph results compared to the index as an effective illustration of volatility. Generally, the more stake students have in the portfolios, the better. One way to increase student participation is to award points for performance.[3] Additional topics could include short-term "gaming" to beat the market.

Portfolios of the pro and dart picks can be formed in a number of ways depending on the goal of the instructor. More advanced students learning financial modeling might use daily returns and form portfolios on the day after the *WSJ* publishes the contest. Or, in the case we present, portfolios may be formed semiannually and results evaluated using monthly returns.

We choose monthly results to focus students more on long-term results instead of day-to-day volatility in returns. We form portfolios at the end of the month the contest is published, and cumulate returns until the next portfolio is formed. Exhibit 1 shows that the contest begins in May 1990, and on the last trading day in May we form equally weighted portfolios. We cumulate returns over the period until the end of the month for the next contest, which is November 1990, and then repeat the process.

We choose the end of the month because the contest does not occur on the same day every period in relation to the end of the month, and forming portfolios on the contest date makes the computations unnecessarily difficult. In a practical sense, this method also avoids having to deal with the "announcement effect" and price run-up. Another teaching point is if professional stock pickers are able to consistently "beat the market," the portfolio formation period should matter little.

Another learning opportunity is the difference in equal weights versus market weights. If the data are available, students can calculate returns using both methods. They will learn about the effect of size in a portfolio as well as how hard it is to keep up with rapidly changing market valuations.

II. Empirical Applications

The *WSJ* typically reports the number of "wins" cumulatively for the pro versus dart picks, but this is an unsatisfactory way to evaluate performance in most cases. Investors should be more concerned with returns—either geometric or arithmetic—and the risk of those returns.[4] These statistics are useful to illustrate the risk and return of picking stocks.

Exhibit 2 presents annualized geometric and arithmetic returns, standard deviations of returns, and modified Sharpe and Treynor ratios for the pro and dart portfolios, the Dow Jones Industrial Average, and the S&P 500 index for the 23 six-month periods from May 1990 through November 2001. Returns and standard deviations are calculated over the six-month interval that does not include the event month. The annualized geometric returns favor the dart picks over the professional portfolio, and neither portfolio beats the indexes. Similarly, the standard deviation is highest for the darts followed by the pro portfolio, and standard deviations of the indexes are half the level of the darts.

The geometric return results are at odds with the *WSJ* reports about cumulative wins for the pros and with conventional wisdom with respect to the value of professional advice.[5] This is a significant result to highlight to help students understand market efficiency— the pros do not beat the darts.

Another teaching opportunity is to explain what inefficient markets would mean in practice. If the professionals always have superior information, market participants who are not professionals would either exit the market or trade irrationally and lose all their wealth. Inefficiency in the form of constantly superior information would allow a permanent class of winners ("informed traders" or investment professionals in this case) to take advantage of losers ("uninformed traders" represented by naive individual investors or the dart picks in this case). O'Hara (2003) discusses the role of informed and uninformed traders in asset pricing and markets. Hence, the dartboard results can

[3]Awarding points for performance has the unintended consequence of creating the same incentive problems for students that portfolio managers face including performance myopia and being rewarded or penalized for market events outside the stock picker's control. The increased stake in performance creates a valuable learning experience, but some students are disillusioned about their lack of control, so caution is urged.

[4]We focus on geometric returns in line with the AIMR Global Investment Performance Standards. We thank an anonymous referee for this suggestion.

[5]Note that the *WSJ* results include the announcement effect unlike ours.

Exhibit 1. Dartboard and Professional Stock Picks as Reported in the *Wall Street Journal* Dartboard Contest for May 1990 through May 2001

Date of *Wall Street Journal* Announcement	Professional Investment Advisor's Picks	Dartboard Picks
5/1990	Windmere Corp	Gillette Co.
	Hecla Mining Co	Borden Inc
	Service Corp International	National City Corp
	Management Company Entmt*	Leggett & Platt Inc
11/1990	St Jude Medical Inc	Fabri Centers America Inc
	Hancock Fabrics Inc	Dollar General Corp
	K Mart Corp	Loyola Capital Corp
	Applied Magnetics Corp	United Missouri Bancshares Inc
5/1991	Texas Pacific Land Trust	Triton Energy Corp
	Allen Organ Co	Communication Cable Inc
	Olsten Corp	Callahan Mining Corp
	Pepsico Inc (Short Sale)	Bell Industries Inc
11/1991	Chrysler Corp	Brown Forman Corp
	I T T Corp	Molex Inc
	Hospital Staffing Services*	Tekelec
	BET*	Moore Corp Ltd
5/1992	General Re Corp	Biomatrix Inc
	Smith International Inc	Hexcel Corp
	Student Loan Marketing Assn	Bassett Furniture Industries Inc
	Alza Corp	Mercury Air Group Inc
11/1992	Loews Corp (Short Sale)	Harris Corp
	Merck & Co Inc	St Ives Laboratories Inc
	Chemical Banking Corp	Option Care Inc
	Liposome Technology Inc	P C A International Inc
5/1993	Mcdonalds Corp	Philip Morris Cos Inc
	Sherwin Williams Co	Imclone Systems Inc
	Cyprus Minerals Co	Marsh Supermarkets Inc
	Loews	Jennifer Convertibles Inc
11/1993	Banc One Corp	Secom General Corp
	K Mart Corp	Unisys Corp
	Interactive Network Inc (Short Sale)	Baker Fentress & Co
	E M C Corp Ma	Guardian Bancorporation L A
5/1994	Copytele Inc (Short Sale)	Trak Auto Corp
	Breed Technologies Inc	Xylogics Inc
	Galoob Lewis Toys Inc	Triad Guaranty Inc
	Scientific Games Hldng Corp	Jennifer Convertibles Inc

*Return series not available during either estimation or evaluation period.

be used to illustrate the efficiency of markets.

The dartboard results also provide a concrete demonstration of the uselessness of measures that do not consider the true performance of an investment strategy over time. The importance of proper benchmarking and in this case, the geometric, arithmetic, and risk-adjusted returns all tell the same story: Professionals do not beat the darts, much less the indexes, on any basis that should concern investors.

Perhaps the most striking result in Exhibit 2 is the ending value of the hypothetical $10,000 invested in each portfolio. The pro picks fall over $2,200 short of the darts and over $24,000 short of the S&P 500 for the period. These much different wealth changes are not as apparent when we look at the arithmetic returns; the dart picks lag the DJIA by only about 2.4

Exhibit 1. Dartboard and Professional Stock Picks as Reported in the *Wall Street Journal* Dartboard Contest for May 1990 through May 2001 (*Continued*)

Date of *Wall Street Journal* Announcement	Professional Investment Advisor's Picks	Dartboard Picks
11/1994	Creative Technologies Corp (Short Sale)	Brothers Gourmet Coffees Inc
	Checkpoint Systems Inc	Meyer Fred Inc Del
	Motorola Inc	Bay Meadows Oper Calif Jockey
	Alco Standard Corp	American Medical Holdings *
5/1995	3D0 Co The (Short Sale)	Financing For Science Intl Inc
	McDonalds Corp	Tylan General Inc
	Diebold Inc	Amerada Hess Corp
	Sphere Drake Holdings Ltd	Orbit Semiconductor Inc
11/1995	Echlin Inc	V I S X Inc
	Hollywood Entertainment (Short Sale)	Home Shopping Network Inc
	Circuit City Stores Inc	Special Devices Inc
	National Media Corp	Wyle Electronics
5/1996	Aaron Rents Inc	Western Digital Corp
	Prudential Reinsurance Holdings	Barrett Business Services Inc
	Global Natural Resources*	Charming Shoppes Inc
	Dreco Energy Services*	Wellcare Management Gr Inc The
11/1996	Emulex Corp	A F C Cable Systems Inc
	Ocean Financial Corp	Zeneca Group Plc
	Biomet Inc	Trimble Navigation Ltd
	A M L Communications Inc	A C T Networks Inc
5/1997	Software Artistry Inc	Popular Inc
	Emulex Corp	Terex Corp New
	Fore Systems Inc	Security Dynamics Techs Inc
	Long Beach Financial Services *	Retirement Care Associates Inc
11/1997	Tab Products Co	Bell Atlantic Corp
	Ashworth Inc	Bioreliance Corp
	Long Beach Financial Corp	N S Group Inc
	Rowan Companies Inc	Deswell Industries *
5/1998	Tuboscope Inc	Apple Computer Inc
	T J X Companies Inc New	C & D Technologies Inc
	Netopia Inc	Cooker Restaurant Corp
	R J R Nabisco Holdings Corp	St John Knits Inc
11/1998	Freeport Mcmoran Copper & Gd Inc	Gadzooks Inc
	United Road Services Inc	Vanguard Cellular Sys Inc
	Jones Apparel Group Inc	D R S Technologies Inc
	Thermo Instrument Systems Inc	Garan Inc

*Return series not available during either estimation or evaluation period.

percentage points, but the terminal wealth differs by over $13,000.

Arithmetic means do not capture changes in wealth, which is why industry standards require geometric means. The wealth effect results also indicate the folly of relying on arithmetic averages when there are negative returns. The differences are more pronounced in the case of geometric means, where pro picks underperform the darts by more than 1 percentage point and the S&P 500 by more than 8.5 percentage points. These examples provide a good way to demonstrate the differences in arithmetic and geometric means.

Exhibit 1. Dartboard and Professional Stock Picks as Reported in the *Wall Street Journal* Dartboard Contest for May 1990 through May 2001 (*Continued*)

Date of *Wall Street Journal* Announcement	Professional Investment Advisor's Picks	Dartboard Picks
5/1999	Q R S Corp	Colgate Palmolive Co
	Philip Morris Cos Inc	Triangle Pharmaceuticals Inc
	International Business Machs Cor	E F C Bancorp Inc
	Affiliated Computer Services Inc	Halliburton Company
11/1999	Citrix Systems Inc	Triton Energy Ltd
	Oracle Corp	Hon Industries Inc
	M C I Worldcom Inc	Detroit Diesel Corp
	Stamps Com Inc	Flightserv Com
5/2000	Intel Corp	Winn Dixie Stores Inc
	Rowan Companies Inc	Staples Inc
	Sungard Data Systems Inc	A M B Property Corp*
	Kansas City Southern Inds Inc	Imax
11/2000	Ingersoll Rand	Gray Global
	Sybron	Rad Comm *
	Amgen	Trustco Bank
	Advanced Digital	Vectron
5/2001	Tyco	Healthtronics
	Packeteer*	Net2phone
	Met Life	North Fork Bancorp
	Virage	Pulte Corp

*Return series not available during either estimation or evaluation period.

Exhibit 2. Wealth Changes in the Dartboard Contest and Benchmark Portfolios from May 1990 through May 2001

Portfolios are formed on the first day of the month following the announcement of the pro and dartboard picks in the *Wall Street Journal* dartboard Contest. Standard deviation is on a six-month basis. Buy-and-hold DJIA and S&P 500 portfolios standard deviations, Sharpe ratios, and Treynor ratios are computed on a six-month basis. The Treynor ratio is computed as the mean six-month return divided by the respective six-month beta while the Sharpe ratio is computed as the mean six-month return divided by the respective standard deviation.

Portfolio	Value	Geometric Return	Annualized Arithmetic Return	Standard Deviation	Modified Sharpe Ratio	Modified Treynor Ratio
Pro Picks	$16959.34	4.70%	7.01%	15.71%	21.94%	3.34%
Dart Picks	$19197.34	5.84%	9.12%	20.13%	22.13%	3.43%
DJIA	$32540.38	10.80%	11.55%	9.50%	59.14%	5.98%
S&P 500	$41845.10	13.25%	14.04%	8.99%	75.55%	7.22%

The return and standard deviation information in Exhibit 2 are helpful to illustrate the benefits of diversification and risk versus return. The professional portfolio has a high standard deviation of over 15% per six-month period; the dart portfolio standard deviation is 28% higher than that. The DJIA and the S&P have standard deviations of under half those of the pro and dart portfolios. The pros picked stocks with higher volatility than the indexes, although much of the increased risk is likely due to a lack of diversification. The modified Sharpe and Treynor ratios (both measures of reward-to-variability) in the last two columns strongly favor the S&P and DJIA over either the pro or dart portfolios.[6]

[6]The instructor can highlight the superiority of the index through adding leverage in a spreadsheet so that the risk is equal to the pro portfolio. Ignoring interest costs, the geometric return for such a levered S&P portfolio is 18.89%, and the ending balance is $73,123.

Figure 1 represents another way to convey the results. The pro portfolio surpasses the dart portfolio and the Indexes for only a brief period in late 1995, and cumulative wealth lies below all the other portfolios most of the time. The pro portfolio ends the period with the lowest balance, as we know. Interestingly, the dart portfolio has the highest value until May 1995, and dominates the pro picks in almost every period throughout the contest when portfolios are formed at the end of the contest month. The unmanaged indexes outperform the darts after May 1996.

We should point out that the decline in the dart portfolio is attributable for the most part to only a few bad months, such as March 1997 when the darts lost 17.6%, mostly because two picks had returns of -17% and -41.1% in that month. The same can be said of the pro portfolio where it returned -14.8% in March 1997, largely because one pick (AML Communications) returned -61.1% in that month. It is instructive in terms of diversification that the indexes did not suffer quite as badly in March 1997; the S&P returned -4.2% and the Dow -4.3% because of their greater diversification. Again this presents rich material for teaching diversification, risk and return, and market efficiency.

Another element to explore is the effect of transactions costs and taxes in the actively managed pro and dart portfolios versus the passive indexes. The instructor can demonstrate what happens in the case of realistic round-trip transactions costs.

Barber and Odean (2000) estimate round-trip trading costs for households from 1991 to 1996 and find costs totaling 2.4%. For NYSE stocks, Berkowitz, Logue, and Noser (1988) estimate the costs were 0.48%. As most of the pro and dart picks are Nasdaq stocks, the costs are likely closer to 2.4%, at least in the earlier part of the sample period. These costs would reduce the overall returns substantially.

Another way to demonstrate the impact of transactions costs would be to ask the students to find the best discount brokerage fees and calculate the cost of rebalancing a portfolio using these costs. One online brokerage firm offers $7 trades for even-lot trades over the Internet. At the minimum, each contest period would thus entail $14 round-trip costs times four stocks twice per year for $112 per year, which reduces the ending wealth by $1,288 ignoring compounding effects. These costs are exclusive of taxes, so the true ending performance would be lower for a taxable investor.

A. Advanced Teaching Opportunities

The dartboard contest provides opportunities to teach advanced students market efficiency and diversification using more sophisticated methods of research. For a Ph.D. seminar, the instructor can introduce market model estimation and add more complicated topics. Students can gain valuable empirical research and statistical skills in a hands-on project that are not as easily learned in studying the literature. Students beginning a doctoral program may have limited experience with data issues, statistical computer software, event studies, and econometrics in general.[7]

Regression analysis may be suggested for MBA students, students doing an independent study, or for Ph.D. students who need experience with traditional market models. We use a standard market model to measure model parameters and estimate abnormal returns:

$$R_{p,t} = \alpha + \beta R_{M,t} + \varepsilon_{p,t}$$

where the dependent variable is the portfolio being analyzed and the market returns are CRSP indexes.

Standard event study techniques may be used to evaluate cumulative abnormal returns (CAR) as in Brown and Warner (1980, 1985). The dartboard contest provides an easily understandable platform to demonstrate this valuable statistical technique. We estimate parameters in the 60 months prior to the contest month (-61 to -1) and then estimate abnormal returns for the equally weighted portfolios. We repeat the process for the next contest and accumulate the results across the entire 11-year contest period.

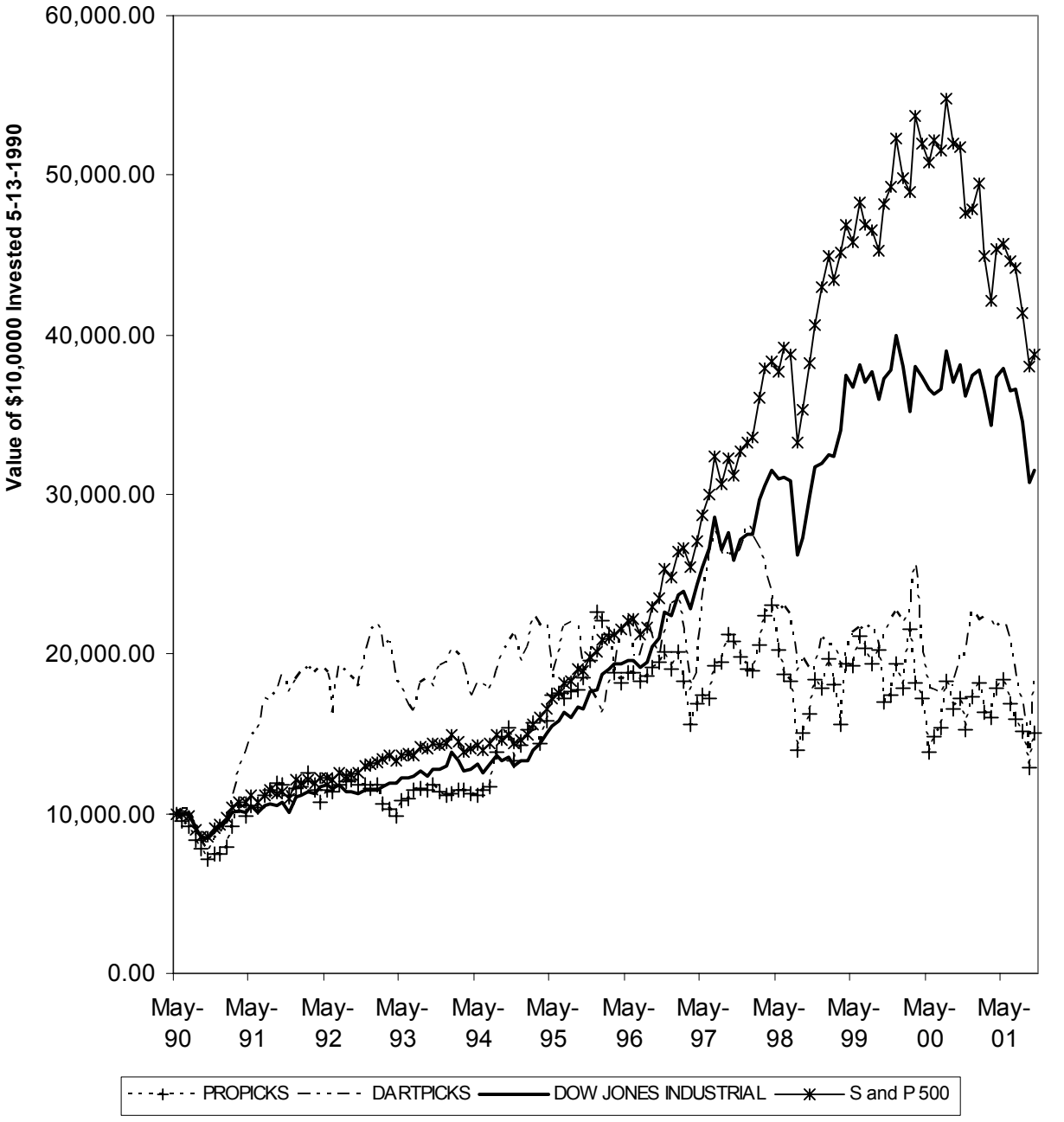
Although there are many potential problems with the standard market model, Malatesta (1986) and Henderson (1990) conclude that the event study approach is robust in detecting mean abnormal returns. Extensions include non-synchronous trading as addressed in Scholes and Williams (1977) by estimation of parameters using returns before and after the event, or in-sample variance as in Mikkleson and Partch (1986). More advanced topics are modeling the presence of autoregressive conditional heteroskedasticity (ARCH) as in Cyree and DeGennaro (2002) or generalized ARCH (GARCH) in event studies such as in Frame and Lastrapes (1998).

B. Empirical Results from Market Models

To model the concept of risk and return, we run a market model regression using monthly returns from the contest

[7]Students can collect returns themselves, but the process tends to be smoother if the instructor provides a spreadsheet of returns and asks the student to calculate model parameters using the spreadsheet's regression function. Returns data that are adjusted for splits and dividends are also readily available from online sources such as Yahoo! Finance, CNBC, or CBS Market Watch. Of course, gathering returns from CRSP can be a valuable experience for Ph.D. students.

Figure 1. Wealth Effects of WSJ Dartboard Contest



portfolios from 1990 to 2001 and use the equally weighted portfolio from the Center for Research in Security Prices (CRSP) data. We reform the pro and dart portfolios every six months when the contest starts anew, and invest in the new picks the month after they are announced in the *Wall Street Journal*.

Exhibit 3 presents the average market model parameters and statistics for the pro and dart picks and the indexes over our time period. The mean pro picks beta is 1.00 indicating the pros chose stocks that were on average as risky as the market. The median beta of 0.62 indicates that the pro picks were skewed toward less risky stocks. This is interesting in and of itself, and suggests that professional money managers prefer to avoid stocks that are too risky in a contest like this one. We would guess managers want to beat the dart picks, or at least not lose too badly, to avoid embarrassment and possible client loss.

The dart portfolio has a much higher mean beta of 1.30 (median of 1.19). While there would be no explicit

Exhibit 3. Beta Estimations for Dartboard Portfolios

Monthly market model parameters are estimated over the preceding 61 months beginning one month prior to portfolio formation (-61, -1), which occurs the first day in the month following the *Wall Street Journal* Dartboard Contest publication date using the CRSP equally weighted index. Firms without returns in the CRSP database during the month preceding the publication date of the dartboard contest are not in the sample. The Betas for the buy-and-hold DJIA and S&P 500 portfolios are calculated during the (-61, -1) period and not recalculated during the sample period.

Portfolio	Mean Beta	Median Beta	Beta Standard Deviation	Minimum Beta	Maximum Beta
Pro Picks	1.001	0.620	1.488	-0.478	7.408
Dart Picks	1.301	1.185	0.763	0.122	9.263
DJIA	0.941				
S&P 500	0.929				

expectation for the beta of a dart portfolio, it is slightly surprising that the beta is this high. Maybe the dart picks result in smaller stocks, when the CRSP index is more diversified. The beta estimates for the more narrow S&P 500 and DJIA are slightly below 1.0, but reasonable for this period.[8]

Exhibit 4 shows the results of the event study over the entire sample period. Only the pro portfolio has a significant CAR over the 23 six-month periods, with abnormal performance of almost -17%. The dart portfolio also has disappointing performance, with a CAR of almost -9% over the period, but this value is not statistically significant. The Wilcoxon sign test does indicate that the number of negative CARs is significant in this case, even though the mean is not statistically different from zero. The Dow and the S&P also underperformed the equally weighted index market model estimates, but the CARs for both indexes are insignificant.

The event study results can be used to illustrate the poor performance of the contest portfolios on a risk-adjusted basis. The instructor can explain the concept of expected returns based on a market model where returns can be positive, but portfolios can still underperform an index. Many students have difficulty grasping this concept, and the market model results illustrate a powerful lesson.[9]

III. Announcement Effects

Students may question the choice of our portfolio formation dates. In fact, the pro picks see considerably greater wealth appreciation if the portfolios are formed in the month of the *Wall Street Journal* announcement. The dartboard exercise offers the opportunity to discuss naïve buying pressure of the type reported by Barber and Loeffler (1993), where a portion of the initial abnormal returns during the announcement period are transitory. Announcement effects are well documented by Pari (1987), Lui, Smith, and Syed (1990), and Metcalf and Malkiel (1994) among others.

Naïve buying pressure resulting from the announcement of a stock recommendation will temporarily boost the price level; the price reverts to its pre-announcement level fairly quickly. If analyst recommendations in the dartboard contest convey relevant new information, however, initial positive abnormal returns on the announcement day are not likely to offset by negative abnormal returns. Market microstructure issues are also relevant around the *WSJ* dartboard contest announcement dates, as in Greene and Smart (1999).

We document the announcement effect for our 11-year sample of the dartboard contest in Exhibit 5. Consistent with the notion that naïve buying pressure occurs around the announcement date, there is a highly significant positive mean cumulative abnormal return of 2.06% (z-statistic = 2.825) during the announcement month that is mostly attributed to the (-1, 1) daily window surrounding the dartboard contest publication date mean CAR of 2.28% (z-statistic = 4.676). Of course, Exhibit 4 has illustrated that these transitory announcement returns are overcome in the longer term to result in a -17% Mean CAR over the entire contest period.

The likelihood an individual investor can earn abnormal returns following public analyst recommendations is a good topic for discussion. Students may ask whether professional analysts have an opportunity to gain abnormal returns if they can own a stock before they make a recommendation in the *Wall Street Journal* and then sell it on the publication date to the naïve buyer—a good chance to discuss securities law and ethics.

[8]In the interest of simplicity, we calculate the betas for the indexes only at the beginning of the sample. Betas could be recalculated for the indexes every six months or rolling betas could be introduced for more advanced students (Fama and MacBeth, 1973).

[9]Students who want their investments just "to make money" do not understand that simply earning a positive return does not necessarily compensate the investor for the risk of the investment.

Exhibit 4. Cumulative Abnormal Returns for the *WSJ* Dartboard Contest

Monthly market model parameter estimates are calculated using the CRSP equally weighted index. Parameters are estimated using a (-61, -1) monthly window and a (+1, +6) month evaluation event window.

Portfolio	Number of Observations	Mean Cumulative Abnormal Return	Z-statistic	Positive: Negative	Signed Rank
Pro Picks	87	-16.94%	-2.848**	37:50	-426.00
Dart Picks	88	-8.82%	-1.596	31:57	-601.00*
DJIA	23	-2.95%	0.373	8:15	-55.00
S&P 500	23	-2.51%	0.385	8:15	-53.00

*, **, Significant at the 5% and 1% level using a two-tailed test.

Exhibit 5. Naïve Buying Pressure around *Wall Street Journal* Dartboard Contest Announcement Date

Mean cumulative abnormal returns are computed for the announcement date of the *WSJ* Dartboard Contest. Announcement month is the month of publication. Mean cumulative abnormal returns are also calculated for the three days beginning one day prior to the dartboard Contest publication date.

Portfolio	N	Mean Cumulative Abnormal Return	Positive: Negative	Z	Signed Rank
Pro Picks (announcement month)	87	2.06%	56:31	2.825**	752.00**
Pro Picks (-1, 1) daily announcement window)	87	2.28%	58:29	4.676***	849.00***
Dart Picks (announcement month)	88	1.27%	47:41	0.160	301.00
Dart Picks (-1, 1) daily announcement window)	88	-0.43%	42:46	-1.032	-259.00

** and *** denote significance at the 1% and 0.1% levels using a two-tailed test.

IV. Summary and Conclusions

Finance students find it hard to believe that professional stock pickers cannot consistently beat the market on a risk-adjusted basis. Many feel they can beat the market themselves, because there are many stories where investors have made large gains. Proving the contrary in an example that is easy to understand is a difficult task for an instructor.

The *Wall Street Journal*'s dartboard contest provides a good way to illustrate market efficiency and portfolio theory. The results are easy for students to grasp and allows for experiential learning. Students can throw their own darts and compete against pros chosen from the financial media, brokerage recommendations, or the *Wall Street Journal* during the semester.

The finding that the *WSJ* dart throwers have over 100 basis points of higher geometric return and have over $2,200 more in terminal value than the pros for the entire 11.5 year period should be compelling. It provides a good occasion to discuss market efficiency and diversification.

The pros and the darts both underperform the unmanaged S&P 500 and the Dow Jones Industrial Average by at least 4.9 percentage points per year and $13,000 in terminal wealth. The wealth figures are dramatic, and so is a plot of the cumulative wealth of each portfolio. This is a diversification lesson, as the pro and the dart portfolios include only four stocks per period. Another diversification benefit should be clear in that much of the poor result for the pros and darts comes from a few bad picks.

Risk is another important concept to teach. The standard deviation of the dart portfolio is more than double the S&P and Dow over the period, indicating the benefits of diversification. The pro picks have lower standard deviations than the darts, but still over 75% higher than the S&P. A leveraged S&P 500 index portfolio with risk commensurate to the pro portfolio would have geometric average returns of over 18.8% and a terminal wealth value of over $73,000 compared to under $17,000 for the pro picks. These terminal wealth results do not include transactions costs or tax effects for the actively traded pro and dart portfolios.

Simplified Sharpe and Treynor measures to judge performance of the portfolios provide students an idea of excess return per unit of risk. The modified Sharpe ratio (return divided by standard deviation) is about the same for the darts and pros, but over twice as high for the indexes, indicating better performance by the DJIA and the S&P. The modified Treynor measure

(return divided by estimated beta from the market model regression) is the worst for the pros. Treynor ratios are about twice as high for the index indicating better performance for the more diversified portfolios.[10]

Estimation of a traditional market model indicates that the cumulative abnormal return for the pro portfolio is almost -17% (highly significant). The dart and the index portfolio CARs are not significantly different from zero. These results demonstrate event study methodology in a very practical way. The finding that the majority of the announcement month returns come from an announcement effect is a very useful way to illustrate reactions to news in the stock market.

[10]The Sharpe and Treynor measures are calculated without the risk-free rate. This variable could be added for more advanced students.

The dartboard contest is a good example that facilitates discussion about a myriad of investment topics including financial reporting, calculating returns and adjusting for dividends, diversification and portfolio theory, risk and return, market efficiency, active versus passive management, transactions costs, and taxes. It is more than a game because it allows students to absorb basic concepts in a setting with real-world features. The dartboard contest provides insight for both the least sophisticated and the most advanced. The contest can be modified to illustrate important points to higher-level Ph.D. students. Try using this contest or creating your one of your own as an effective way to involve students and teach important financial concepts.■

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