Portable Alphas from Pension Mispricing

To enhance performance significantly.

Francesco Franzoni and José M. Marín

In the last few years, the funding status of defined-benefit (DB) pension plans in corporate America has attracted the attention of practitioners, legislators, and the media. The combination of a bear stock market and record low levels of interest rates during the first two years of the new millennium resulted in an unprecedented deterioration of the funding status of DB plans, causing analysts to raise red flags over the correct valuation of many companies. Many firms faced pension liabilities, even pension shortfalls, that exceeded by far their market capitalization.[1]

Intervention of the Pension Benefit Guaranty Corporation (PBGC) in taking over the pension plans of US Airways and United Airlines, triggered the President's plan for pension reform, released on January 10, 2005, but the latest figures available still point to a large exposure of American companies to pension liabilities. For instance, pension plan assets for companies reported in Compustat totaled about $1.75 trillion at the end of 2003. This figure is short some $464 billion of the approximately $2.2 trillion represented by the total pension obligations.

We propose a successful dynamic trading strategy based on the systematic mispricing of companies sponsoring DB plans. This strategy, which draws on the pricing anomaly we identify in Franzoni and Marín [2006], is not the result of data mining or manipulating tricks that enhance the performance of risk-reward measures.[2]

We provide robust evidence of significant overpricing of companies that sponsor defined-benefit pension plans running large pension shortfalls. It is hard to relate this mispricing to any of the known sources of economic risk. We provide here new insights on the economic principles behind the mispricing and capitalize on them to build our *pension plan underfunding* (PPU) trading strategy.

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EXHIBIT 1
Cumulative Returns

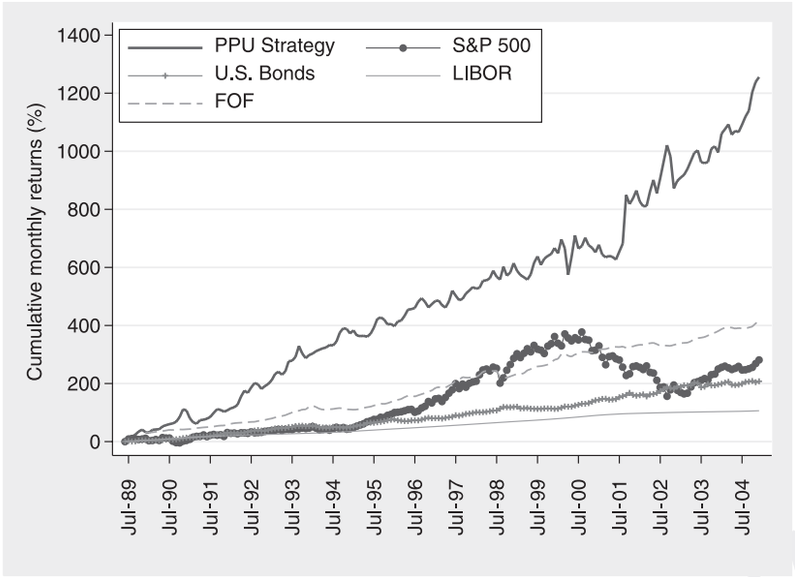


Exhibit 1 provides a first approximation of the outstanding performance of the strategy from July 1989 through December 2004. The exhibit reports the cumulative monthly returns of a version of the strategy that is neutral to the three Fama and French [1993] factors. As one can see, the strategy beats not only its natural benchmarks (LIBOR and bond returns) but also the S&P 500 and the HFR funds of hedge funds index. Furthermore, the strategy performs reasonably well during the turbulent market period of 2000-2002. Indeed, as we report later, the strategy is negatively correlated with credit spreads, which makes it an attractive hedge for several strategies in the hedge fund industry that are exposed to this risk. Even more striking, it offers outstanding performance during 2002-2004, a quiet period in the hedge fund industry.

This graphic overview suggests we are in the presence of a true active constituent in many portable alpha strategies.

DB PENSION PLAN ELEMENTS

In a defined-benefit pension plan, the sponsoring firm commits to provide retirement benefits to employees according to a formula that takes into account the employee's years of service and current and future salaries. The sponsor must make financial contributions over time according to legally specified formulas. These contributions are invested in assets at the sole discretion of the employer.

Hence, a company sponsoring a DB pension plan has a financial *liability* that is equal to the present value of the retirement benefits, and holds a portfolio of *assets* dedicated to the plan. When the market value of the pension assets is less than the value of the liability the pension plan is "underfunded"; otherwise the plan is "overfunded." We will refer to underfunded or overfunded plan sponsors as *underfunded or overfunded companies*.

The funding status of each plan sponsored by an employer is reported annually in IRS Form 5500. The aggregate funding status of the sponsoring firms is reported annually in the footnotes of the company's financial statements (SEC 10-K filings).

The funding status of DB plans affects corporate earnings and cash flows via mandatory contributions and amortization rules. For our purposes, and for the sake of brevity, it is enough to sketch out how mandatory contributions affect cash flows.[3]

Companies with overfunded pension plans are not required to make contributions. Companies with underfunded plans must contribute an amount equal to the larger of two components: the minimum funding contribution and the deficit reduction requirement.

The first one is defined as the previous year "normal cost" of the plan (i.e., the present value of pension benefits accrued during the period) plus the unfunded obligation amortized over a period of 5 to 30 years. The deficit reduction requirement calls for full amortization of the underfunding during three to five years and sets the fraction that must be contributed during the first year according to the formula *min* {0.30, [0.30 – 0.25 (*funding status* – 0.35)]}, where funding status is defined as plan liabilities over plan assets.[4]

A firm with an underfunded plan can waive the contribution if the ratio of assets to liabilities in the plan is above 80% in the current year and was more than 90% for the past two years. As a consequence, a company running a largely underfunded plan for a few years in a row cannot avoid making the contributions.

We argue that this feature of the regulatory environment is at the basis of the success of our strategy. That is, the regulatory environment makes it possible to forecast

an important component of future cash flows using the company's funding history information.

We take advantage of the role played by the mandatory deficit reduction contribution for companies that cannot avoid transferring money to the fund. This contribution can be as high as 30% of the shortfall for plans that did not experience shortfalls in the past, but can be even greater in the case of plans that have been underfunded for a few consecutive years.

THEORY OF DB COMPANY MISPRICING

In Franzoni and Marín [2006] we provide evidence of significant overpricing of companies experiencing large deficits in their DB pension plans, and argue that the mispricing is not related to risk. We find alphas of around −10.6% annually for the decile portfolio of the most underfunded companies, according to the most widely accepted asset pricing models (i.e., controlling for the three Fama and French [1993] factors). We do not find evidence of mispricing in the case of overfunded companies.

What are the economic principles behind this type of asymmetric mispricing? Our theory relies on two basic assumptions: investors' limited attention, and corporate management's "short-termism."

As the mispricing is not related to risk, it must be the case that financial analysts, or investors in general, do miss some important information in a companies' funding status either because they do not pay enough attention to this type of information or because they are unable to interpret it correctly. Hence, investors learn about this information when contributions hit the company's earnings and cash flows.[5]

Moreover, given the institutional framework describe that we, in the presence of corporate management short-termism we should expect the managers of firms running pension deficits to delay as much as possible the recognition of the shortfall in cash flows and earnings.[6] They can do this by contributing and amortizing the smallest allowable amount in the short term and hope for reversals in funding status in the long run. Hence, these companies will tend to be overpriced (as the current price does not adjust to the new liability the company faces). Later on, when the funding situation does not improve and managers are compelled to reduce earnings and cash flows, investors are surprised and prices adjust downward.

We conjecture that companies running pension surpluses behave in the opposite way, using the overfunding to bust earnings and cash flows as soon as they arise. Because earnings and cash flows adjust immediately, we do not expect these companies to be mispriced.

PENSION PLAN UNDERFUNDING STRATEGIES

In Franzoni and Marin [2006], we obtain the underpriced portfolio by selecting the most underfunded companies at each portfolio formation date. If the driving force of these results is the one we expose above, we should be able to increase the size of the overpricing by identifying companies prone to experience the largest cash flow corrections in the period after portfolio formation. These firms are not necessarily the same as those facing the largest shortfalls.

This is the basic philosophy behind our PPU strategy and represents a departure from Franzoni and Marín [2006]; one chooses companies facing the largest expected cash flows corrections in the near term due to their funding history, rather than firms running large pension deficits in the most recent fiscal year.

One simple way to achieve this goal is to select companies that have experienced large pension shortfalls for several consecutive years. For these companies, corporate managers can no longer delay the impact of mandatory contributions on cash flows. Accordingly, prices adjust within the year after portfolio formation. This simple forecasting rule is enough to form portfolios of underfunded companies that exhibit alphas of about −15.4% annually with respect to the Fama and French [1993] model. In other words, we are able to amplify the mispricing reported in Franzoni and Marin [2006] by almost 50%.

First Building Block: The Overpriced Portfolio

As in Franzoni and Marín [2006], we define a firm's funding ratio for year t as:

$$FR_t = \frac{FV\,PA_t - PBO_t}{Mkt\,Cap_t} \tag{1}$$

where:

- *FVPA* represents the market value of the assets (stocks, bonds, and other investments) that are set aside and restricted (usually in a trust) to pay benefits when due;
- *PBO* represents the actuarial present value of vested and non-vested benefits earned by an employee for

service rendered to date plus projected benefits attributable to salary increases; and

- *Mkt Cap* is the company's market capitalization in December of the calendar year the pension items are measured.

Thus, the variable FR_t measures the aggregate funding status of a company over all its pension plans relative to a measure of its size, that is, market capitalization. The pension data items can be obtained from Compustat.

In July of year *t*, we construct a value-weighted portfolio of underfunded companies with high expected cash flow corrections due to pension shortfalls. We choose July to make sure that all the necessary information for the construction is public. By that date, the accounting data, where the company funding status is reported, should be publicly available.

This portfolio is composed of the companies in the bottom quintile of the distribution of FR_{t-1}, conditional on those companies that displayed a negative value of FR in years $t-1$, $t-2$, $t-3$, and $t-4$. Hence, the portfolio includes the most highly underfunded stocks in year $t-1$ among those that have run four consecutive years of underfunded pension plans. This feature is intended to capture the companies that cannot avoid the contributions to the pension plans.

Portfolios are reformed each year to obtain the time series of monthly returns of the strategy. There are an average of 72 stocks in this portfolio for the period between July 1984 and December 2004.[7]

We provide evidence of the mispricing of this portfolio with respect to three different models: a one-factor model (CAPM), the Fama-French three-factor model, and a four-factor model composed of the Fama-French three factors plus a momentum factor.

Exhibit 2 reports the intercepts (alphas), factor loadings, and R-squared from the time series regression of portfolio excess returns (returns in excess of the one-month T-bill rate) on three different sets of factors between July 1984 and December 2004, according to the regression:

$$R_{it} = \alpha_i + \beta_i \, factors_t + \varepsilon_{it} \qquad (2)$$

The factors are the excess return on the market value-weighted portfolio (Mkt-Rf); the return on a value factor (High-minus-Low Book-to-Market portfolio, HML); the return on a size factor (Small-minus-Big portfolio, SMB); and the return on the momentum portfolio (return on past 12 months' winners minus return on past 12 months' losers, MOM). T-statistics are given in parentheses.

EXHIBIT 2
Alphas

	Alpha	Mkt-Rf	HML	SMB	MOM	R^2
1 Factor	-0.69	1.16				0.48
	(-1.99)	(15.29)				
3 Factors	-1.28	1.48	1.00	0.38		0.61
	(-4.12)	(19.10)	(8.64)	(4.02)		
4 Factors	-1.07	1.44	0.97	0.41	-0.20	0.62
	(-3.43)	(18.71)	(8.49)	(4.32)	(-3.11)	

In all cases reported in Exhibit 2, the mispricing of our portfolio is more than 40% greater than the mispricing identified in Franzoni and Marín [2006]. For example, for the three Fama-French factors, this portfolio produces a strikingly high alpha (in absolute terms) of 1.28% monthly (about 14.4% annually), compared to 0.89% monthly obtained in Franzoni and Marín [2006].

Basic PPU Strategy

The portfolio we have examined exhibits remarkable mispricing according to widely accepted asset pricing models, but its returns are still sensitive to economic risks. We can construct dynamic trading strategies based on this portfolio and hedging those risks.

Since the strategy is based on equities, we first compute an equity risk-neutral version of the strategy. Following the standard procedure in the literature, we use the three Fama-French factors to summarize this risk. Cumulative returns of the resulting neutral strategy are reported in Exhibit 1.

In order to make the strategy neutral to the factors, we need to estimate the portfolio betas or factor loadings. Using the returns on the portfolio examined in Exhibit 2, we run time series regressions of portfolio excess return on the three factors over five years of monthly data. The 60-month estimation window rolls forward by one month between July 1984 and December 2004. Then, each month between July 1989 and December 2004, we can construct a portfolio that is long in the three factors by an amount equal to the latest estimated betas and short in one unit of the portfolio considered in Exhibit 2. The rest of the portfolio is invested in the risk-free rate, that is, the one-month T-bill.

We call the resulting portfolio the *pension plan underfunding* (PPU) strategy. The returns on this strategy are neutral (on average) to equity risk, which is summarized by the three Fama-French risk factors.

Exhibit 3 reports summary statistics on the monthly return percentages of this strategy, along with the returns of the S&P 500 and the HFR Funds of Funds Index (FoF). We choose these two benchmarks because the PPU strategy is equity-based, and, given its short position, it has the characteristics of a hedge fund.

It is remarkable that does our strategy performs well not only in the bull market of the 1990s but also in the bear market that followed. Even in the most recent years, notoriously disappointing for the hedge fund industry, the PPU strategy does not lose its vigor.

For the sake of completeness, we must note that the outstanding performance in 2001 is due largely to an extreme observation in September, when the strategy earned about 21.4%. It is possible that the crash that followed September 11, 2001, hastened the revelation that firms with underfunded pension plans were mispriced. Excluding that September gives an average return in 2001 of 0.53% monthly, still higher than the two benchmarks, while the average return in the whole sample is largely unaffected at 1.40%.

Exhibit 3 also shows that the PPU strategy displays excess kurtosis, even though it is less than half the kurtosis for the funds of funds index. The returns on the PPU strategy are also positively skewed, unlike the returns on the S&P 500 and the hedge funds index. We address normality later, but for now suffice it to say that results so far merit mean-variance analysis.

Exhibit 4 extends the comparison of the risk-return characteristics of the PPU strategy to other benchmark portfolios. We include the S&P 500 index; the value factor (HML) and the size factor (SMB) to check that the strategy is neutral to U.S. equities; an index of global equities—the MSCI Global Equity Index (Gl. Eq.); two bond indexes—the JP Morgan U.S. Bonds Index (U.S. B.) and the JP Morgan Global Bonds Index (Gl. B.); a hedge fund index—the HFR Funds of Funds Index; and a strategy that has received considerable attention in the last years, the momentum portfolio (MOM).

We also include two superneutral versions of the PPU strategy. The first one (PPUb) is neutral to the three Fama and French factors plus the two bond factors; the second one (PPUm) is neutral to the three Fama and French factors plus the momentum factor (MOM). All the series range from July 1989 through December 2004 (except for the HFR index, which starts in January 1990).

In terms of average returns, the strategy beats all the other portfolios, including the momentum strategy. Its risk is similar to the risk of the equity portfolios, so it is higher than bond risk and much higher than the hedge fund risk. In terms of Sharpe ratios, the strategy is beaten only by the index of funds of funds. This fact is expected, as in the index of hedge funds the idiosyncratic risks of many alpha strategies are diversified away, which results in a portfolio that is less volatile than the individual alpha strategies.

By construction, the strategy exhibits very low correlations with the S&P and the value and size factors. This

EXHIBIT 3
Annual Performance and Summary Statistics

Year	PPU	S&P500	FoF
1989	4.99	1.84	NA
1990	3.90	-0.44	0.61
1991	0.19	2.06	0.90
1992	3.18	0.39	0.94
1993	2.56	0.58	1.83
1994	1.46	-0.09	-0.37
1995	0.60	2.49	0.97
1996	1.09	1.59	1.30
1997	0.85	2.37	1.34
1998	1.08	2.18	0.16
1999	0.63	1.56	1.27
2000	0.03	-0.78	0.61
2001	2.28	-1.01	0.42
2002	0.41	-2.03	0.09
2003	0.80	2.02	0.82
2004	1.81	0.74	0.58
Average	1.51	0.81	0.76
Std Dev	4.44	4.20	1.23
Skewness	0.41	-0.44	-0.92
Exc. Kurt.	2.68	0.62	6.30

EXHIBIT 4
Performance Comparison

				Correlations								
	Mean	St. Dev.	S. R.	PPU	S&P500	HML	SMB	Gl. Eq.	U.S. B.	Gl. B.	FoF	MOM
PPU	1.51	4.44	0.26	1.00								
S&P500	0.81	4.20	0.11	-0.02	1.00							
HML	0.33	3.51	0.09	-0.12	-0.43	1.00						
SMB	0.14	3.78	0.04	0.06	0.00	-0.44	1.00					
Gl. Eq.	0.56	4.29	0.05	0.01	0.82	-0.42	0.13	1.00				
U.S. B.	0.61	1.33	0.20	0.21	0.02	0.11	-0.18	-0.01	1.00			
Gl. B.	0.68	1.83	0.18	0.23	0.07	0.02	-0.13	0.22	0.65	1.00		
FoF	0.76	1.23	0.34	0.11	0.52	-0.30	0.40	0.53	0.09	-0.01	1.00	
MOM	0.95	4.93	0.19	0.28	-0.23	-0.06	0.11	-0.14	0.23	0.14	0.12	1.00
PPUb	1.34	4.47	0.22	0.97	-0.02	-0.14	0.03	-0.02	0.06	0.05	0.08	0.26
PPUm	1.19	4.44	0.19	0.97	0.02	-0.13	0.04	0.03	0.17	0.20	0.07	0.08

means the strategy can be ported into arbitrary equity benchmarks to create an equity-based portable alpha strategy.

Yet the strategy is positively correlated with bond returns and the momentum portfolio. Intuitively, a decline (increase) in interest rates generates a deterioration (improvement) in the pension status of a company, all else equal, which in turn tends to increase (reduce) the return of our strategy, as well as the return of a portfolio of bonds.

As for momentum, note that the PPU strategy is short in underfunded companies. In Franzoni and Marín [2006] we show that these companies experienced poor past operating performance and have earned negative returns in the recent past. Our strategy does well because these stocks display negative returns in the period after portfolio formation also. Hence, there is momentum in the PPU portfolio. Indeed, it is plausible that our sorting procedure, which is based on accounting data, partly overlaps with the sorting procedure in momentum strategies, which is based entirely on past returns.

The positive correlation with bonds and momentum raises questions as to the qualification of the PPU strategy as a pure alpha strategy, i.e., as an investment whose returns are not related to the performance of primary assets.[8]

To address these concerns, we derive versions of the strategy that are immunized to these benchmarks and that preserve the outstanding performance of the original PPU strategy. That is, we obtain versions that are neutral to bonds and momentum in addition to the three Fama-French factors. We add an extra long position in the new assets (either the two bond indexes or the momentum factor). The last two rows in Exhibit 4 report the risk/return characteristics of these super-neutral strategies (PPUb is bond-neutral and PPUm is momentum-neutral).

Neutralizing the exposure to bonds reduces the monthly alpha by 17 basis points, from 1.51% to 1.34%. Neutralizing the momentum return is more costly, up to 32 monthly basis points. In both cases, the volatility of the strategy remains almost unchanged.

The important fact, however, is that the two versions of the strategy beat many of the alternative asset classes included in Exhibit 4 in terms of Sharpe ratio. Evidence below confirms that the actual correlation with bond returns or momentum is not high enough to denote the PPU strategy as a bond market style or a trend-following style.

PPU AS A PORTABLE ALPHA STRATEGY

The analysis so far shows that the returns on the PPU strategy (either in its original version or in its super-neutral versions) are not strongly correlated with the returns of primary assets. This evidence suggests that the strategy is a pure alpha constituent in general portable alpha strategies.

First, we perform a style analysis using as benchmarks the asset classes that have been shown to capture most of the variation in mutual fund returns.[9] We follow Fung and Hsieh [1997] and choose eight indexes: the MSCI U.S. Equity Index (US Eq); the MSCI non-U.S. Equity Index (Non-US Eq); the MSCI Emerging Markets

Index (Em Mkt); the JP Morgan U.S. Bonds Index (US Bond); the JP Morgan non-U.S. Bonds Index (Non-US Bond); the one-month eurodollar deposit rate (1-Month ED); the gold price index (Gold); and the Federal Reserve's Trade Weighted Dollar Index (US Dollar).

Exhibit 5 reports the results from the regression of the PPU strategy (in a version immunized to the three Fama-French factors) on the eight benchmarks. We consider three samples. The longer sample coincides with the period of availability of the PPU returns. The two subperiods have been chosen as in Fung and Hsieh [2004] to isolate two potential structural breaks in the market: the collapse of Long-Term Capital Management in September 1998, and the end of the Internet bubble in March 2001.

In all samples, the explanatory power of the factors is very low; the adjusted R^2 never exceeds 6%. Also, none of the proposed benchmarks is statistically significant at conventional levels (the t-statistics are in parentheses). The factor with the highest explanatory power is the U.S. Bonds Index, confirming the correlation of the PPU strategy with bond returns.

Finally, in two regressions out of three, there is an economically and statistically significant intercept, confirming that the returns on the PPU strategy are largely unexplained by the conventional benchmarks.[10]

The eight factors work well for mutual funds, because the location choice, i.e., the choice of the asset class, is more relevant than the dynamic aspect of the trading strategy (see Fung and Hsieh [1997]). The PPU trading strategy is inherently dynamic, however, and it involves short positions. These characteristics make it resemble a hedge fund strategy. It is commonly believed that a style analysis of the type proposed by Sharpe [1992] is not suitable to describe the performance of actively managed portfolios such as hedge funds (see, for example, Brown and Goetzmann [1997] and Fung and Hsieh [1997]).

For this reason, we replicate the style analysis using a set of alternative benchmarks that have been found to capture the dynamic connotation of hedge fund strategies. These factors are the seven asset-based styles (ABS) identified by Fung and Hsieh [2004].

There are two equity-oriented benchmarks: the S&P 500 index (S&P 500) and a portfolio that captures the size risk, the Wilshire 17500 index minus the Wilshire 750 index (SC – LC). Two factors describe the bond market: the month-end to month-end change in the Federal Reserve's ten-year constant maturity yield (10Y); and the month-end to month-end change in the difference between Moody's Baa yield and the Federal Reserve's ten-year constant maturity yield (Cred Spr). Finally, there are three factors that capture the returns of trend-following managers: a portfolio of look-back straddles on bond futures (Bd Opt); a portfolio of look-back straddles on currency futures (FX Opt); and a portfolio of look-back straddles on commodity futures (Com Opt).

The results from the style analysis with these alternative benchmarks are reported in Exhibit 6. In terms of explanatory power, the ABS do not perform better than the standard benchmarks; the R^2 is never higher than 6%.

The only factors that have some statistical significance (at least in the overall sample) according to the t-statistics reported in parentheses are the size spread (SC – LC) and the credit spread factors. This finding of a negative correlation with credit spreads is very interesting, as it highlights a potential role of the strategy as a hedge for the many strategies in the hedge fund industry

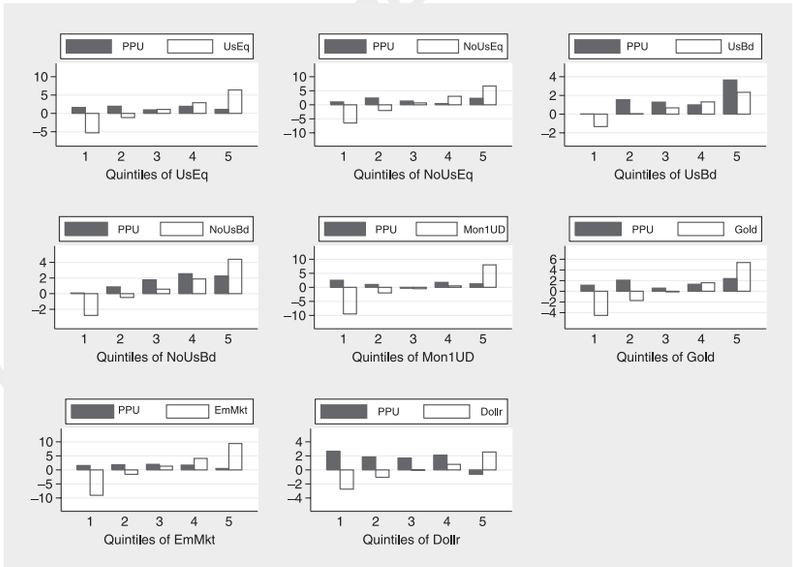
EXHIBIT 5
Style Analysis with Standard Benchmarks

	Dep. Var.: PPU		
	Jul 89 - Dec 04	Jul 89 - Sep 98	Apr 02 - Dec 04
Intercept	1.23	1.72	0.45
	(3.19)	(3.11)	(0.62)
US Eq	0.04	0.08	0.25
	(0.39)	(0.52)	(0.68)
Non-US Eq	-0.06	-0.01	-0.46
	(-0.51)	(-0.11)	(-1.08)
Em Mkt	-0.03	-0.02	-0.04
	(-0.45)	(-0.21)	(-0.21)
US Bond	0.60	0.74	0.27
	(1.90)	(1.48)	(0.52)
Non-US Bond	-0.21	-0.52	-0.13
	(-0.56)	(-1.09)	(-0.15)
1-Month ED	-0.02	0.04	-0.08
	(-0.33)	(0.54)	(-0.93)
Gold	0.07	-0.04	0.22
	(0.74)	(-0.32)	(1.10)
US Dollar	-0.64	-1.07	-1.03
	(-1.38)	(-1.79)	(-0.89)
R^2	0.04	0.01	0.06

EXHIBIT 6
Style Analysis with Alternative Benchmarks

	Dep. Var.: PPU		
	Jan 94 - Dec 04	Jan 94 - Sep 98	Apr 02 - Dec 04
Intercept	1.02	1.07	1.35
	(3.04)	(2.74)	(2.00)
S&P500	0.00	0.13	0.09
	(-0.02)	(1.24)	(0.52)
SC-LC	0.23	0.24	-0.13
	(2.23)	(1.62)	(-0.55)
10Y	0.44	4.10	-3.10
	(0.27)	(1.90)	(-1.04)
Cred Spr	5.92	6.70	4.69
	(1.86)	(1.28)	(0.81)
Bd Opt	-0.01	-0.01	0.02
	(-0.37)	(-0.38)	(0.46)
FX Opt	0.00	0.01	-0.01
	(-0.05)	(0.75)	(-0.15)
Com Opt	0.04	0.00	0.09
	(1.27)	(0.08)	(1.48)
R^2	0.03	0.06	0.03

EXHIBIT 7
PPU by Quintiles of Standard Benchmarks



that tend to exhibit poor performance when credit spreads widen. The fact that neither the bond factors nor the trend-following styles are significant addresses the concern raised by the correlation of PPU returns with bond and momentum returns—our trading strategy does not overlap with bond market or trend-following styles. Finally, the high and significant intercepts confirm that the set of alternative benchmarks does not capture the performance of the PPU strategy.

Overall, the evidence in Exhibits 5 and 6 suggests that the PPU strategy, which is hedged against the risks in the three Fama-French factors, does not load on any source of risk that describes the performance of mutual funds or hedge funds. This finding lets us characterize PPU returns as a portable alpha for standard and alternative investments.

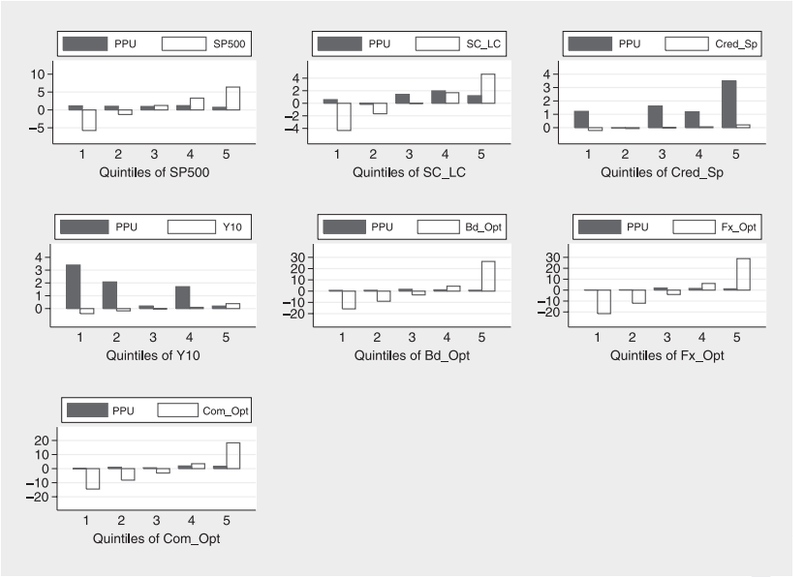
Style analysis rules out linear dependence on the returns of benchmark portfolios. To check robustness, we want to make sure that the PPU strategy does not display a non-linear relationship with these factors, an important requirement for portability. We use the method developed in Fung and Hsieh [2006].

The monthly returns on the eight standard benchmarks and the seven ABS factors are individually sorted into quintiles from worst to best. The average return for each quintile of the indexes and the average of the corresponding months for the PPU returns are graphed; Exhibit 7 shows the eight plots for the standard benchmarks and Exhibit 8 the corresponding plots for the seven alternative factors.

With a few exceptions, the prevalent pattern is a flat relationship between PPU returns and the benchmarks, which suggests a lack of non-linear dependence. The exceptions are the bond market factors in the two sets of benchmarks. There is some positive (negative) correlation between bond returns (yields) and PPU returns. We first presented this finding above when we showed that a version of the PPU strategy that is neutral to bond risk factors still displays outstanding performance (see Exhibit 4).

Finally, we need to assess the normality of PPU returns; according to the statistical tests of skewness and kurtosis reported in Exhibit 3, normality is rejected. If excess kurtosis is due to time-varying volatility, though, returns could still be normal and

EXHIBIT 8
PPU by Quintiles of Alternative Benchmarks



mean-variance analysis would be justified. Hence, as in Fung and Hsieh [2006], we fit an AR(1) model to PPU returns and a GARCH(1, 1) model to the conditional volatility. Then we consider the distribution of the standardized residuals (that is, the residuals divided by the conditional volatility).[11]

At first, it seems that normality is still rejected for the standardized residuals. Upon closer examination, we identify September 2001 as the outlier that causes the excess kurtosis. In this anomalous month, PPU returns were extremely high (21.4%). Once we discard this unusual month, the excess kurtosis of the standardized residuals is 0.06; the skewness is 0.08; and normality is not rejected.

CONCLUDING REMARKS

We formally establish here that the pension-related mispricing we identify in Franzoni and Marín [2006] can be magnified by at least 50% to achieve an annual alpha of about –15.4%. We construct a hedged trading strategy that can be used in combination with a wide range of benchmarks to create portable alphas, particularly to enhance indexing in equity and bond portfolios.

A combination of the institutional settings of defined-benefit pension plans and corporate management's short-termism drives the performance of the strategy. Given no major changes in these two elements in the next few years, we believe the strategy or some refined version of it will continue to perform well in the near future.

ENDNOTES

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[1]The cases of AMR Corp and Delta Airlines represent but the tip of an iceberg that includes a long list of companies (see Zion and Carcache [2002]).

[2]That is, the strategy does not rely on the the use of option-like strategies to exhibit superior performance in "normal times" (say, rolling over short positions on deep out-of-the-money put options on some market index) or curtailing the upper and lower tails of the distribution of the portfolio to increase the Sharpe ratio (see Goetzmann et al. [2003]).

[3]We focus on the legal framework applicable during the period our study covers, particularly on the rules established by the Pension Protection Act of 1987.

[4]The Retirement Protection Act of 1994 changed the deficit reduction rules so that the first-year deficit reduction is equal to $min\{0.30, [0.30 - 0.40\ (\textit{funding status} - 0.60)]\}$.

[5]There is a generalized view that the rules that regulate the incorporation of pension elements in income statements of the sponsoring firm and the mandatory contributions in case of shortfalls are too complex (for instance, see Zion and Carcache [2002]) and too vulnerable to management manipulation (Bergstresser, Desai, and Rauh [2006]).

[6]For evidence on opportunistic behavior by managers of DB companies, see, for instance, Bergstresser, Desai, and Rauh [2006]; for an analysis of management short-termism in general, see Stein [1989].

[7]Further details on constructions of the pension variables and treatment of outliers are provided in Franzoni and Marín [2006].

[8]Strictly speaking the momentum strategy is not a primary asset. We include it here because there remains a question on whether momentum is a proxy for some risk factor or an alpha.

[9]First introduced in Sharpe [1992] for the study of mutual fund performance, style analysis was later extended in Fung and Hsieh [1997] to hedge fund performance.

[10]The cause of the insignificant intercept in the later subperiod is a large negative realization in the currency factor, due to the U.S. dollar depreciation. Yet the lack of statistical

significance of both the loading on the currency factor and the intercept cannot lead us to conclude that returns on the PPU strategy are explained by this factor.

[11]Estimated coefficients are available upon request.

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