

# Chapter 10

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## CONDITIONAL PERFORMANCE EVALUATION

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### Abstract

*Measures for evaluating the performance of a mutual fund or other managed portfolio are interpreted as the difference between the average return of the fund and that of an appropriate benchmark portfolio. Traditional measures use a fixed benchmark to match the average risk of the fund. Conditional performance measures use a dynamic strategy as the benchmark, matching the fund's risk dynamics. The logic of this approach is explained, the models are described and the empirical evidence is reviewed.*

**Keywords:** security selection; market timing; investment performance; benchmark portfolio; alpha; market efficiency; conditional alpha; risk dynamics; stochastic discount factor; conditional beta; portfolio weights; mutual funds; pension funds

### 10.1. Conditional Performance Evaluation

Conditional Performance Evaluation is a collection of empirical approaches for measuring the investment performance of portfolio managers, adjusting for the risks and other characteristics of their portfolios. A central goal of performance evaluation in general, is to identify those managers who possess investment information or skills superior to that of the investing public, and who use the advantage to achieve superior portfolio re-

turns. Just as important, we would like to identify and avoid those managers with poor performance. Since the risks and expected returns of financial assets are related, it is important to adjust for the risks taken by a portfolio manager in evaluating the returns. In order to identify superior returns, some model of “normal” investment returns is required, i.e. an asset pricing model is needed (see the entries on Asset Pricing Models and Conditional Asset Pricing).

Classical measures of investment performance compare the average return of a managed portfolio to that of a “benchmark portfolio” with similar risk. For example, Jensen (1968) advocated “alpha” as a performance measure. This is the average return minus the expected return implied by the Capital Asset Pricing Model (Sharpe, 1964). The CAPM implies that the expected return is a fund-specific combination of a safe asset and a broad market portfolio, and so this combination is the benchmark. Chen et al. (1987), Connor and Korajczyk (1986), and Lehmann and Modest (1987) extended this idea to multi-beta asset pricing models, where several returns are combined in the benchmark to adjust for the fund's risk.

It is traditional to distinguish between investment ability for security selection and ability for market timing. Security selection refers to an ability to pick securities that are “undervalued” at current market prices, and which therefore may be expected to offer superior future returns.

Market timing refers to an ability to switch the portfolio between stocks and bonds, anticipating which asset class will perform better in the near future. The classical performance measures are “unconditional,” in the sense that the expected returns in the model are unconditional means, estimated by past averages, and the risks are the fixed unconditional second moments of return. If expected returns and risks vary over time, the classical approach is likely to be unreliable. Ferson and Schadt (1996) showed that if the risk exposure of a managed portfolio varies predictably with the business cycle, but the manager has no superior investment ability, then a traditional approach will confuse common variation in the fund’s risk and the expected market returns with abnormal stock picking or market timing ability. “Conditional Performance Evaluation” (CPE) models the conditional expected returns and risk, attempting to account for their changes with the state of the economy, thus controlling for any common variation.

The problem of confounding variation in mutual fund risks and market returns has long been recognized (e.g. Jensen, 1972; Grant, 1977), but these studies tend to interpret such variation as reflecting superior information or market timing ability. A conditional approach to performance evaluation takes the view that a managed portfolio whose return can be replicated by mechanical trading, based on readily available public information, should not be judged to have superior performance. CPE is therefore consistent with a version of market efficiency, in the semi-strong form sense of Fama (1970).

In the CPE approach a fund’s return is compared with a benchmark strategy that attempts to match the fund’s risk dynamics. The benchmark strategy does this by mechanically trading, based on predetermined variables that measure the state of the economy. The performance measures, the “conditional alphas,” are the difference between a fund’s return and that of the benchmark dynamic strategy. This generalizes the classical performance

measures, such as Jensen’s alpha, which compare a fund’s return with a fixed benchmark that carries the same average risk. Since CPE uses more information than traditional performance measures, it has the potential to provide more accuracy. In practice, the trading behavior of managers overlays portfolio dynamics on the dynamic behavior of the underlying assets that they trade. For example, even if the risk of each security were fixed over time, the risk of a portfolio with time-varying weights, would be time varying. The desire to handle such dynamic behavior motivates a conditional approach. Investors may wish to understand how funds implement their investment policies dynamically over time. For example, how is a fund’s bond–stock mix, market exposure, or investment style expected to react in a time of high-interest rates or market volatility? CPE is designed to provide a rich description of funds’ portfolio dynamics in relation to the state of the economy.

A conditional approach to performance evaluation can accommodate whatever standard of superior information is held to be appropriate, by the choice of the lagged instruments, which are used to represent the public information. Incorporating a given set of lagged instruments, managers who trade mechanically in response to these variables get no credit for superior performance. To represent public information, much of the empirical literature to date has focused on a standard set of lagged variables. Examples include the levels of interest rates and interest rate spreads, dividend-to-price ratios, and dummy variables indicating calendar-related patterns of predictability. More recent studies expand the analysis to consider a wider range of indicators for public information about the state of the economy (e.g. Ferson and Qian, 2004).

## 10.2. Examples

Implementations of Conditional Performance Evaluation have typically used either simple linear regression models or “stochastic discount factor”

methods. (See the entry on Asset Pricing.) Ferson and Schadt (1996) used simple linear regressions. To illustrate, let  $r_{mt+1}$  be the return on a market or benchmark index, measured in excess of a short-term Treasury return. For example, the benchmark index could be the Standard & Poor's 500, a "style" index such as "small cap growth," or a vector of excess returns. The traditional regression for Jensen's alpha is:

$$r_{pt+1} = \alpha_{pJ} + \beta_p r_{mt+1} + \varepsilon_{pt+1}, \quad (10.1)$$

where  $r_{pt+1}$  is the return of the fund in excess of a short term "cash" instrument and  $\alpha_{pJ}$  is Jensen's alpha. Ferson and Schadt (1996) proposed the conditional model:

$$r_{pt+1} = \alpha_p + \beta_o r_{mt+1} + \boldsymbol{\beta}' [r_{mt+1} \otimes \mathbf{Z}_t] + u_{pt+1}, \quad (10.2)$$

where  $\mathbf{Z}_t$  is the vector of lagged conditioning variables and  $\alpha_p$  is the conditional alpha. The coefficient  $\beta_o$  is the average beta of the fund, and  $\boldsymbol{\beta}' \mathbf{Z}_t$  captures the time-varying part of the conditional beta. The interaction terms  $[r_{mt+1} \otimes \mathbf{Z}_t]$  in the Ferson and Schadt regression model control for common movements in the fund's "beta", and the conditional expected benchmark return. The conditional alpha,  $\alpha_p$ , is thus measured net of these effects.

To see more explicitly how Equation (10.2) compares the fund's return to a benchmark strategy with the same risk dynamics, recall that the excess returns are  $r_{pt+1} = R_{pt+1} - R_{ft+1}$  and  $r_{mt+1} = R_{mt+1} - R_{ft+1}$ , where  $R_{ft+1}$  is the gross return of a risk-free asset. The benchmark strategy is to invest the fraction  $\beta_o + \boldsymbol{\beta}' \mathbf{Z}_t$  of the portfolio in the market index with return  $R_{mt+1}$ , and the fraction  $1 - \beta_o - \boldsymbol{\beta}' \mathbf{Z}_t$  in the risk-free investment. This benchmark strategy has a time-varying beta equal to  $\beta_o + \boldsymbol{\beta}' \mathbf{Z}_t$ , the same as that ascribed to the fund. The conditional alpha is just the difference between the fund's average return and the average return of the benchmark strategy.

Christopherson et al. (1998) propose a refinement of Equation (10.2) to allow for a time-varying conditional alpha:

$$r_{p,t+1} = \alpha_{p0} + \boldsymbol{\alpha}_{1p}' \mathbf{Z}_t + \beta_o r_{m,t+1} + \boldsymbol{\beta}' [r_{m,t+1} \otimes \mathbf{Z}_t] + u_{pt+1}. \quad (10.3)$$

In this model, the term  $\alpha_{p0} + \boldsymbol{\alpha}_{1p}' \mathbf{Z}_t$  captures the time-varying conditional alpha.

An alternative approach to Conditional Performance Evaluation uses "SDF" models, as developed by Chen and Knez (1996), Dalhquist and Soderlind (1999), Farnsworth et al. (2002) and Ferson et al. (2006). With this approach, abnormal performance is measured by the expected product of a fund's returns and a SDF. (See the entry on Asset Pricing Models for a discussion of stochastic discount factors.) Specifying the stochastic discount factor corresponds to specifying an asset pricing model. For a given SDF, denoted by  $m_{t+1}$ , we can define a fund's "conditional SDF alpha" as:

$$\alpha_{pt} \equiv E(m_{t+1} R_{pt+1} | \mathbf{Z}_t) - 1, \quad (10.4)$$

where one dollar invested with the fund at time  $t$  returns  $R_{pt+1}$  dollars at time  $t + 1$ . In the case of an open-end, no-load mutual fund, we may think of  $R_{pt+1}$  as the net asset value return. More generally, if the fund generates a payoff  $V_{pt+1}$  for a cost  $c_{pt} > 0$ , the gross return is  $R_{pt+1} \equiv V_{pt+1}/c_{pt}$ . A SDF is said to price the vector of underlying primitive assets with returns  $\mathbf{R}_{t+1}$  if their gross returns satisfy the equation  $E_t\{m_{t+1} \mathbf{R}_{t+1}\} = \mathbf{1}$ .

If the SDF prices the primitive assets,  $\alpha_{pt}$  will be zero when the fund (costlessly) forms a portfolio of the primitive assets, provided the portfolio strategy uses only the public information at time  $t$ . In that case  $R_{p,t+1} = \mathbf{x}(\mathbf{Z}_t)' \mathbf{R}_{t+1}$ , where  $\mathbf{x}(\mathbf{Z}_t)$  is the portfolio weight vector. Then Equation (10.3) implies that  $\alpha_{pt} = [E(m_{t+1} \mathbf{x}(\mathbf{Z}_t)' \mathbf{R}_{t+1} | \mathbf{Z}_t)] - 1 = \mathbf{x}(\mathbf{Z}_t)' [E(m_{t+1} \mathbf{R}_{t+1} | \mathbf{Z}_t)] - 1 = \mathbf{x}(\mathbf{Z}_t)' \mathbf{1} - 1 = 0$ .

When the SDF alpha of a fund is not zero, this is interpreted to indicate "abnormal" performance relative to the model that provides the specification of  $m_{t+1}$ . The economic intuition is simple when  $m_{t+1} = \rho u'(C_{t+1})/u'(C_t)$  in the consumer choice problem: Maximize the expected utility function  $E_t\{\sum_{j \geq 0} \rho^j u(C_{t+j})\}$ . Then, the condition  $E_t\{m_{t+1} \mathbf{R}_{t+1}\} = \mathbf{1}$  is the necessary first-order

condition of the maximization. If the consumer–investor in this problem can invest in a fund with a given SDF alpha, the consumer–investor would wish to hold more of the fund with  $\alpha_{pt} > 0$ , and less of the fund with  $\alpha_{pt} < 0$ .

### 10.3. Conditional Market Timing

A classical market timing regression, when there is no conditioning information, is the quadratic regression:

$$r_{pt+1} = a_p + b_p r_{mt+1} + \gamma_{imu} [r_{m,t+1}]^2 + v_{pt+1}. \quad (10.5)$$

Treynor and Mazuy (1966) argue that  $\gamma_{imu} > 0$  indicates market timing ability. The logic is that a market timing manager will generate a return that has a convex relation to the market. When the market is up, the fund will be up by a disproportionate amount. When the market is down, the fund will be down by a lesser amount. However, a convex relation may arise for a number of other reasons. Chen et al. (2005) provide an analysis of various nonlinear effects unrelated to true-timing ability. One of these is common time variation in the fund’s risk and the expected market return, due to public information on the state of the economy. In a market timing context, the goal of conditional performance evaluation is to distinguish timing ability that merely reflects publicly available information, from timing based on better information. We may call such informed timing ability “conditional market timing.”

Admati et al. (1986) describe a model in which a manager with constant absolute risk aversion in a normally distributed world, observes at time  $t$  a private signal equal to the future market return plus noise,  $r_{mt+1} + \eta$ . The manager’s response is to change the portfolio beta as a linear function of the signal. They show that the  $\gamma_{imu}$  coefficient in regression in Equation (10.5) is positive, if the manager increases market exposure when the signal about the future market return is favorable. Bhattacharya and Pfleiderer (1983), and Lee and Rahman (1990) show how to use the squared re-

siduals of the regression to separate the manager’s risk aversion from the signal quality, measured by its correlation with the market return.

In a conditional model, the part of the correlation of fund betas with the future market return, which can be attributed to the public information, is not considered to reflect conditional market timing ability. Ferson and Schadt (1996) developed a conditional version of the Treynor–Mazuy regression:

$$r_{pt+1} = a_p + b_p r_{mt+1} + \mathbf{C}_p'(\mathbf{Z}_t r_{mt+1}) + \gamma_{imc} [r_{m,t+1}]^2 + v_{pt+1}, \quad (10.6)$$

where the coefficient vector  $\mathbf{C}_p$  captures the linear response of the manager’s beta to the public information,  $\mathbf{Z}_t$ . The term  $\mathbf{C}_p'(\mathbf{Z}_t r_{mt+1})$  controls the public information effect, which would bias the coefficients in the original Treynor–Mazuy model. The coefficient  $\gamma_{imc}$  measures the sensitivity of the manager’s beta to the private market timing signal, purged of the effects of the public information.

Merton and Henriksson (1981) and Henriksson (1984) described an alternative model of market timing in which the quadratic term in Equation (10.5) is replaced by an option payoff,  $\max(0, r_{m,t+1})$ . This reflects the idea that market timers may be thought of as delivering (attractively priced) put options on the market index. Ferson and Schadt (1996) developed a conditional version of this model as well.

Becker et al. (1999) developed conditional market timing models with explicit performance benchmarks. In this case, managers maximize the utility of their portfolio returns in excess of a benchmark portfolio return. The model allows separate identification of the manager’s risk aversion and skill, as measured by the signal quality. Performance benchmarks often represent an important component of managers’ incentive systems, but they have been controversial, both in practice and in the academic literature. Starks (1987), Grinblatt and Titman (1989a,b), and Admati and Pfleiderer (1997) argue that benchmarks don’t properly align

managers' incentives with those of the investors in the fund. Carpenter et al. (2000) provide a theoretical justification of benchmarks, used in combination with investment restrictions.

#### 10.4. Conditional weight-based Performance Measures

Returns-based measures of performance compare the return earned by the fund with a benchmark return over the evaluation period. The benchmark is designed to control for risk, and it may also control for style, investment constraints, and other factors. The manager who performs better than the benchmark has a positive "alpha." In some situations, information on the manager's investment positions or portfolio weights is also available. In these situations, weight-based measures of performance are attractive. With weight-based measures the manager's choices are directly analyzed for evidence of superior ability. The idea is that a manager, who increases the fund's exposure to a security or asset class before it performs well, or who avoids "losers" ahead of time, is seen to add investment value.

Cornell (1979) was among the first to propose the usage of portfolio weights to measure the performance of trading strategies. Copeland and Mayers (1982) modify Cornell's measure and use it to analyze Value Line rankings. Grinblatt and Titman (1993) proposed a weight-based measure of mutual fund performance. A number of studies have used the Grinblatt and Titman measure, including Grinblatt and Titman (1989); Grinblatt et al. (1995); Zeng (1999); and Wermers (1997). These studies combine portfolio weights with unconditional moments of returns to measure performance.

Ferson and Khang (2002) consider conditioning information in weight-based measures of performance. The idea is similar to that of conditional, returns-based measures. Any predictive ability in a manager's portfolio weights that merely reflects the lagged, public information is not considered to represent superior ability. By using lagged instru-

ments and portfolio weight data, conditional weight-based measures should provide more precision in measuring performance.

The use of portfolio weights may be especially important in a conditional setting. When expected returns are time varying and managers trade between return observation dates, returns-based approaches are likely to be biased. Even conditional returns-based methods are affected. This bias, which Ferson and Khang call the "interim trading bias," can be avoided by using portfolio weights in a conditional setting.

The following stylized example illustrates the idea. Suppose that returns can only be measured over two periods, but a manager trades each period. The manager has neutral performance, but the portfolio weights for the second period can react to public information at the middle date. By assumption, merely reacting to public information does not require superior ability. You have to trade "smarter" than the general public to generate superior performance. If returns were independent over time there would be no interim trading bias, because there would be no information at the middle date about the second-period return.

Suppose that a terrorist event at the middle date increases market volatility in the second period, and the manager responds by shifting into cash at the middle date. If only two-period returns can be measured and evaluated, the manager's strategy would appear to have partially anticipated the higher volatility. For example, the fund's two-period market exposure would reflect some average of the before- and after-event positions. Measured from the beginning of the first period, the portfolio would appear to partially "time" the volatility increasing event because of the move into cash. A returns-based measure over the two periods will detect this as superior information.

In this example, since only two-period returns can be measured and evaluated, a Conditional Weight-based Measure (CWM) would examine the ability of the manager's choices at the beginning of the first period to predict the subsequent

two-period returns. To record abnormal ability under the CWM, the manager would have to anticipate the higher volatility and adjust the portfolio prior to the event. If the manager has no information beyond the public information, the CWM is zero. The ability of the manager to trade at the middle period thus creates no interim trading bias in a CWM.

The CWM is the conditional covariance between future returns and portfolio weights, summed across the asset holdings:

$$CWM = E\{\sum_j w_j(Z, S)[r_j - E(r_j|Z)]|Z\}. \quad (10.7)$$

The symbol  $w_j(Z, S)$  denotes the portfolio weight in asset  $j$  at the beginning of the period and  $r_j - E(r_j|Z)$  denotes the unexpected or abnormal excess return. The expectation is taken from the perspective of an investor, who only sees the public information  $Z$  at the beginning of the period. As viewed by an investor with this information, the sum of the conditional covariances between the weights, measured at the end of December, and the subsequent abnormal returns for the securities in the first quarter, is positive for a manager with superior information,  $S$ . If the manager has no superior information,  $S$ , then the covariance is zero.

It is important to recognize that weight-based measures do not avoid the issue of specifying a performance benchmark. For example, Equation (10.7) can also be written as

$$CWM = E\{\sum_j w_j(Z, S)r_j - \sum_j E(w_j(Z, S)|Z)r_j\}. \quad (10.8)$$

This shows that the measure is the expected difference between the portfolio return and the return of a portfolio that uses the weights that would have been expected on the basis of the public information. The latter portfolio may be interpreted as the benchmark.

In a portfolio with abnormal performance, the covariance between the weights and subsequent abnormal returns need not be positive for every security. Consider two securities, which are highly

correlated with each other. A manager with superior ability may buy one and sell the other as a result of hedging considerations. However, under certain assumptions the sum of the covariances across securities will be positive (Grinblatt and Titman, 1993).

Ferson and Khang (2002) introduce an explicit “external” benchmark with weights,  $w_{jb}(Z)$ , which are in the public information set  $Z$  at the beginning of the period. Their empirical measure is then:

$$CWM = E\{\sum_j [w_j(Z, S) - w_{jb}(Z)] [r_j - E(r_j|Z)]|Z\}. \quad (10.9)$$

Because  $w_b$  is assumed to be known given  $Z$ , it will not affect the conditional covariance in theory. However, in practice it is desirable to measure performance relative to an external benchmark. One reason is statistical: the weights  $w_j$  may be highly persistent over time, while the deviations from benchmark are better behaved. The benchmark also helps the interpretation. Equation (10.9) is the difference between the unexpected return of the fund and the unexpected return of the benchmark.

In Ferson and Khang, the benchmark at time  $t$  is formed from the actual lagged weights of the fund at  $t - k$ , updated using a buy-and-hold strategy. With the buy-and-hold benchmark, the measure examines the deviations between a manager’s weights and a strategy of no trading during the previous  $k$  periods. This takes the view that a manager with no information would follow a buy-and-hold strategy.

### 10.5. Empirical Evidence Using Conditional Performance Evaluation

There is a large body of empirical literature on the performance of mutual funds. Equity-style mutual funds have received the most attention. There are fewer studies of institutional funds such as pension funds, and a relatively small number of studies focus on fixed-income-style funds. Research on the performance of hedge funds has been accumulating rapidly over the past few years.

Traditional measures of the average abnormal performance of mutual funds, like Jensen's alpha, are found to be negative more often than positive across many studies. For example, Jensen (1968) concluded that a typical fund has neutral performance, only after adding back expenses. Traditional measures of market timing often find that any significant market timing ability is perversely "negative," suggesting that investors could time the market by doing the opposite of a typical fund. Such results make little economic sense, which suggests that they may be spurious.

The first conditional performance evaluation studies, by Chen and Knez (1996), Ferson and Schadt (1996), and Ferson and Warther (1996) found that conditioning on the state of the economy is both statistically and economically significant for measuring investment performance. Ferson and Schadt (1996) find that funds' risk exposures change in response to public information on the economy, such as the levels of interest rates and dividend yields. Using conditional models, Ferson and Schadt (1996), Kryzanowski et al. (1997), Xeng (1999), Becker et al. (1999), and Mamaysky et al. (2003) find that the distribution of mutual fund alphas shifts to the right, and is centered near zero. Farnsworth et al. (2002) use a variety of conditional SDF models to evaluate performance in a monthly sample of U.S. equity mutual funds, using a simulation approach to control for model biases. They find that the conditional performance of the average mutual fund is no worse than a hypothetical random stock-picking fund.

Ferson and Warther (1996) attribute differences between unconditional and conditional alphas to predictable flows of public money into funds. Inflows are correlated with reduced market exposure, at times when the public expects high returns, due to larger cash holdings in response to inflows at such times. In pension funds, which are not subject to high-frequency flows of public money, no overall shift in the distribution of fund alphas is found when moving to conditional models (Christopherson et al., 1998). A similar result is found for hedge

funds, which often use lockup periods and notification periods to control the flows of funds (e.g. Kazemi, 2003).

Henricksson (1984), Chang and Lewellen (1984), Grinblatt and Titman (1989a), Cumby and Glen (1990), Ferson and Schadt (1996), and others estimated unconditional models to assess market timing ability for equity mutual funds. They find a tendency for negative estimates of the timing coefficients. Ferson and Schadt (1996) found that this result does not occur in conditional models. Becker et al. (1999) simultaneously estimate the fund managers' risk aversion for tracking error and the precision of the market timing signal, in a sample of more than 400 U.S. mutual funds for 1976–1994, including a subsample with explicit asset allocation objectives. The estimates suggest that U.S. equity mutual funds behave as risk averse benchmark investors, but little evidence of conditional timing ability is found. Chen (2003) finds a similar result in a sample of hedge funds, using a variety of market indexes. Jiang (2003) presents a nonparametric test of mutual fund timing ability, and again finds no evidence of ability after the effect of lagged public information variables is accounted for. Thus, controlling for public information variables, there seems to be little evidence that mutual funds have conditional timing ability for the level of the market return.

Busse (1999) asks whether fund returns contain information about market volatility. He finds evidence using daily data that funds may shift their market exposures in response to changes in second moments. Laplante (2003) presents a model of market timing funds that accommodates timing in response to signals about both the first and second moments of return. Given the prevalence of market timing funds and the dearth of evidence that such funds can time the first moments of returns, further research on the higher moments is clearly warranted.

Ferson and Khang (2002) study the conditional weight-based approach to measuring performance. Using a sample of equity pension fund managers (1985–1994), they find that the traditional returns-

based alphas of the funds are positive, consistent with previous studies of pension fund performance. However, these alphas are smaller than the potential effects of interim trading bias. The conditional weight-based measures indicate that the pension funds have neutral performance.

In summary, conditional performance measures are superior to traditional measures, both on theoretical and statistical grounds. Conditional measures eliminate the perverse, negative timing coefficients often observed with unconditional measures, and in some cases are found to deliver more precise performance measures. Overall, the empirical evidence based on conditional performance measures suggests that abnormal fund performance, after controlling for public information, is rare.

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