First Chicago
January 1994

An Introduction to Conditional Asset Allocation

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1. Introduction

- The most important components in any asset allocation strategy are the forecasts of the asset returns.

- That is, mistakes in the expected returns inputs will have a much larger impact that mistakes in the risk inputs.

- Hence, it is critical to get the best possible forecasting methodology for the asset returns.

- Of course, the decision to allocate must be made on the basis of understanding both the conditionally (forecasted) expected returns and the conditional risk.
1. Introduction

**Goals of Presentation:**

1. To assess the predictability of U.S. and international equity and fixed income returns.

2. To explore how this predictability can be translated into a simple conditional asset allocation strategy.

3. To compare the performance of conditional strategies with traditional ones.
• For many years, it was believed that stock prices followed random walks.

• With the random walk model, the best prediction of the next period's stock price is today's price plus a "drift" term.

• The "drift" is just the average return over the history.

• This model implies that stock returns are completely unpredictable.

• Recent research has shown that stock and bond returns are indeed predictable. However, the degree of predictability is limited.
The Intuition Behind Predictability

If you were asked to forecast next year's real GDP growth, it unlikely that you would give the average GDP growth over the past 20 years – or even the average growth over the past 5 years.

Your forecast of real GDP growth would be conditioned on important economic information that is available today.

Similarly, if you were asked to forecast next year's stock return, why use the average return over 5 years?

Your forecast of the stock return for next year should be conditioned on the key economic and financial information available today.
When a fund manager allocates on the basis of average returns over the past, say five years, I refer to this as **unconditional** asset allocation.

This type of forecasting is consistent with the random walk model.

The forecasts are **unconditional** because they ignore the important information available today. That is, the forecasts are just an average of past returns – they are not conditioned on the information that investors are using today to set prices.

By ignoring important information today (or not using the information in an optimal way), the manager fails to achieve the best conditionally expected return-risk profile.
The Economics of Predictability

Consider the fundamental valuation model:

\[ P_t = \frac{E_t[\text{div}_{t+1}]}{E_t[k_{t:t+1}]} + \frac{E_t[\text{div}_{t+2}]}{E_t[k_{t:t+2}]} + \ldots \]

Our goal is to forecast the change in price: \( P_t \) to \( P_{t+1} \).

To take the stand that the return is unpredictable implies:

1. No ability to forecast the economy and how it influences a particular security’s cash flows.

2. No ability to forecast the economy’s impact on the risk of the security.

3. No ability to forecast economy-wide rewards for risk.

Most now agree that at least one of these items is predictable.

⇒ The key is translating this potentially small degree of predictability into successful asset allocation.
A Simple Example:

Consider a U.S. fund manager that chooses to allocate into two portfolios: the S&P 500 and money market instruments (T-bill).

We will examine three strategies:

1. Unconditional asset allocation with average risk aversion.
2. Unconditional asset allocation with higher than average risk aversion.
3. Conditional asset allocation with average risk aversion.

Each of these strategies will produce a different allocation. They will be tracked over the January 1970–September 1991 period.

This is a ‘simple’ example because only two asset classes are considered.
2. Predictability

Strategy 1: (Buy-hold)

This strategy implies a buy and hold equities portfolio. Unconditionally, the average equity return is much higher than the average money market return. Hence, a manager with average risk aversion will hold 100% equities.

Strategy 2: (90/10)

This strategy also implies a buy and hold portfolio. However, to lower the risk of the portfolio, the manager holds a combination of money market and equities. For our example, we will assume a 90% equity and 10% money market composition.

Strategy 3: (Conditional)

This strategy will likely produce a portfolio that switches among the two asset classes depending upon the forecasts of the equity returns.
If the forecasted equity returns are always above the money market rate, the Strategy 3 will be identical to Strategy 1.

*It is in this sense that the Unconditional Asset Allocation is a special case of the Conditional Asset Allocation. The strategies will be identical when it is impossible to accurately forecast the equity returns.*
The Details of Strategy 3:

A linear regression is used to forecast the S&P 500 return.

The regression equation is:

\[ \text{SPRET}_t = \alpha_0 + \alpha_1 \text{BILL}_{t-1} + \alpha_2 \text{SPDIV}_{t-1} + \alpha_3 \text{3-1BILL}_{t-1} + \alpha_4 \text{Baa-Aaa}_{t-1} + \varepsilon_t \]

where

1BILL = Yield on one month U.S. Treasury Bill,
SPDIV = Annual dividend yield on S&P 500 stock index,
3-1BILL = Return spread on 3 and 1 month U.S. T-bills,
Baa-Aaa = Yield spread on U.S. Baa and Aaa rated bonds,
\( \varepsilon \) = Regression error (unexpected part of the return).

Notice that this is a forecasting equation. The conditioning information (1BILL, SPDIV, 3-1BILL and Baa-Aaa) are available at time \( t - 1 \).

These variables are used to forecast the next period returns for time \( t \).
Implementing Strategy 3:

If this equation is estimated with monthly data over the 1947:2–1991:9 period, the $R^2$ is 6.9%.

The R-square measures the precision of our predictions.

- An $R^2=100\%$ means our predictions are perfect.
- An $R^2=0\%$ implies our predictions are equal to $\alpha_0$ – which is just the average equity return.

An $R^2$ of zero, implies that the unconditional strategy (Strategy 1 – buy and hold) is the best.

Hence, the worst case scenario for our forecasting model implies the unconditional asset allocation strategy.
Implementing Strategy 3:

Although the $R^2$ is low, it is best to evaluate our forecasting model using dollars rather than statistical measures.

It is important to produce out-of-sample forecasts.

**METHOD**

1. Estimate coefficients using returns data through the end of December 1969 (and information variables through November 1969).

2. Apply coefficients to the information variables known at the end of December 1969 and calculate a forecast of the stock return for January 1970. Trade based on the forecasted return.


4. Use new coefficient and information variables known at the end of January 1970 to form the forecasted return for February 1970.

5. Repeat this procedure every month.
2. Predictability

The Trades:

⇒ If forecasted equity return is greater than money market rate, enter the equity market with 100% allocation.

⇒ If forecasted equity return is less than the money market rate but greater than zero, then enter the money market with a 100% allocation.

⇒ If forecasted equity return is less than zero, then short equities with -100% weight. Assume that 50% noninterest bearing margin is required.

Evaluate position at the end of each month.
2. Predictability

Evaluation:

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Strategy 1 Buy-Hold</th>
<th>Strategy 2 90/10</th>
<th>Strategy 3 Conditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total profit</td>
<td>233.87%</td>
<td>226.40%</td>
<td>346.58%</td>
</tr>
<tr>
<td>Monthly profit</td>
<td>0.90%</td>
<td>0.86%</td>
<td>1.33%</td>
</tr>
<tr>
<td>Monthly std. dev.</td>
<td>4.68%</td>
<td>4.21%</td>
<td>4.10%</td>
</tr>
<tr>
<td>Annual profit</td>
<td>10.76%</td>
<td>10.41%</td>
<td>15.94%</td>
</tr>
<tr>
<td>Annual std. dev.</td>
<td>16.22%</td>
<td>14.59%</td>
<td>14.21%</td>
</tr>
</tbody>
</table>
2. Predictability

- Conditional strategy greatly enhances returns and lowers overall risk.

- The benefits are impressive given the fairly low $R^2$.

- The proportion of correct market entries is 61.5%.

- The proportion of correct market exits is 53.8%.

- Return enhancement would not be eliminated by reasonable transactions costs.

- Potential for even higher returns if filter is applied to forecast. I.e., if forecasted equity return is trivially above the T-bill rate do not enter the equity market.

- My empirical work clearly documents predictability in U.S. and International stock and bond markets and, especially, in new emerging stock markets.
Predictability of U.S. Portfolio Returns from Ferson and Harvey (1991)
Figure 2

Predictability of Country Equity Returns from Harvey (1991)

Adj. $R^2$

Country:
- AUI
- Aus
- Bel
- Can
- Den
- Fra
- Ger
- HK
- It
- Jap
- Net
- Nor
- S/M
- Sp
- Swe
- Swi
- UK
- US
- Wrld

Adjusted R-Square
2. Predictability

Figure 3

Predictability of World Industry Returns from Harvey, Solnik and Zhou (1992)

Adj. $R^2$

Industry

- Adjusted R-Square
2. Predictability

Figure 4

Predictability of World Bond Returns
from Harvey, Solnik and Zhou (1992)

Adj. $R^2$

Canada  France  Germany  Japan  Neth.  Switz.  U.K.  U.S.
Bond

Adjusted $R$-Square
2. Predictability

Figure 5

Predictability of Emerging Returns

<table>
<thead>
<tr>
<th>Country</th>
<th>Common Information</th>
<th>Local Information</th>
</tr>
</thead>
</table>

U.S. $ Returns, Full Sample
Why does this allocation strategy work?

- When new assets are added to a mean-variance optimizer, the frontier shifts to the left.

- Traditional mean-variance analysis gives us portfolio weights that will put us on the efficient frontier.
  
  - However, weights based on knowledge of returns over, say five years.
  
  - Weights are fixed throughout the sample.
  
  - Unlikely a portfolio manager will hold fixed weights.

- Traditional analysis delivers a set of efficient portfolios among all fixed weight strategies.
Predictability implies portfolio strategies with time-varying weights.

- Information available at time $t - 1$ may cause managers to change allocation weights.

- "Trading strategies" based on the information variables are like "new assets."

- When the trading strategies are added to the allocation, the frontier shifts to the left.
Fama and French (1992) find "no relation between beta and expected return."

Does this mean the CAPM is dead?

- No, it means that the benchmark portfolio they used was inefficient.

- If the benchmark was efficient, the CAPM would have held with 100% $R^2$!
What does this mean for portfolio managers?

- It means that for the same level of beta risk, there is a wide range of expected returns.

- Actually, a portfolio manager *prefers* to be benchmarked to an inefficient portfolio – it is easier to beat.

- Manager can maximize alpha by maximizing portfolio expected return for some level of market beta.

- Optimizer picks the best portfolio among all portfolios with a particular market beta.
It makes more sense to look at multiple sources of risk.

- When sources of risk are traded assets, it is likely that a portfolio of these sources (including the market portfolio) is more efficient than any single source of risk.

What is the portfolio strategy?

- Example. Suppose you are constrained to have unit S&P 500 beta.
  
  - Estimate loading of S&P 500 on, say, 3 additional sources of risk.

  - Optimize, with four additional constraints. Set portfolio S&P 500 beta equal to one. Double the exposures on the other sources of risk.

  - The expected returns are much higher on this strategy.

  - This is (roughly) what Roll and Ross Asset Management does.
5. Sources of Predictability

It is critical to understand the sources of predictability in asset returns for successful asset allocation.

So far, I have talked about allocation among classes (or portfolios) of assets.

These portfolio returns are predictable.

It is more difficult to forecast individual asset returns.

⇒ When we understand the sources of predictability, we can use these insights to forecast the returns on any asset.

⇒ Asset pricing theory provides a framework to evaluate the sources of predictability.
5. Sources of Predictability

*The Main Idea:*

The theory restricts an asset's conditionally expected returns to be a linear function of the asset's risk.

All assets' risk exposures are rewarded by *economy-wide risk premiums*.

If the pricing model provides a reasonable description, then predictable variation in the expected returns should be driven by:

- variation in the *risk exposures* and/or
- variation of the economic *risk premiums*. 

THE MODEL:

\[ E[R_{it} | Z_{t-1}] = \lambda_0(Z_{t-1}) + \sum_{j=1}^{k} \beta_{ij,t-1} \left( \underbrace{\lambda_j(Z_{t-1})}_{\text{Risk Exposures}} \right), \]

Where:

- \( E[R_{it} | Z_{t-1}] \) = expected return on asset \( i \),
- \( Z_{t-1} \) = available information,
- \( \beta_{ij,t-1} \) = the conditional betas,
- \( \lambda_j(Z_{t-1}) \) = the economic risk premiums.

In this model, there are \( k \) sources of risk.
I will concentrate on the results presented in Ferson and Harvey (1991). Here we only examine U.S. returns. We have a new paper which deals with international returns.

We prespecify six sources of risk:

1. Market risk
   The value weighted excess return on the NYSE

2. Business-cycle risk
   Growth in nondurable consumption expenditures

3. Default risk
   Junk bond return spread

4. Inflation risk
   Unexpected inflation

5. Real interest rate risk
   Real Treasury bill return

6. Yield curve risk
   Change in long to short yield spread
5. Sources of Predictability

Investors use $Z_{t-1}$ to forecast returns:

1. XEW: Lagged equally weighted CRSP NYSE index
2. 3-1BILL: Lagged excess return on a 3 month Treasury bill
3. Baa-Aaa: Lagged junk yield spread
4. SPDIV: Lagged dividend yield on S&P 500
5. 1BILL: Nominal, 1 month Treasury bill

The U.S. asset returns are:

- 10 value weighted size portfolios
- 12 value weighted industry portfolios
- 3 fixed income portfolios
Expected risk premiums change through time

For example, the expected premium associated with the market return exhibits distinct patterns.

- In recessions, expected premiums are very high.
- In recovery, expected premiums are lower.

Figure 6

Fitted Values from a Regression of the Risk Premia (Univariate Model) Value Weighted Market (XVW) on the Instrumental Variables January (Dash) Rest of the Year (Line)
5. Sources of Predictability

Decomposing Predictable Variation

The asset pricing model provides a decomposition of the predictable variation in asset returns.

\[ r_{it} = \left\{ \sum_{j=1}^{k} \beta_{i,j,t-1} \lambda_{jt} \right\} + \left\{ \lambda_{0t} + \epsilon_{it} \right\} \]

- The first term is related to the cross sectional structure of risk.
- The second term is a residual that should be unpredictable.
Decomposing Predictable Variation

A variance ratio can be formed:

\[
\frac{\text{Variance [Expected (Captured by Model)]}}{\text{Variance [Expected (Returns)]}}
\]

If the model is capturing all of the predictability, then this ratio should be equal to 1.0.

The ratio can be compared to:

\[
\frac{\text{Variance [Expected (Unexplained by Model)]}}{\text{Variance [Expected (Returns)]}}
\]

If the model is capturing all of the predictability, then this ratio should be equal to 0.0.
Figure 7

Decomposing the Predictability of U.S. Monthly Portfolio Returns from Ferson and Harvey (1991)

% of predictable variance

Industries  Size Deciles  Bonds

Unexplained  Captured by Model  Predictable Variance
The Forces that Determine Predictability

We can isolate the amount of variance that each source of risk contributes:

\[
\frac{\text{Variance} \left[ \text{Expected} \left( \text{Exposure}_{ij} \times \text{Premium}_j \right) \right]}{\text{Variance} \left[ \text{Expected} \left( \text{Returns}_i \right) \right]}
\]

There will be a variance ratio for each \( (j) \) source of risk and for each asset \( (i) \).
Contribution of Various Risk Factors to the Predictability of Portfolio Returns from Ferson and Harvey (1991)
Risk Premium vs. Risk Exposure

The variance ratios do not tell us whether time-varying expected risk premiums or time-varying risk exposures are driving the predictable variation.

A further decomposition is suggested for each portfolio:

\[
\text{Variance}[E(\text{Returns Captured by Model})] = \\
E(\text{Exposure})^2 \text{Variance}[E(\text{Premium})] \\
+ E(\text{Premium})^2 \text{Variance}[E(\text{Exposure})] \\
+ \text{interaction terms}
\]

The interaction terms arise because of covariance between the time-varying risk premiums and exposures.
Figure 9

Decomposing the Predictability of U.S. Portfolio Returns Captured by APT from Ferson and Harvey (1991)

Predictable Variance

Size Deciles
- Interaction effect
- Changing premiums

Industries
- Changing betas

Bonds
- Predicted by model
• The changing structure of risk explains most of the predictable variation in asset returns.

• Both risk exposures and economic risk premiums exhibit significant time variation.

• Economic risk premiums vary with the business cycle.

• Variation in economic risk premiums accounts for more of the predictable variation in asset returns than variation in risk exposures.
7. Implications for asset management

- Calculate the conditional risk exposures of individual assets.

- With careful analysis and forecasting of the economy-wide risk premiums, we can identify the assets that have maximum yield possibilities.

- Optimize. Instead of just naively doubling up on non-market risk, allocate to those assets with high exposures to factors whose premiums are expected to be high.

- Expected performance dominates unconditional strategies in that the lower bound or worst case scenario (no predictability) implies the unconditional allocation.