#2 - 2012

NBIM DISCUSSION NOTE

This paper was part of the NBIM memo "On rebalancing" (February 2012)

Return Predictability and Implications for Rebalancing

30/03/2012

We review the academic literature on the empirical phenomenon of return predictability and discuss its implications for the rebalancing policy of long-term investors.

Main findings

- Many institutional investors fix the strategic weights of asset classes in their portfolios and frequently rebalance back to those fixed weights.
- Samuelson (1969) shows that this is the optimal dynamic investment policy when certain restrictive assumptions are met, in particular when asset returns are identically and independently distributed random variables. In other words, it is the optimal policy when expected returns are constant over time, but essentially unpredictable.
- However, the more recent academic literature indicates that return predictability is present across different asset classes. In the presence of predictability, rebalancing back to the fixed strategic weight is no longer optimal.
- Long-term investors are likely to benefit from rebalancing to weights that take into account the time variation in risk premia, i.e. by increasing exposure to risky assets when premia are perceived to be high and reducing them when they are low.
- Predictability is most likely related to discount rate variation (and hence risk premia). The risk premium view of predictability is supported by the observation that predictable variations in market returns are often related to the macroeconomic cycle.
- Imposing economic structure on predictive relationships or using non-parametric approaches may yield more robust predictions with better out-of-sample power.

Introduction

The literature on dynamic asset allocation was greatly influenced by the seminal paper of Samuelson (1969). He derives the conditions under which the optimal investment strategy is independent of wealth and constant over time, namely when asset returns are i.i.d. (independently and identically distributed), the utility function is CRRA (exhibits constant relative risk aversion), only investment income is considered, and there are no transaction costs. In this frictionless world with constant risk premia, investors continuously rebalance to a static optimal allocation. Many institutional investors, including the Government Pension Fund Global, are guided explicitly or implicitly by the work of Samuelson when they determine a strategic asset allocation with fixed asset class weights and frequently rebalance to those strategic weights.

However, the extensive literature on return predictability casts doubt on this prescription. Return predictability is one of the most-researched and controversially debated empirical questions in financial economics. Up until the early 1980s, the academic consensus was that stock and bond returns were largely unpredictable. Informational market efficiency, the belief that asset prices incorporate new information immediately and opportunities for making risk-adjusted profits vanish swiftly, had been supported by empirical evidence thus far. In subsequent studies starting in the 1980s, researchers began to question the "no predictability" paradigm. Shiller (1981) and Summers (1986) are early proponents of predictability in stock markets. Instead of forecasting changes in fundamentals, such as earnings and dividends, equity prices appear to contain information about future returns. The initial findings of predictability were interpreted as indications of market inefficiency.

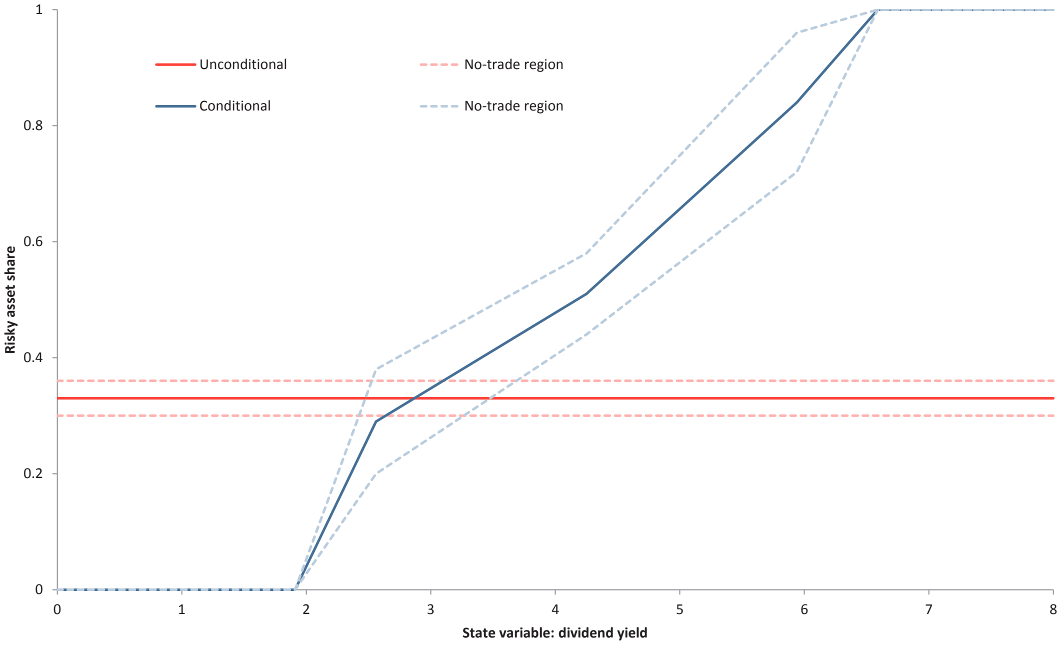
However, Fama and French (1988a, 1989) propose an alternative rationale for predictability that would be consistent with informational market efficiency. They hypothesise that return predictability is a manifestation of time variation in the rates at which future cash flows are discounted. Discount rates can also be interpreted as "required" or "expected" rates of return. More recent general equilibrium models provide some theoretical support for this economic framework of discount rate variation. Such time variation can be a consequence of changing risk aversion (Campbell and Cochrane 1999), long-term consumption risk (Bansal and Yaron 2004) or evolving risk-sharing opportunities.

The presence of time variation in risk premia raises the question of whether asset allocation should be varied over time based on predictive relationships. A rich literature has studied the economic significance of time-varying risk premia for long-term investors, especially in the face of transaction costs and estimation risk. Brennan, Schwartz and Lagnado (1997) and Campbell and Viceira (1999) examine the optimal portfolio decision of long-term investors when the equity risk premium is mean-reverting (i.e. predictable).

With regard to dynamic asset allocation and rebalancing, the following conclusion emerges from these two papers, and is reproduced in later studies: Investors should invest more in equities when expected returns are high (for example when dividend yields are high) and less when they are low, i.e. they should try to time the market. Failure to time can cause large welfare losses relative to the optimal policy.

In the context of comparing a regime of rebalancing to constant weights with a more dynamic approach, turnover and transaction costs should be taken into account. Balduzzi and Lynch (1999) and Lynch and Balduzzi (2000) explicitly incorporate transaction costs into their analysis of the dynamic portfolio choice of a long-lived investor without labour income when returns are predictable. They find that the results obtained by Brennan, Schwartz and Lagnado (1997) and later contributions continue to hold in the presence of realistic transaction costs. In particular, predictability causes the risky asset share to be a function of relevant state variables, for example the dividend yield. This can be seen from Chart 1, which plots the optimal allocation to equities including the no-trade region against the dividend yield.

Chart 1: Optimal allocation (Balduzzi and Lynch, 1999)



Source: Balduzzi and Lynch (1999)

The chart shows two cases: an investor who believes that the expected return is always equal to the unconditional mean (denoted by "unconditional") and an investor who takes into account the observed predictability (denoted by "conditional"). The unconditional investor's optimal decision is to keep the equity share constant and rebalance when it goes outside the no-trade zone. The conditional investor's optimal allocation rises with the dividend yield. While transaction costs cause the no-trade range to widen around their mid-point, the investor rebalances more frequently than in the absence of predictability because the optimal risky asset share fluctuates over time. Lynch and Balduzzi also find that behaving myopically (acting short-term when the true investment horizon is long), ignoring transaction costs and ignoring predictability cause substantial losses in investor utility.

In conclusion, the literature on dynamic asset allocation in the presence of predictability suggests that a constant asset allocation with rebalancing around fixed weights is not optimal.

Before acting on this result, it is important to study the historically observed degree of predictability in various asset markets and assess whether it is likely to persist. Therefore, we survey the literature on return predictability and time-varying risk premia. While the economic rationale for the observed predictability is important, we focus on the *empirical* phenomenon. In section 2 of this note, we review the academic work on the predictability of equity returns and the equity risk premium. Subsequently, we conduct a similar exercise for predictability in fixed-income and currency markets. In section 4, we review how practitioners apply the insights from the academic literature in building forecasting models. We conclude by discussing the implications of return predictability for the rebalancing policy of long-term investors.

Predictability of equity returns

The equity risk premium is arguably one of the most important variables in finance and a central input into long-term investment decisions. It is defined as the additional return investors demand to hold equities (or more precisely, a market-weighted portfolio of all equities outstanding) compared to risk-free securities, usually three-month Treasury bills. Not surprisingly, the academic finance literature has a long tradition of investigating the time series predictability of stock returns, using several different approaches.

The first methodology, employed in Rozeff (1984), Fama and French (1988a), and Campbell and Shiller (1989), tests for the predictive power of the dividend yield (and related valuation ratios such as the earnings yield) for subsequent equity returns. In the early 1990s, seminal papers by Campbell (1991) and Cochrane (1992) argue that dividend yield variation could mainly be attributed to time-varying risk premia rather than changes in expected cash flow growth or expected future risk-free rates. In other words, dividend yields are predictive of prospective excess returns. Furthermore, predictability increases with the time horizon.

In the second approach, Fama and French (1988b) argue that the time series properties of stock returns contain information about forecastability. They find substantial negative autocorrelations in equity returns for holding periods beyond a year, consistent with the notion that mean-reverting price components are important in the variation of returns.

The third, and more indirect sign of predictability, is the so-called "excess volatility" phenomenon studied by LeRoy and Porter (1981) and Shiller (1981), who contend that equity returns are too volatile to be accounted for by changes in expected future dividend growth.

Fama (1991) argues that the aforementioned evidence of return predictability cannot necessarily be interpreted as being indicative of market inefficiency. Time series tests of predictability are unable to distinguish irrational bubbles from rational time-varying expected returns. Fama and French (1989) suggest that if variation in expected returns is common to different asset classes, it may be a rational result of discount rate variation rather than market inefficiency. To support their argument, they show that the dividend yield on US stocks helps to predict returns on corporate bonds as well as equities. Reversing the predictability relationship, they also demonstrate that two indicators of fixed-income risk, the spread between Baa and Aaa corporate bonds and the term premium between long- and short-term Treasury securities, are useful in forecasting returns on equities. Such commonality in expected returns appears to extend to international markets. Harvey (1991) finds that the dividend yield and term-structure variables in the US help to predict the returns of foreign equities.

In search of an economic interpretation of time-varying risk premia, Lettau and Ludvigson (2001) examine the aggregate consumption-wealth ratio (CAY) as a predictor of equity returns. They find that the consumption-wealth ratio forecasts real and excess returns of US stocks over the short and medium term better than standard financial ratios. They regard the ratio of consumption to aggregate wealth (including human capital and financial assets) as an indicator for agents' expectations of returns to aggregate wealth, which is consistent with models of optimal consumer behaviour. Their findings can be interpreted as further supportive evidence of an efficient-markets explanation of return predictability.

Critique and defence of time series predictability

Despite the intuitive appeal of rational time variation in expected returns and discount rates, predictability as an empirical phenomenon was questioned forcefully. The conventional wisdom of economically meaningful predictability was challenged on econometric grounds and for poor *out-of-sample* power.

One criticism was one of data snooping, raised for example by Lo and MacKinlay (1990) and Foster, Smith and Whaley (1997), who point out that the extent of predictability is not surprising given a large number of candidate explanatory variables.

The second challenge is based on the econometric critique of predictive regressions raised by Nelson and Kim (1993), Stambaugh (1999), Lanne (2002) and Ferson, Sarkissian and Simin (2003). Nelson and Kim (1993) argue that the small samples used in predictability studies render conventional inference using t-tests misleading. Stambaugh (1999) shows how the persistence of predictive variables makes researchers overestimate the statistical significance of return predictability. When the dividend-price ratio is used as a predictor for US stock returns, Stambaugh finds that the true probability of the no-predictability hypothesis based on exact finite-sample distributions is 15 percent rather than the much lower levels found in other studies. Lanne (2002), Ferson, Sarkissian and Simin (2003) and Boudoukh, Richardson and Whitelaw (2008) suggest that data-mining and the use of highly persistent predictor variables combine to raise the likelihood of spurious predictability relationships.

A distinct econometric challenge arises from using overlapping observations in direct regressions with long horizons. For example, when the forecast period is *n* years and data is observed on a monthly basis, the return over *n* years at time *t* overlaps with all of the return in *t-1* bar one month. Valkanov (2003) shows that conventional statistical inference can be misleading when employing overlapping return data in long-horizon regressions. The t-statistics may not converge to well-defined distributions and the R^2 is an inadequate measure of the goodness of fit.

The third challenge is related to the poor out-of-sample predictive power of many commonly employed explanatory variables such as the dividend or the earnings yield in univariate regressions and was forcefully made by Welch and Goyal (2008). In a thorough re-examination of a large set of variables suggested by the literature they find that some regressors that previously performed well in-sample turn out to be poor predictors with newer data. In addition, the out-of-sample performance of nearly all considered variables – which include dividend and earnings yield, book-to-market, equity issuance and the consumption-to-wealth ratio – is no better than the sample mean of equity excess returns. Intuitively, this may be explained by the tendency of unrestricted regressions to fit the "noise" rather than the fundamental relationships in relatively small samples, which leads to over-fitting and instability of estimated coefficients.

A similar critique of the predictability evidence was made by Malkiel (2004), who doubts whether the predictability that is detected in-sample can actually be used to make portfolio decisions in real time. In a similar argument, Cooper, Gutierrez and Marcum (2005) suggest that the difference between ex-post and ex-ante predictability is substantial. Based on a recursive out-of-sample implementation of common predictive relationships, they show that predictability claims may be exaggerated.

These challenges were met with improvements in the forecasting and inference methodology. In response to the econometric critique, several researchers explicitly account and correct for the persistence problem and show that the forecastability of stock returns is restored. For example, Lewellen (2004), Campbell and Yogo (2006) and Polk, Thompson and Vuolteenaho (2006) all propose different methods whereby the econometric problems with biased t-statistics in predictive regressions could be addressed. Furthermore, there are ways to correct for overlapping returns data, for example the rescaled t-statistic put forward in Valkanov (2003). Another means of dealing with overlapping data is to avoid using it altogether by employing vector autoregressions (VARs). By so doing, researchers can infer the long-horizon R^2 measures from multi-step forecasts of the VAR rather than estimating the long-horizon regression directly. This approach has been taken by Campbell and Shiller (1989), Campbell (1991) and Hodrick (1992), among others.

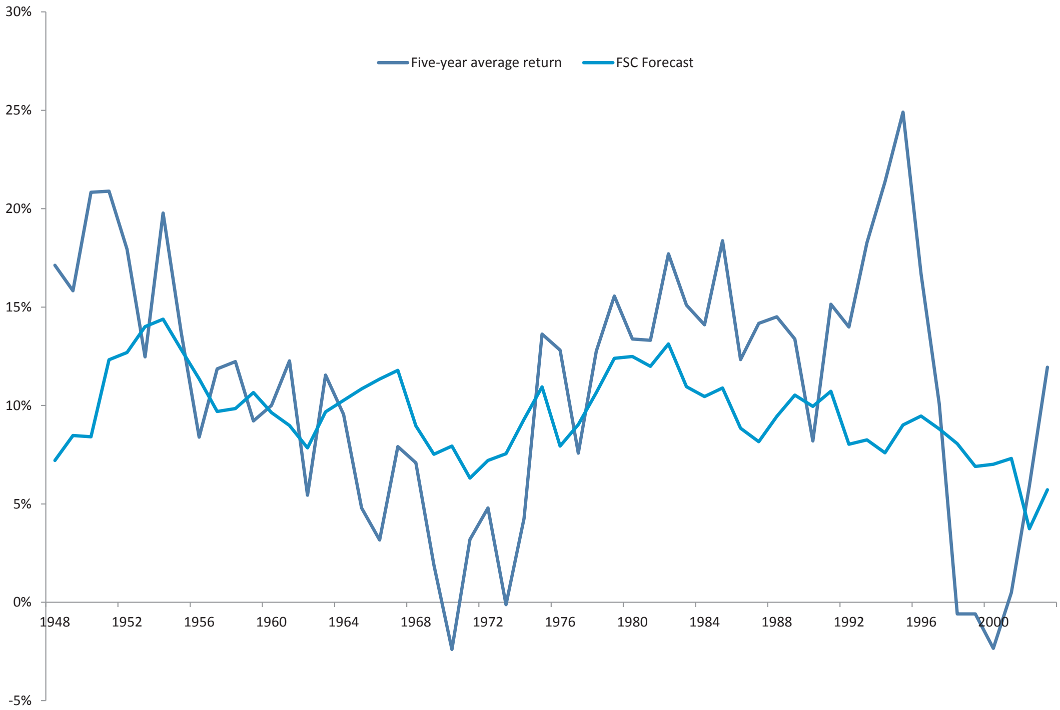
The other line of innovation involves imposing economic structure on predictive regressions to enhance out-of-sample predictability, an approach that has often worked well in empirical economics. The work by Campbell and Thompson (2008) is a case in point. By imposing restrictions on the sign of coefficients and return forecasts, they show that many predictive regressions can outperform the sample mean return. Intuitively speaking, an unrestricted regression estimated over a short sample period can easily generate a coefficient that is opposite in sign to what theory would suggest. Restricting coefficients is a way of preventing the regression from generating counterintuitive results. Importantly, restricted regressions produce a small, but economically meaningful incremental improvement in explanatory power, which can be further improved on by imposing the restrictions of steady-state valuation models. In a similar vein, Ferreira and Santa-Clara (2011) present their so-called "sum-of-the-parts approach" (SOP) which can be shown to be equivalent to a restricted predictive regression. The idea of the SOP approach is to forecast separately the three components of stock market returns, i.e. P/E multiple growth, earnings growth and the dividend yield. In the simplest version of the SOP model for the S&P 500, Ferreira and Santa-Clara set P/E multiple growth to zero, use the current dividend-to-price ratio as an estimate for the dividend yield and a 20-year moving average of historical earnings as a predictor for earnings growth. Thus, the SOP approach in its simplest version is equivalent to running a restricted predictive regression of the form:

$$r_{e,t+1} = \alpha + \beta \log \frac{D_t}{P_t} + \epsilon_{t+1}$$

where r_e is the real return of equities, D_t/P_t is the dividend/price ratio, α is the 20-year moving average of earnings growth, and $\beta = 1$.

Despite this exceedingly simple specification, the out-of-sample performance of the model is notable. In Chart 2, the forecast of the simplest SOP model due to Ferreira and Santa-Clara (FSC) is plotted against the subsequent five-year average realised return of the S&P 500. Visual inspection suggests that the FSC predictor co-moves with actual returns. Ferreira and Santa-Clara compute R-squares that compare the predictive power of their SOP with the historical mean return, which corroborates the visual impression. For the simplest version, they report R^2 (over and above the mean return) of 1.3 percent with monthly data and 13.4 percent with yearly data, which translates into a Sharpe ratio gain of 0.3 if implemented as a market-timing strategy. Based on this evidence, Ferreira and Santa-Clara conclude *"that there is substantial predictability in stock returns and that it would have been possible to profitably time the market in real time."*

Chart 2: Ferreira/Santa-Clara forecast versus five-year realised market return of S&P 500



Source: Ferreira and Santa-Clara (2011)

The robustness of this result for the US is tested by studying different subsamples and international data. With regard to the latter, the SOP method interestingly yields stronger predictability for the UK and Japan than for the US. In other studies using international data, Hjalmarsson (2010) tests the predictive power of four common forecasting variables (the dividend and earnings yield, the short interest rate, and the term spread) in 24 developed and 16 emerging economies. He finds that the short interest rate and the term spread are more robust predictors of stock returns in developed markets than either the earnings or the dividend yield.

Our review of the academic literature suggests that real equity returns and equity excess returns are somewhat predictable, especially when economic structure is imposed on the predictive regressions. Statistical inference of the magnitude of predictability is difficult due to the persistence of many regressor variables and needs to be conducted with great care.

An additional complication arises from structural breaks in the forecasting relationships and the economy. Boudoukh et al. (2007) suggest that the dividend yield became less informative about stock returns because US companies started using share repurchases as a way of returning cash to shareholders instead of paying dividends. This has led to a secular decline in the dividend yield since the early 1980s. They find that the predictive power of various payout yield measures that incorporate gross or net share buybacks is better than that of the dividend yield. It is debatable whether investors would have been able to identify the shift in dividend policy, and the associated loss of predictive power in the dividend yield, in real time.

Similarly, Lettau and Van Nieuwerburgh (2008) show that the poor out-of-sample record of predictive regressions may be attributed to structural shifts in the steady-state mean of the economy. While there are ways of adjusting predictive financial ratios for such shifts and the in-sample predictive performance of such adjusted ratios is impressive, it is less clear whether such modifications can be made in real time. Lettau and Van Nieuwerburgh (2008) suggest that the uncertainty over the size of structural shifts in particular makes it difficult to take advantage of predictive relationships out-of-sample.

On a more optimistic note, Rapach, Strauss and Zhou (2010) demonstrate how combining several forecasting models can overcome the problem of model uncertainty and instability. Combining models yields statistically better forecasts and economically significant out-of-sample gains relative to the historical mean benchmark introduced by Welch and Goyal. The benefits of forecast combination arise from the use of a larger set of economic information while reducing forecast volatility.

Implications for rebalancing of the equity share

As outlined in the introduction to this note, predictability has important implications for optimal dynamic asset allocation, including rebalancing. Many contributions to the literature concentrate on the equity-bond (or equity-cash) decision in the US. In one of the first studies to consider the economic significance of return predictability, Brennan, Schwartz and Lagnado (1997) examine the portfolio decisions of short- and long-term investors who take into account return predictability in stocks and bonds. In a similar approach, Campbell and Viceira (1999) look at infinitely lived agents with Epstein-Zin utility who face a mean-reverting equity risk premium. With regard to rebalancing of the equity share, both papers suggest that investors should invest more in equities when indicators of expected returns, for example dividend yields, are high, and less when they are low.

As predictive relationships are estimated with error, recognising parameter uncertainty may tilt a Bayesian investor against trying to take advantage of predictability. Kandel and Stambaugh (1996) show that a sceptical one-period investor (whose prior is against predictability and who is cognisant of parameter uncertainty) may still find it worthwhile to use the predictive regressions in determining the optimal portfolio.

In a related study, Barberis (2000) looks at a long-term buy-and-hold investor who also incorporates parameter uncertainty into the decision-making. He finds that the empirical predictability in returns is sufficiently strong to entice investors to allocate substantially more to stocks the longer their horizon. Avramov (2004) studies an asset allocation framework that allows for prior beliefs about the extent of stock return predictability as well as sample evidence to be reflected in investment decisions. He shows that asset allocations based on conditional models perform better than the framework that ignores return predictability for a wide range of beliefs.

Wachter and Warusawitharana (2009) study a variation on the Bayesian investor model introduced by Barberis. They allow for intermediate rebalancing and market timing, but arrive at a similar conclusion. Even an investor who has a sceptical bias against predictability will be persuaded by the data to take advantage of the time-varying equity risk premium.

In markets outside the US, Guidolin and Timmermann (2005) statistically identify "bull" and "bear" regimes in UK stock and bond returns and study their economic implications for asset allocation. They find that the regime probability influences the optimal investment strategy significantly, especially at shorter investment horizons. Taking into account parameter uncertainty does not invalidate the conclusion that return forecastability linked to market regimes should impact an investor's optimal asset allocation.

Dahlquist and Harvey (2001) show how conditioning information, which is related to the phases of the business cycle, can be used in the process of global asset allocation using a world equity index. Based on their backtest, they argue that active asset allocation strategies that take advantage of these predictability relationships between business cycle indicators and financial market returns have the potential to outperform passive strategies. In a similar exercise, Lo and MacKinlay (2002) form portfolios of stocks and of bonds that maximise predictability in an out-of-sample context with respect to a set of conditioning variables. They argue that predictability is statistically and economically significant, even after controlling for data-mining biases.

Practitioner work corroborates the potential importance of predictability for long-term investors. Desclee et al. (2011) illustrate how the ratio of the cyclically-adjusted earnings yield to the long-maturity bond yield can be used countercyclically in a dynamic asset allocation strategy that would have outperformed a static 60/40 equity-bond allocation in terms of both absolute and risk-adjusted returns. Using annual US data from 1926 to 2010, they show that the return of the dynamic strategy is more than 100 basis points higher than the static allocation, albeit with a slightly higher average equity share and portfolio volatility.

To be sure, there are some cautionary notes and caveats in the literature. Handa and Tiwari (2006) point out that the performance of dynamic asset allocation based on predictive relationships can be very poor for certain periods. The dividend yield was a poor forecasting device in the 1989-2002 period, hence market timers may have to endure long episodes of poor performance.

Despite these valid objections and challenges to the predictability paradigm, on balance the academic literature seems to come out on the side of an economically meaningful degree of predictability. It clearly stresses the importance of taking into account the parameter and model uncertainty of predictive relationships as well as realistic transaction costs. Even with these additional complications, the majority of the papers reviewed here advocate rebalancing to a state-dependent rather than a fixed equity share.

Predictability in fixed-income and currency markets

The evidence of predictability is not limited to equities. There is similarly strong support for time-varying risk premia and predictability of returns in fixed-income and currency markets. We have previously (NBIM 2011) discussed the empirical evidence with regard to the term premium and the credit premium in detail. This section gives a brief summary of the academic literature.

Term premium

The term premium is the excess return that an investor obtains in equilibrium from committing to hold a long-term bond instead of a series of shorter-term bonds. Most of the empirical research has focused on the post-World War II period and the US Treasury market, and finds that the term premium is positive on average.

The presence of excess returns on long-maturity bonds over Treasury bills contradicts the expectations hypothesis of the term structure (for example, Roll 1970, Sargent 1979, Hansen and Sargent 1981, and Campbell and Shiller 1991). In addition, several studies show that a strategy where the investor sells fixed-income securities with a short maturity and invests in securities with a long maturity when this interest rate spread is wide will earn a greater excess return over time. This suggests that the term premium is time-varying (for example, Campbell and Shiller 1991) and an investor should adopt a dynamic approach towards duration exposure in order to best capture this premium.

The predictive power of the yield spread (or the forward rate spread) is somewhat surprising since it conceptually is a noisy measure of the underlying term premium. Two major factors affect the slope of the yield curve: investors' expectations for future short-term interest rates and risk premia that investors require for holding long-term bonds. A steep yield curve may thus incorporate market expectations of rising interest rates or high bond premia, or a combination of both.

Several approaches have been taken to extract the pure risk premium component from yield curve spreads. While the finance-orientated research follows the seminal contribution by Vasicek (1977) in focusing on the volatility of the short-term interest rate as the primary driver of the term premium, the reduced-form approach emphasises uncertainty about the macroeconomy, i.e. growth and inflation. As an example of the finance-orientated literature, Cochrane and Piazzesi (2005) show that a statistical factor derived from the forward curve predicts excess returns on one- to five-year maturity bonds with high in-sample R^2, which also strongly contradicts the expectations hypothesis. In an unpublished appendix, Cochrane and Piazzesi (2006) evaluate the out-of-sample economic significance of a trading rule based on their predictive forward curve factor. They find that while the out-of-sample profits are smaller than the in-sample returns, they remain significantly positive.

The so-called macro-finance methodology, which combines elements of the aforementioned schools of thought, tentatively gives credence to the notion that a positive term premium is compensation for risk with regard to the evolution of policy interest rates, which in turn is driven by underlying macroeconomic factors (Ang and Piazzesi 2003). Intuitively, survey information about expected growth and inflation should therefore be useful in separating the expected interest rate path from the risk premium component.

Kim and Wright (2005) and Rosenberg and Maurer (2008) find that survey-based measures provide robust ad hoc estimates of the term premium that are predictive of excess returns. Recent research also points to the importance of a cross-asset-class approach when assessing the risk premium of bonds.

Campbell, Sunderam and Viceira (2010) argue that covariances and not variances should determine risk premia. They identify the stock-bond correlation as key to determining the "hedging" property of nominal bonds, and hence their warranted risk premium. If the correlation of bonds and equities is negative, as it has been during most of the last four decades, the required risk premium for bonds is lower because they cushion investors against a fall in stock markets.

However, evidence on the predictability of bond excess returns is not unanimous. Thornton and Valente (2010) examine the out-of-sample economic gain for investors who attempt to take advantage of the predictability of bond excess returns by using forward rates or forward spreads. They find that risk-averse investors would not benefit from employing a dynamic portfolio strategy that takes into account predictability.

On balance, however, the literature tends to be supportive of the predictability argument in fixed income. As a good way of summing up the discussion, we show the predictive power of various indicators over short- and medium-term horizons in Table 1, reproduced from Ilmanen (2011). Risk premium proxies, including the Cochrane-Piazzesi measures and the Kim-Wright term premium as well as the ex ante real yield, are shown to have the highest correlations with subsequent excess returns over all horizons. Since these risk premium measures are highly persistent, the simple correlation measure does not tell the whole story and more careful econometric inference should be undertaken. It is noteworthy that many of the other indicators studied, including measures of equity-bond correlation, public debt and real activity indicators, have lower and in some cases even counterintuitive correlations with excess returns.

Table 1: Correlations with subsequent excess returns of seven- to ten-year Treasuries, 1962-2009

Horizon	Next quarter	Next year	Next 5 years
Yield curve(10Y-3M	0.21	0.34	0.06
Cochrane Piazzesi term premium	0.24	0.44	0.32
Survey based term premium (1983 -)	0.19	0.38	0.67
Kim-Wright term premium (1990 -)	0.25	0.43	0.34
Ex-ante real yield	0.28	0.48	0.69
Expected 10-year inflation	-0.02	0.01	0.31
Bond volatility	0.11	0.22	0.64
Equity market returm (60-day)	-0.15	-0.14	-0.07
Equity market volatility (60-day)	0.11	0.08	0.27
Equity-bond-correlation	0.01	0.06	0.22
Debt/GDP	0.06	0.11	0.16
Debt share of Treasuries > 10 years	0.13	0.28	0.66
ISM index	-0.1	-0.2	-0.3
CFNAI index	-0.09	-0.19	-0.19
Corporate profits/GDP	-0.13	-0.25	-0.52
Unemployment rate	0.11	0.18	0.24

Source: Ilmanen (2011)

Credit premium

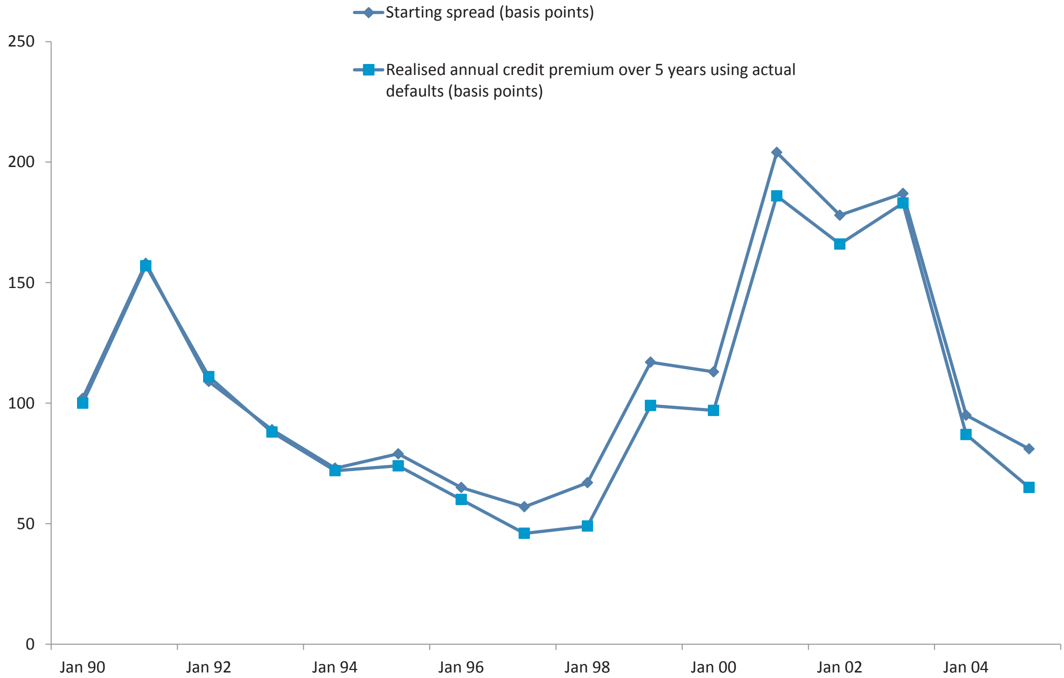
In addition to earning excess returns from taking on term risk, investors can hope to be rewarded for exposing themselves to credit risk. The credit premium is the excess return that an investor obtains for holding bonds issued by entities other than the most highly-rated governments. Among many other contributions, Giesecke et al. (2010) document positive credit excess returns (after factoring in default losses) in the order of 80 basis points over more than a century of US data. This stylised fact has initially been regarded as a puzzle in the sense that structural models such as the one proposed by Merton (1974) fail to explain the magnitude of default-adjusted spreads as well as the volatility of credit spreads. The puzzle suggests either that the Merton assumption of time-invariant default probabilities is too restraining or that priced factors are missing from the early models.

More recent structural models like Chen, Collin-Dufresne and Goldstein (2009) argue that credit spreads can be accounted for by extending the standard models along the same dimensions that have previously been used to explain the equity premium puzzle. If structural models incorporate strongly time-varying reward-to-volatility ratios and take into account the greater likelihood of default during recessions, they can capture both the level and time variation of historical spreads. NBIM (2011) shows that credit excess returns are worst during recessions, similar to the "bad times" argument for low returns on value stocks in equity markets.

Similarly, Ilmanen (2011) argues that credit spreads, cyclical factors and supply/demand factors have some ability to predict excess returns. On a hold-to-maturity horizon, however, the starting spread is the most powerful predictor of realised excess returns, if these are measured correctly. In Chart 3, we plot the starting spread of US investment-grade corporate bonds in the years 1990 to 2005 against the subsequent realised excess return of those corporates over Treasuries, net of actual defaults. Ng and

Phelps (2010) argue that the realised credit premium measured on this basis exceeds that recorded by widely used IG benchmarks, as index rules force investors to dispose of certain securities at inopportune moments (downgrades to speculative grade, residual maturity falling below one year, etc.).

Chart 3: Starting spread versus realised excess return over five years using actual defaults (1990-2005) – investment-grade corporate bonds



Source: Barclays Capital

Currency

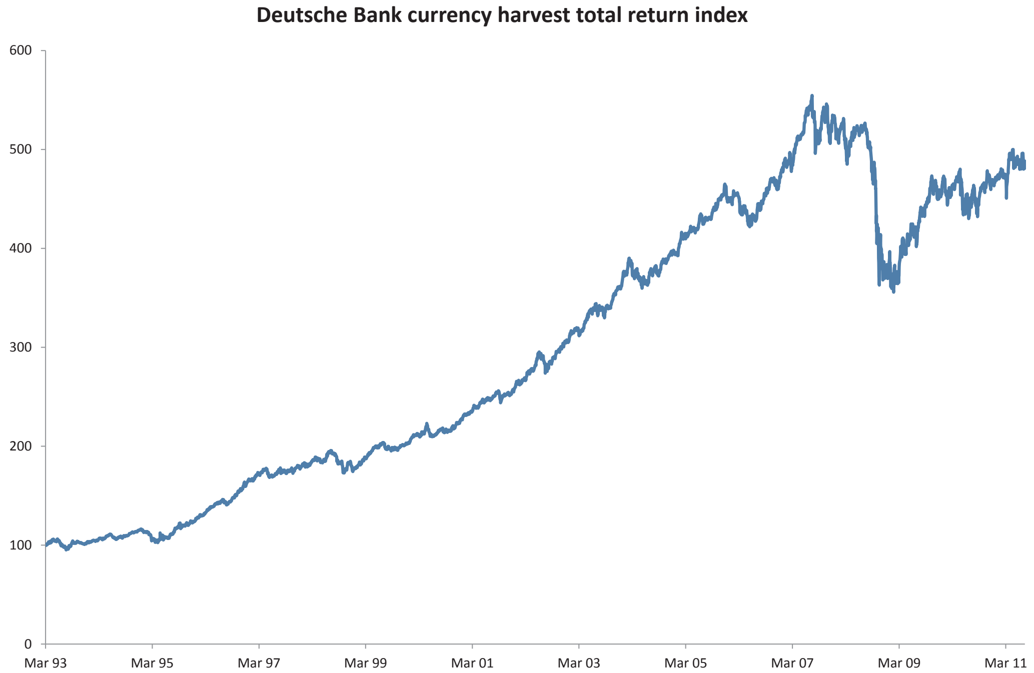
Lastly, a rich literature also documents the predictability phenomenon in the foreign exchange markets. In an analogy to the expectations hypothesis of the term structure, the uncovered interest rate parity condition holds that investors should be indifferent to the available interest rates in two countries because the exchange rate will adjust to bring about the same return in either currency. In other words, a high relative interest rate in one currency should be offset by expected (and, on average, subsequently realised) depreciation of that currency.

In practice, even the opposite is often observed. A wave of empirical studies has documented the tendency of high-interest currencies to appreciate rather than depreciate, which is also known as the forward discount puzzle. Tests of the uncovered interest parity condition conducted by regressing the change in the log of the exchange rate against the forward discount show that the coefficient on the latter often has the wrong sign (Engel 1996, Froot and Thaler 1990).

The forward discount puzzle underlies the so-called "carry trade", which is a strategy often employed by practitioners and involves buying currencies with high short-term interest rates and selling low-yielding ones.

The total return of that strategy applied to the G10 currencies between 1993 and 2011 is shown in Chart 4. In the sample period, the strategy produced an annual return of nearly 9 percent and an excess return over Treasury bills of around 5.5 percent. The severe drawdown that the strategy endured in 2008/2009 suggests that it may be related to general market risk, i.e. the equity risk premium, or liquidity risk. However, the strategy performed well during the 2000-2002 equity bear market, which would contradict the market risk argument.

Chart 4: Return on a forward discount bias trading strategy



Source: Deutsche Bank

Burnside et al. (2006) and Burnside, Eichenbaum and Rebelo (2007) also find that portfolios of currencies formed on the basis of the forward discount anomaly in developed and emerging markets yield high Sharpe ratios. They argue, based on regressions of strategy returns against equity returns, that the high risk-adjusted returns are difficult to rationalise as compensation for bearing general market risk (however, the 2008/2009 episode was not in their sample).

Another possible explanation is to evoke the peso problem, which holds that market participants expect with a positive probability a large negative tail event in the carry trade that did not materialise in the sample. However, even after the very severe financial market crisis of 2008/2009, excess returns over the sample period remained significantly positive, as shown in Chart 4. For developed currencies, Burnside et al. (2006) present evidence that transaction costs drive a wedge between the average and marginal Sharpe ratio, with the latter approaching zero once bid-ask spreads and market impact are accounted for.

Della Corte, Sarno and Tsiakas (2009) are more optimistic on the scope for dynamic strategies in currency markets to add considerable economic value. They study the performance of exchange rate forecasting models using forward exchange rates and economic data as predictors in- and out-of sample. Incorporating realistic transaction costs, they find that risk-averse investors would find it worthwhile to pay high performance fees to employ a dynamic portfolio strategy based on predictability relationships rather than assuming a random walk. They also show that combining different forecasting models adds further economic value compared to the random walk benchmark.

Practitioner models

In this section, we discuss how practitioners incorporate insights from the academic predictability literature in forecasting returns on equity, fixed income and currencies to support asset allocation decisions.

Equity forecasting

Having discussed the importance of imposing economic structure on forecasting models, it is somewhat reassuring that many practitioner models incorporate steady-state valuation principles rather than going down the route of unrestricted uninvariate regressions. For example, in addition to the commonly used valuation metrics tested in the finance literature, practitioners often employ dividend discount models (DDMs) to solve for measures of the implied rate of return and the equity risk premium.

The Gordon growth model (Gordon 1962) can be thought of as the simplest version of a DDM with a stable perpetual growth assumption. Practitioners frequently apply more complex frameworks with multiple stages during which the growth rate of cash flows varies over time. Most often, explicit consensus or proprietary forecasts about the short-term path of earnings and dividends are combined with a transition to sustainable long-term growth rates in these variables over the medium and longer term.

The model developed by Daly, Nielsen and Oppenheimer (2009) at Goldman Sachs is a four-stage DDM developed for the major global equity markets. The authors perform a forecasting "horserace" over various time horizons between the implied equity return from their model and widely used valuation metrics, – including the P/E ratio (based on 12-month trailing earnings), the cyclically adjusted P/E ratio, dividend yield, and Tobin's q. In addition, they compare the predictive power of the valuation metrics with that of a set of market and macroeconomic variables, including trailing GDP growth over three years and "perfect foresight" GDP growth over the next three years.

The R^2 from the forecasting exercise are reported in Table 2. At the one-quarter horizon, the share of variability that is explained by any of the valuation metrics is very low, as one would expect. The perfect foresight three-year GDP variable does best at this short horizon. The predictive power of valuation measures increases with lengthening investment periods and peaks at the five-year horizon.

Table 2: R2 of forecasting models of the real US equity return

Time Horizon	1 Quarter	1 Year	2 Years	5 Years	10 Years
P/E ratio	3 %	9 %	19 %	39 %	31 %
Cyclically adjusted P/E ratio	2 %	7 %	18 %	47 %	25 %
Dividend yield	3 %	8 %	11 %	32 %	21 %
RRR from GS DDM	3 %	19 %	33 %	52 %	24 %
Tobin's q	1 %	4 %	10 %	31 %	20 %
3-yr historical GDP growth	1 %	0 %	0 %	0 %	0 %
3-yr future GDP growth	9 %	18 %	31 %	18 %	9 %

Source: Daly, Nielsen and Oppenheimer (2009)

Surprisingly, several valuation metrics, including simple P/E and dividend yield measures, outperform even perfect knowledge of three-year-ahead GDP growth for this timeframe, and the implied rate of return performs in line with the perfect foresight metric at the one- and two-year horizons. This finding is consistent with the view that variation in implied rates of return and risk premia reflects changes in expected returns rather than rational changes in expected fundamentals. Current valuations are more important in forecasting future long-term equity returns than future economic growth.

Similar models are built and deployed in guiding asset allocation decisions by other sell-side strategists. For example, Macleod, Kwan and Rawat (2011) at UBS use a multi-stage model that explicitly incorporates the growth dynamics of emerging markets.

Other practitioners deviate from the academic approach by adjusting valuation ratios for accounting distortions and other measurement errors. Bianco et al. (2010) at Bank of America Merrill Lynch emphasise the importance of normalising earnings for cyclical fluctuations when imputing the market-implied cost of equity and the equity risk premium. In the HOLT methodology used by Credit Suisse (e.g. Holland and Matthews 2011) and the CROCI approach employed by Deutsche Bank (Curto et al. 2011), practitioners aim to see through international differences in accounting standards by focusing on cash flow returns on capital when inferring market-implied rates of return.

Fixed-income and currency forecasting

Insights from the academic predictability literature are also applied and adapted by practitioners in the fixed-income, currency and commodities markets. A good example of that is the macro investing framework outlined in Morris (2009) and Naik and Balakrishnan (2010) at Nomura. The authors employ a scorecard approach whereby various classes of predictive variables are combined into one signal using simple weighted summation.

The indicators are often motivated by academic research and are broadly classified into four categories:

- economic variables
- risk premium proxies
- momentum
- risk appetite proxies

Using economic variables as conditioning information is in line with the macro-finance literature of fixed-income return predictability and consistent with the notion that risk premia are driven by the time variation in economic risks. Proxies for risk premia derived from the term structure of government and corporate bonds are motivated by the finance-orientated literature. While momentum is a much better-explored phenomenon in equity markets, practitioners have applied the concept to other financial markets. Lastly, the behavioural finance literature provides a theoretical foundation for the use of risk appetite measures which are designed to capture predictability over shorter time horizons.

Once signals from these four classes of variables have been tested for predictive ability, they enter the scorecard in a standardised format (using a Z-score methodology) and are summed up using a predetermined weighting scheme. The scorecard approach is philosophically related to the restricted regressions employed by Ferreira and Santa-Clara (2011) and Campbell and Thompson (2008) in the sense that relationships are constrained to be economically plausible and correlations implicitly forced to have the "correct" sign.

Naik and Balakrishnan (2010) report the results of employing this systematic framework with four classes of predictive variables across four asset classes: government bonds, corporate bonds, the G7 currencies and commodities. Their backtest shows that the signals add economic value in each of the four asset classes, and the information ratios are particularly high (well over 1 in the 1950-2009 period) when the strategies are combined across asset classes.

Similar studies in combining risk premia signals across equity, fixed-income and currency markets to form systematic portfolios have also been conducted by Rennison (2010) and Ambastha et al. (2010) at Barclays Capital. The latter show how strategies based on equity valuation, term premium, currency carry and momentum can be overlaid on a global fixed-income benchmark to generate very high information ratios. Weightings of risk premia are determined by an enhanced mean-variance optimisation framework that uses turnover controls and priors on the correlation matrix.

On the whole, there is evidence for predictability in returns across fixed-income and currency markets that in some cases resembles the time variation in the equity risk premium. This suggests that common drivers, most likely macroeconomic risks, are responsible for that time variation. For some observed phenomena, notably the forward discount puzzle in foreign exchange markets, the relationship with equity risk is less obvious.

Practitioner studies show that combining strategies which make use of different predictability relationships across several asset classes can improve risk-adjusted returns. The pervasiveness of predictability argues for a comprehensive approach to dynamic asset allocation that extends beyond the equity-bond share.

Conclusions

A large and growing body of empirical work has found forecastability of returns in equity and across other financial markets. Such predictability in expected returns is not necessarily inconsistent with market efficiency. Discount rate variation, i.e. time variation of the rate at which rational investors discount expected future cash flows, offers a theoretical framework that can reconcile market efficiency with predictability in financial market returns.

Our survey documents the econometric and conceptual challenges that have been mounted against the early predictability evidence, as well as the empirical refinements that have taken place in response to those challenges. On balance, we interpret the literature as being supportive of predictability in returns and the return-to-risk relationship (see also Lettau and Ludvigson 2010).

Such predictability has important implications for the asset allocation of investors, at least in partial equilibrium. Our survey of the literature suggests that long-term investors should take into account the predictability evidence when making their rebalancing decision. In particular, one strand of the literature advocates, in principle, the countercyclical market timing of the portfolio equity share, using predictive variables that proxy expected returns. In this context, rebalancing to a fixed strategic equity share ignores the time variation in the equity risk premium. If such variation is real and persists in a similar way to in the historical asset return data, a fixed strategic equity weight is suboptimal. The rebalancing of the equity share should therefore be modified so as to incorporate predictability in a transparent way.

Academic and practitioner work in fixed-income and currency markets corroborates the evidence for the stock markets. The dynamic nature of these other risk premia (including term, credit and currency) and their interactions with the equity premium makes it difficult to take advantage of predictability within the confines of a rebalancing framework. A more flexible approach is probably warranted if dynamic asset allocation decisions are to go beyond the equity share. However, the literature advises investors to be mindful of the potential for estimation error and the risk of instability in predictive relationships.

From a general equilibrium perspective, it should also be borne in mind that not all investors can act like the long-term investor described in this survey and buy risky assets when expected returns are high. Some investors may find it rational to sell equities despite high expected returns, for example due to high marginal utility of wealth in times of economic downturns or institutional and regulatory constraints.

As a matter of arithmetic, the average currency unit invested must hold the market portfolio. The scope for rational deviations from the market portfolio arises when investors are different from each other, due to risk preferences or regulations and other market frictions. It is therefore of vital importance to investors to determine whether and how they distinguish themselves from other market participants before actively seeking to take advantage of the predictability evidence.

References

Ambastha, M., A. Desclee, B. Phelps and S. Polbennikov (2010): "A Case Study in Combining Active Strategies", Barclays Capital Quantitative Portfolio Strategy, 25 May 2010.

Ang, A. and M. Piazzesi (2003): "A no-arbitrage vector autoregression of term structure dynamics with macroeconomic and latent variables", *Journal of Monetary Economics*, 50(4), 745-787.

Balduzzi, P. and A. Lynch (1999): "Transaction Costs and Predictability: Some Utility Cost Calculations", *Journal of Financial Economics*, 52(1), 47-78.

Bansal, R. and A. Yaron (2004): "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles", *Journal of Finance*, 59(4), 1481-1509.

Barberis, N. (2000): "Investing for the Long Run when Returns are Predictable", *Journal of Finance*, 55(1), 225-264.

Bianco, D., P. Hariani, D. Suzuki, K. Desai and J. Carey (2010): "Raising S&P 500 estimates", Bank of America Merrill Lynch Equity Strategy, 8 February 2010.

Boudoukh, J., M. Richardson and R. Whitelaw (2008): "The Myth of Long-Horizon Predictability", *Review of Financial Studies*, 21(4), 1577-1605.

Boudoukh, J., R. Michaely, M. Richardson and M.R. Roberts (2007): "On the Importance of Measuring Payout Yield: Implications for Empirical Asset Pricing", *Journal of Finance*, 62(2), 988-915.

Brennan, M., E. Schwartz and R. Lagnado (1997): "Strategic asset allocation", *Journal of Economic Dynamics and Control*, 21, 1377-1403.

Burnside, A.C., M. Eichenbaum, I. Kleshchelski and S. Rebelo (2006): "The Returns to Currency Speculation", CEPR Discussion Paper No. 5883.

Burnside, C., M. Eichenbaum and S. Rebelo (2007): "The Returns to Currency Speculation in Emerging Markets", *American Economic Review*, 97(2), 333-338.

Campbell, J.Y. and J.H. Cochrane (1999): "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior", *Journal of Political Economy*, 107(2), 205-251.

Campbell, J.Y. and L.M. Viceira (1999): "Consumption and Portfolio Decisions When Expected Returns Are Time Varying", *Quarterly Journal of Economics*, 114(2), 433-495.

Campbell, J.Y. and M. Yogo (2006): "Efficient tests of stock return predictability", *Journal of Financial Economics*, 81, 27-60.

Campbell, J.Y. and R.J. Shiller (1989): "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors", *Review of Financial Studies*, 1(3), 195-228.

Campbell, J.Y. and R.J. Shiller (1991): "Yield Spreads and Interest Rate Movements: A Bird's Eye View", *Review of Economic Studies*, 58, 495-514.

Campbell, J.Y. and S.B. Thompson (2008): "Predicting Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average?", *Review of Financial Studies*, 21(4), 1509-1531.

Campbell, J.Y. (1991): "A Variance Decomposition for Stock Returns", *Economic Journal*, 101(405), 157-179.

Campbell, J.Y., A. Sunderam and L. Viceira (2010): "Inflation Bets or Deflation Hedges? The Changing Risk of Nominal Bonds", working paper, Harvard University.

Chen, L., P. Collin-Dufresne and R.S. Goldstein (2009): "On the Relation between the Credit Spread Puzzle and the Equity Premium Puzzle", *Review of Financial Studies*, 22(12), 5099-5131.

Cochrane, J.H. (1992): "Explaining the Variance of Price-Dividend Ratios", *Review of Financial Studies*, 5(2), 243-280.

Cochrane, J.H. and M. Piazzesi (2005): "Bond Risk Premia", *American Economic Review*, 95(1), 138-160.

Cochrane, J.H. and M. Piazzesi (2006): "Appendix to 'Bond Risk Premia'", mimeo, University of Chicago.

Cooper, M., R.J. Gutierrez and Marcum, B. (2005): "On the Predictability of Stock Returns in Real Time", *Journal of Business*, 78(2), 469-500.

Curto, F., J. Lear, V. Galas, C. McKenzie, C. Town, D. Walters and C. Wane (2011): "The danger to equities from inflation", Deutsche Bank Global Markets Research, 1 April 2011.

Dahlquist, M. and C.R. Harvey (2001): "Global Tactical Asset Allocation", *The Journal of Global Capital Markets,* 2001, 1-9.

Daly, K., A.E.B. Nielsen and P. Oppenheimer (2010): "Finding Fair Value in Global Equities: Part II—Forecasting Returns", *Journal of Portfolio Management*, 36(3), 56-70.

Della Corte, P., L. Sarno and I. Tsiakas (2009): "An Economic Evaluation of Empirical Exchange Rate Models", *Review of Financial Studies*, 22(9), 3491-3530.

Desclée, A., J. Hyman, A. Maitra, I. Mirciov and S. Polbennikov (2011): "Long Horizon Dynamic Asset Allocation", mimeo, Barclays Capital Quantitative Portfolio Strategy, August 2011.

Engel, C. (1996): "The forward discount anomaly and the risk premium: A survey of recent evidence", *Journal of Empirical Finance*, 3(2), 123-192.

Fama, E.F. (1991): "Efficient Capital Markets: II", *Journal of Finance*, 46(5), 1575-1617.

Fama, E.F. and K.R. French (1988a): "Dividend Yields and Expected Stock Returns", *Journal of Financial Economics*, 22, 3-27.

Fama, E.F. and K.R. French (1988b): "Permanent and Temporary Components of Stock Prices", *Journal of Political Economy*, 96(2), 246-273.

Fama, E.F. and K.R. French (1989): "Business Conditions and Expected Returns on Stocks and Bonds", *Journal of Financial Economics*, 25, 23-49.

Ferreira, M.A. and P. Santa-Clara (2011): "Forecasting Stock Market Returns: The Sum of the Parts is More than the Whole", *Journal of Financial Economics*, 100, 514-537.

Ferson, W.E., S. Sarkissian and T.T. Simin (2003): "Spurious Regressions in Financial Economics*?",* *Journal of Finance*, 58(4), 1393-1413.

Foster, D., T. Smith and R. Whaley (1997): "Assessing Goodness-of-Fit of Asset Pricing Models: The Distribution of the Maximal R-Squared", *Journal of Finance*, 52(2), 591-607.

Froot, K.A. and R.A. Thaler (1990): "Foreign Exchange", *Journal of Economic Perspectives*, 4, 179-92.

Giesecke, K., F.A. Longstaff, S.M. Schaefer and I.A. Strebulaev (2010): "Corporate Bond Default Risk, A 150-Year Perspective", *NBER Working Paper Series*, 15848.

Gordon, M.J. (1962): *The Investment, Financing, and Valuation of the Corporation*, Homewood, IL: R.D. Irwin.

Guidolin, M. and A. Timmermann (2005): "Economic Implications of Bull and Bear Regimes in UK Stock and Bond Returns", *Economic Journal*, 115(500), 111-143.

Handa, P. and A. Tiwari (2006): "Does Stock Return Predictability Imply Improved Asset Allocation and Performance? Evidence from the U.S. Stock Market (1954-2002)", *Journal of Business*, 79(5), 2423-2468.

Hansen, L.P. and T.J. Sargent (1981): "Exact Linear Rational Expectations Models: Specification and Estimation", *Federal Reserve Bank of Minneapolis Staff Report 71*.

Harvey, C.R. (1991): "The World Price of Covariance Risk", *Journal of Finance*, 46(1), 111-117.

Hjalmarsson, E. (2010): "Predicting Global Stock Returns", *Journal of Financial and Quantitative Analysis*, 45(1), 49-80.

Hodrick, R.J. (1992): "Dividend yields and expected stock returns: Alternative procedures for inference and measurement", *Review of Financial Studies*, 5, 357-86.

Holland, D. and B. Matthews (2011): "The HOLT Discount Rate as a Signal for Market Expectations", HOLT Model Development Group Studies, Credit Suisse, 28 February 2011.

Ilmanen, A. (2011): *Expected Returns*, Chichester: Wiley & Sons.

Kandel, S. and R. Stambaugh (1996): "On the predictability of stock returns: An asset allocation perspective", *Journal of Finance*, 51(2), 385-424.

Kim, D.H. and J.H. Wright (2005): "An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates", *Finance and Economics Discussion Series*, working paper 2005-33.

Lanne, M. (2002): "Testing the Predictability of Stock Returns", *Review of Economics and Statistics*, 84(3), 407-415.

LeRoy, S. and R. Porter (1981): "The Present Value Relation: Tests Based on Variance Bounds", *Econometrica*, 49(3), 555-557.

Lettau, M. and S.C. Ludvigson (2001): "Consumption, Aggregate Wealth and Expected Stock Returns", *Journal of Finance*, 56(3), 815-849.

Lettau, M. and S. Van Nieuwerburgh (2008): "Reconciling the Return Predictability Evidence: In-Sample Forecasts, Out-of-Sample Forecasts, and Parameter Instability", *Review of Financial Studies*, 21(4), 1607-1652.

Lettau, M. and S.C. Ludvigson (2010): "Measuring and Modeling Variation in the Risk-Return Tradeoff", in Aït-Sahalia, Y. and L.P. Hansen (eds.) (2010): *Handbook of Financial Econometrics*, vol. 1, pp. 617-690, Amsterdam: Elsevier.

Lewellen, J.W. (2004): "Predicting Returns with Financial Ratios", *Journal of Financial Economics*, 74, 209-235.

Lo, A.W. and A.C. Mackinlay (1990): "Data-Snooping Biases in Tests of Financial Asset Pricing Models", *The Review of Financial Studies*, 3(3), 431-467.

Lo, A.W. and A.C. Mackinlay (2002): *A Non-Random Walk Down Wall Street*, 5th ed., Princeton: Princeton University Press.

Lynch A. and P. Balduzzi (2000): "Predictability and Transaction Costs: The Impact on Rebalancing Rules and Behavior", *Journal of Finance*, 55(5), 2285-2310.

Macleod, N., T. Kwan and A. Rawat (2011): "How cheap are Asian equities relative to bonds", UBS Investment Research, 10 January 2011.

Malkiel, B.G. (2004): "Models of Stock Market Predictability", *Journal of Financial Research*, 27(4), 449-459.

Merton, R.C. (1974): "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance*, 29(2), 449-470.

Morris, A. (2009): "Getting real about risk and return", Quantitative Strategies, Nomura Fixed Income Research, 7 July 2009.

Naik, V. and S. Balakrishnan (2010): "Nomura Macro Scorecards: A quantitative framework for timing rates, credit, commodity and currency markets", Nomura presentation, 21 September 2010.

NBIM (2011): "On Fixed Income Investments", enclosure to letter to Ministry of Finance, 18 March 2011.

Nelson, C.R. and M.J. Kim (1993): "Predictable Stock Returns: the Role of Small Sample Bias", *Journal of Finance*, 48(2), 641-661.

Ng, Y.K. and B. Phelps (2010): "Capturing Credit Spread Premium", Barclays Capital Quantitative Portfolio Strategies, 3 June 2010.

Polk, C., S.B. Thompson and T. Vuolteenaho (2006): "Cross-sectional Forecasts of the Equity Premium", *Journal of Financial Economics*, 81(1), 101-141.

Rapach, D.E., J.K. Strauss and G. Zhou (2010): "Out-of-Sample Equity Premium Prediction: Combination Forecasts and Links to the Real Economy", *Review of Financial Studies*, 23(2), 821-862.

Rennison, G., A.D. Staal, K. Ghia and A. Lazanas (2011): "Barclays Capital Risk Premia Family: Sequencing the strategy genome", Barclays Capital Systematic Strategies Research, 2 May 2011.

Roll, R. (1970): *The Behavior of Interest Rates: The Application of the Efficient Market Model to U.S. Treasury Bills*, New York: Basic Books.

Rosenberg, J.V. and S. Maurer (2008): "Signal or Noise? Implications of the Term Premium for Recession Forecasting", *Federal Reserve Bank of New York – Economic Policy Review*, 14(1), 1-11.

Rozeff, M.S. (1984): "Dividend Yields Are Equity Risk Premiums", *Journal of Portfolio Management*, 11(1), 68-75.

Samuelson, P.A. (1969): "Lifetime portfolio selection by dynamic stochastic programming", *Review of Economics and Statistics*, 51(3), 239-246.

Sargent, T.J. (1979): "A Note on Maximum Likelihood Estimation of the Rational Expectations Model of the Term Structure", *Journal of Monetary Economics*, 5(1), 133-43.

Shiller, R.J. (1981): "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?", *American Economic Review*, 71(3), 421-436.

Stambaugh, R.F. (1999): "Predictive Regressions", *Journal of Financial Economics*, 54(3), 375-421.

Summers, L.H. (1986): "Does the Stock Market Rationally Reflect Fundamental Values?", *Journal of Finance*, 41(3), 591-601.

Thornton, D.L. and G. Valente (2010): "Predicting Bond Excess Returns with Forward Rates: an Asset-Allocation Perspective", working paper 2010-034, Federal Reserve Bank of St. Louis.

Valkanov, R. (2003): "Long-Horizon Regressions: Theoretical Results and Applications", *Journal of Financial Economics*, 68, 201-232.

Vasicek, O.A. (1977): "An Equilibrium Characterization of the Term Structure", *Journal of Financial Economics*, 5, 177-188.

Wachter, J.A. and M. Warusawitharana (2009): "Predictable returns and asset allocation: Should a skeptical investor time the market?", *Journal of Econometrics*, 148(2), 162-178.

Welch, I. and A. Goyal (2008): "A Comprehensive Look at the Empirical Performance of Equity Premium Prediction", *Review of Financial Studies*, 21(4), 1455-1508.

Norges Bank Investment Management (NBIM)
Bankplassen 2
Postboks 1179 Sentrum
N-0107 Oslo

Tel.: +47 24 07 30 00
www.nbim.no