



Forecasting the direction of the US stock market with dynamic binary probit models

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Abstract

Several empirical studies have documented that the signs of excess stock returns are, to some extent, predictable. In this paper, we consider the predictive ability of the binary dependent dynamic probit model in predicting the direction of monthly excess stock returns. The recession forecast obtained from the model for a binary recession indicator appears to be the most useful predictive variable, and once it is employed, the sign of the excess return is predictable in-sample. The new dynamic “error correction” probit model proposed in the paper yields better out-of-sample sign forecasts, with the resulting average trading returns being higher than those of either the buy-and-hold strategy or trading rules based on ARMAX models.

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1. Introduction

There is a considerable amount of evidence in the financial econometric literature that excess stock market returns are, to some extent, predictable. The main objective has been to predict the overall level, that is, the conditional mean, of excess stock returns. It is emphasized that even though the predictability is statistically weak, it can be economically meaningful.

However, many studies have documented that only the direction of excess stock returns or other asset returns are predictable (see, among others, Breen, Glosten, & Jagannathan, 1989; Christoffersen &

Diebold, 2006; Hong & Chung, 2003). A possible explanation for this is that the noise in the observed returns is too high for the accurate forecasting of the overall return. Leitch and Tanner (1991) find that the direction of the change is the best criterion for predictability, because traditional statistical summary statistics may not be closely related to the profits that investors are seeking in the financial market. Directional predictability is also important for market timing, which is crucial for asset allocation decisions between stock and risk-free interest rate investments.

The previous findings of directional predictability are based mainly on time series models for the excess stock return. For instance, Christoffersen and Diebold (2006) and Christoffersen, Diebold, Mariano, Tay, and Tse (2007) considered the theoretical connection

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between asset return volatility and asset return sign predictability, and verified that the volatility and higher-order conditional moments of returns have a statistically significant explanatory power in sign prediction. Even though there is not much previous research, binary dependent time series models provide another way of forecasting the direction of excess stock returns. Various classification-based qualitative models, such as traditional static logit and probit models, were considered by [Leung, Daouk, and Chen \(2000\)](#), whereas [Anatolyev and Gospodinov \(2010\)](#), [Hong and Chung \(2003\)](#), and [Rydberg and Shephard \(2003\)](#) used the so-called autologistic model to predict the return direction. In the last two papers, the return is decomposed into a sign component and an absolute value component, which are modeled separately before the joint forecast is constructed.

We consider various commonly used financial variables as explanatory variables for forecasting the signs of the one-month US excess stock returns from the S&P500 index and of size-sorted small and large firms' stock indices in probit models. The paper introduces a model in which the recession forecast constructed for a binary recession indicator is used as an explanatory variable in the predictive model. To the best of our knowledge, this kind of approach has not previously been applied to forecasting stock return signs. As a motivation for this model, for example, [Chen \(1991\)](#) and [Fama and French \(1989\)](#) propose that business conditions are important determinants of expected stock returns, and therefore, the recession forecast may be a useful predictive variable in our model. Further, [Chauvet and Potter \(2000\)](#) stressed that the stock market "cycle" leads the business cycle. This argument is based on the fact that the expectations about changes in future economic activity could have an important predictive power to predict excess stock returns. If there are expectations of a coming recession, excess stock returns are low, while stock returns should be positive after a recession period.

In this paper, the new dynamic probit models suggested by [Kauppi and Saikkonen \(2008\)](#) are employed and extended. Since there is not much earlier evidence relating to suitable explanatory variables in sign prediction with probit models, various explanatory variables and their in-sample forecasting performances are first evaluated. After that, the out-of-sample

directional predictability for the excess stock return sign is considered. It is not evident, however, how much the in-sample evidence should be emphasized in assessing the overall return predictability, as it does not guarantee out-of-sample predictability, as has been emphasized in many previous studies (see the discussion by [Campbell & Thompson, 2008](#); [Goyal & Welch, 2008](#), for example).

The results show that the probit models have statistically significant in-sample predictive power for the signs of excess stock returns. A proposed new "error correction" model outperforms the other probit and alternative predictive models, such as "continuous" AR-MAX models, out-of-sample. The excess investment returns received over the buy-and-hold trading strategy are also economically significant. Comparisons between different probit models indicate that the forecasting framework based on the constructed recession forecasts yields more accurate sign predictions than the models where only financial explanatory variables are employed. Especially in the case of small and large size firms, the excess stock return signs seem to be predictable out-of-sample as well.

This paper proceeds as follows. The forecasting model employed, together with recession forecasts, suggested dynamic probit models, and, in particular, the new error correction model, is presented in Section 2. In Section 3, the goodness-of-fit evaluation of the sign forecasts and statistical tests for sign predictability are introduced. The empirical evidence on the directional predictability of the US excess stock returns is reported in Section 4. Finally, Section 5 concludes.

2. Forecasting model

2.1. Dynamic probit models in directional forecasting

Let r_t be the excess stock return over the risk-free interest rate. In many studies, the directional predictability of excess stock returns is examined by using models for continuous dependent variables. For example, [Christoffersen et al. \(2007\)](#) proposed a method for forecasting the direction of excess stock returns, where they first model the conditional variance σ_t^2 and the conditional mean μ_t . Assuming that the data generating process of r_t is

$$r_t = \mu_t + \sigma_t \varepsilon_t,$$

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