2011 International Conference on Financial Management and Economics
IPEDR vol.11 (2011) © (2011) IACSIT Press, Singapore

Model-Based Earnings Forecast and Macroeconomic Conditions

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Abstract. This paper examines the role of macroeconomic conditions when forecasting firms' earnings. We augment Hou et al.'s (2010) cross-sectional model by three macroeconomic factors, which are derived from a principal component analysis of various macroeconomic activity indicators. We use this model to forecast one-, two-, and three-year-ahead earnings from 1962-2010. We find consistent evidence that macroeconomic conditions should be incorporated when predicting firms' future earnings, and particularly in the early sample period, macroeconomic factors therefore enhance the predictive accuracy of the model.

Keywords: Macroeconomic factors, earnings forecast, principal component analysis

1. Introduction

It is well known that earnings forecast is an important tool for (i) investors who need to value stocks and also (ii) business executives who need to manage risk and control long term financial wellbeing within their enterprise. Currently there are two ways to obtain the earnings forecast. One is from financial analysts who issue forecast reports for specific firms periodically.[1] The other is based on the earnings forecasting models which are either time-series or cross-sectional.[2]

Previous studies show that the forecast accuracy of both financial analysts and cross-sectional models tends to outperform their time-series counterparts (which are purely confined to past earnings), especially for short forecast horizons. Further, since analysts' forecasts are only relevant to a small sample of firms of strategically important and/or high value and are typically limited to one- or two-years, we are more interested in cross-sectional model-based earnings forecast here. This is also consistent with the wider literature in firm-level earnings forecast analysis owing to complex survival bias problems that generally preclude the use of time series analytic methods.

In a recent study, Hou et al. (2010) use a pooled cross-sectional model to forecast individual corporate earnings, which is thought to be a promising model (Richardson, Tuna, and Wysocki 2010). They find that the model produces earnings forecasts that are comparable, although inferior on average, to the analyst forecasts in terms of accuracy, but present much lower forecast bias and much higher earnings response coefficients. Their model is successful in plausibly describing specific components of the earnings function that may be of strategic interest to various decision makers. However, industrial and macroeconomic factors have been widely discussed to be in the analysts' information set when preparing firm specific earnings forecasts. Those factors are not considered in the work of Hou et al. (2010), creating potential for omitted variable bias to affect the accuracy of the analysis when compared with analysts' forecasts. While Fairfield et al. (2009) find no incremental explanatory power from including industry information for predicting financial performance, including macroeconomic factors remains to be a potential way to influence earnings forecasting model performance. Indeed, one of fundamental relationships in economics is that realized corporate earnings are highly pro-cyclical.[3] Therefore, if investors are rational, macroeconomic conditions

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[1] See Ramnath et al. (2008) for a recent survey.
[2] Typical literature includes those by Foster (1977), Ou and Penman (1989) as well as Abarbanell and Bushee (1997).
[3] See Hess and Kreutzmann (2010) for more explanations.

should be an important determinant of expected earnings. Thus, it is of interest to examine whether incorporating macroeconomic information into the cross-sectional earnings forecasting model can improve the model's predictive accuracy.

In this paper, we focus on the impact of macroeconomic conditions on firm-level future earnings in a cross-sectional model. More specifically, we evaluate the predictive power of macroeconomic conditions based on the modified Hou et al.'s (2010) model. The rest of the paper proceeds as follows. The next section briefly describes the data and the methodology. Section 3 presents the empirical results, while the last section concludes the paper.

2. Data and Methodology

Our sample covers U.S. firms over the period 1962 to 2010 excluding financial firms and regulated utilities. We obtain accounting variables from the Compustat North America Fundamental Annual database and use the similar variable definitions as in Hou et al. (2010). Levels are scaled by either total assets or common/ordinary equity to address the effect of scale difference. To be in the sample, firm-years should have no missing values for the accounting variables to be included in the regression. We exclude firms with assets less than 5 million and book value less than 3 million to avoid extreme value caused by scaling. We also drop observations without enough information for one-, two-, and three-lag earnings to make one-, two-, and three-step-ahead prediction comparable. Doing so gives us 41,055 observations for 6,038 unique firms in total. We then wincorize the data by both top 0.5% and bottom 0.5% of the distribution to mitigate the effects of any remaining extreme outliers. For the additional macroeconomic data, the Federal Reserve Economic Database (FRED) is used to obtain 23 main macro-variables from all categories on its website for the relevant time period and frequency, which contain all important macroeconomic relations. We then conduct the principal component analysis to extract three macro factors to absorb 95% macroeconomic information. The first factor is a composite score of almost all macroeconomic variables except for the unemployment rate. The second factor is a composite score of several macro-variables with the highest loading on the unemployment rate. And the last factor has the highest loading in the federal fund rate.

Our scaled earnings forecasting model turns out to be consistent with the framework developed in Hou and van Dijk (2010) but we augment it by incorporating three macro factors. Specifically, we have the following regression model:

$$\frac{E_{i,t+\tau}}{A_{it}} = \beta_0 + \theta_1 \frac{E_{it}}{A_{i,t-1}} + \beta_1 \frac{V_{it}}{A_{it}} + \beta_2 \frac{D_{it}}{B_{it}} + \beta_3 \frac{AC_{it}}{A_{it}} + \beta_4 \frac{A_{it} - A_{i,t-1}}{A_{i,t-1}} + \delta_1 DD_{it} + \delta_2 NegE_{it} + \gamma_1 \frac{PC1_t}{A_{it}} + \gamma_2 \frac{PC2_t}{A_{it}} + \gamma_3 \frac{PC3_t}{A_{it}} + \eta_{i,t+\tau}$$

where $E_{i,t+\tau}$ (τ =1, 2, or 3) denotes the net earnings before extraordinary items of firm i in year $t+\tau$, A_{it} is the total assets, B_{it} is the common/ordinary book equity, V_{it} is the firm value defined as its total assets plus market equity (stock price times outstanding share numbers) minus book equity, D_{it} is the common stock dividends, AC_{it} is the operating accruals calculated as in Sloan (1996), DD_{it} is the dividend paid dummy that equals 0 for dividend payers and 1 for non-payers, and $NegE_{it}$ is the negative earnings dummy that equals 1 for firms with negative earnings and 0 otherwise. We include the asset growth to control for variation in the scaling variable. Lagged earnings are also included in the model to identify possible mean-reverting property of earnings (this is often referred to as a partial adjustment mechanism or PAM). We divide three macro factors by firm specific total assets since there is no obvious reason why macroeconomic conditions should have the same impact on all firms.

Following Hou et al.'s (2010) methodology, we perform the pooled cross-sectional regression using the previous ten years (three years minimum) of data for each year between 1962 and 2010. The resulting time-series of yearly coefficients are averaged and the significances of these average coefficients are based on the time-series standard deviations of the yearly coefficients, which comply with Fama and MacBeth's (1973) approach.

3. Empirical Results

The empirical regression results are summarized in Table 1, which presents average coefficients and their time-series *t*-statistics of the regression for the model with and without macro factors respectively. All

coefficients for the explanatory variables have the same sign for the one-, two-, and three-year-ahead earnings regressions. Our coefficients of financial explanatory variables are qualitatively similar to those in Hou and van Dijk (2010). The coefficients of the first two macro factors are relatively insignificant on average but exhibit significance in several sample periods. The coefficients of the macro factor *PC*3 are significantly negative for all one-, two-, and three-year-ahead earnings, suggesting that the interest rate information has a negative impact on firms' future earnings which has an intuitive appeal.

	(Constant)	*(Value)*	*(Dividend)*	*(Accruals)*	*(Div. paid)*	*(Neg. earn.)*	*(As. gr.)*	*(PAM)*	*(PC1)*	*(PC2)*	*(PC3)*	R^2
Full sample with macro fundamentals												
Coefficient values												
One-step	0.024	0.012	0.07	-0.008	-0.006	0.002	-0.026	0.55	0.045	0.116	-0.041	0.388
Two-step	0.04	0.008	0.131	-0.012	-0.006	0.005	-0.03	0.402	0.046	0.166	-0.072	0.214
Three-step	0.047	0.006	0.178	-0.012	-0.008	0.005	-0.029	0.31	0.015	0.033	-0.086	0.138
Time series t-statistics												
One-step	21.712	16.715	8.758	-9.368	-9.643	0.374	-11.396	20.418	1.477	1.684	-2.15	
Two-step	23.632	14.127	17.736	-12.971	-6.395	1.343	-17.327	18.712	1.036	1.804	-2.387	
Three-step	26.606	14.137	23.092	-13.67	-5.804	1.93	-21.657	20.877	0.501	0.546	-3.274	
Full sample without macro fundamentals												
Coefficient values												
One-step	0.025	0.012	0.064	-0.007	-0.005	0.002	-0.027	0.555				0.386
Two-step	0.041	0.008	0.121	-0.011	-0.005	0.005	-0.031	0.407				0.209
Three-step	0.048	0.006	0.166	-0.01	-0.007	0.006	-0.031	0.317				0.132
Time series t-statistics												
One-step	21.846	16.66	7.307	-7.84	-7.694	0.454	-11.377	20.19				
Two-step	23.316	13.309	16.057	-11.592	-5.004	1.431	-16.629	18.039				
Three-step	26.044	11.996	21.331	-10.94	-4.815	1.982	-19.499	19.376				

Table 1: Results of Fama and MacBeth (1973) type cross-sectional regressions.

Table 1 also reports the average regression adjusted R^2. The slightly increased R^2 from 38.6% to 38.8% indicates little incremental explanatory power of macroeconomic conditions on the predicted earnings on average. We look at this aspect further by conducting the likelihood ratio test (LR) for excluding macro factors from the model jointly. The results are plotted in Figure 1 for all one-, two-, and three-step models. The critical value of the χ^2 test statistic with 3 degrees of freedom at a 95% level of confidence is 7.815. Values on the graph which are greater than this number indicate that macro factors should not be excluded. Therefore, the results give the evidence that macro factors should be present in the forecasting model most of the time.

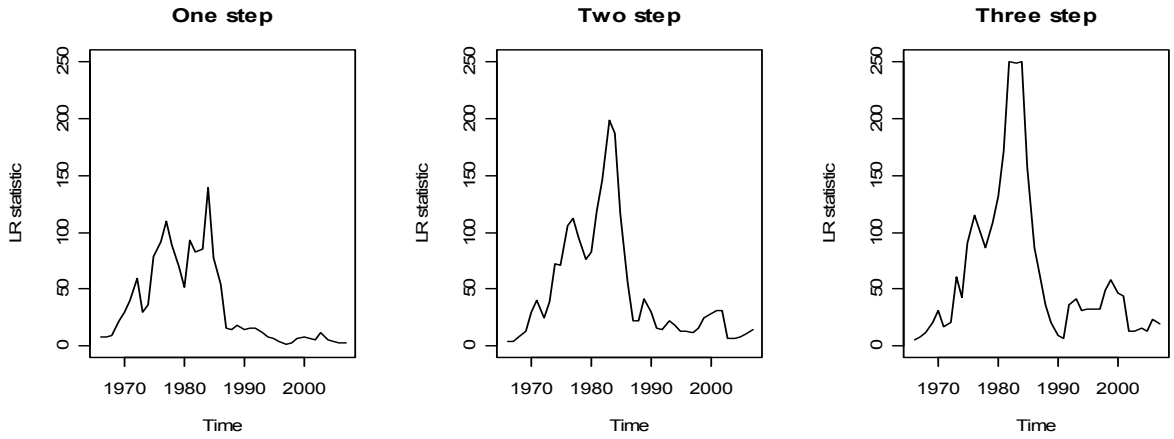

Fig. 1: LR test statistics for excluding macro factors from the model.

Given our model construction, we can easily examine the predictive power of macroeconomic conditions following Hou et al.'s (2010) methodology. As a conventional measure of forecasting accuracy, the average

Root Mean Squared Errors (RMSE) are reported in Table 2 for both models with and without macro factors.

	One-step	Two-step	Three-step
RMSE of model with Macro	0.0608	0.0685	0.0734
RMSE of model without Macro	0.0610	0.0688	0.0737

Tab. 2: RMSE for one-, two-, three-step-ahead forecasting.

Again on average, slightly reduced RMSEs almost demonstrate no forecasting improvement by incorporating macroeconomic conditions to the earnings forecasting model. But when we look at RMSEs individually over time, we find that in the sample period prior to 1986 including macro factors to the model does generate substantially lower RMSE, as shown in Figure 2. The line across charts presents the average percentage reduction in RMSEs for model including macro factors relative to the model excluding macro factors. These results together indicate that macroeconomic conditions have predictive power for corporate future earnings in some periods but not for all periods. Using a simple average measure of forecasting accuracy just obscures the predictive power of macroeconomic information. Further, we note that the forecasting power of macro factors becomes stronger in the longer forecast horizons, indicating the long term impact of macro factors.

4. Conclusion

We examine the role of macroeconomic conditions on the model-based corporate earnings forecasts. We modify and extend the framework developed in Hou et al. (2010) to incorporate three macro factors, which are resulted from the principal component analysis over a wider set of macroeconomic indicators. The empirical results show that macroeconomic information should be incorporated to predict firm's future earnings in almost all cases; and in the early sample period macro factors help improve the predictive accuracy of the cross-sectional earnings forecasting model. These general results hold for one-, two-, and three-year forecast horizons, with the additional finding that the strength of impact of macroeconomic conditions increases with the length of the forecast horizon.

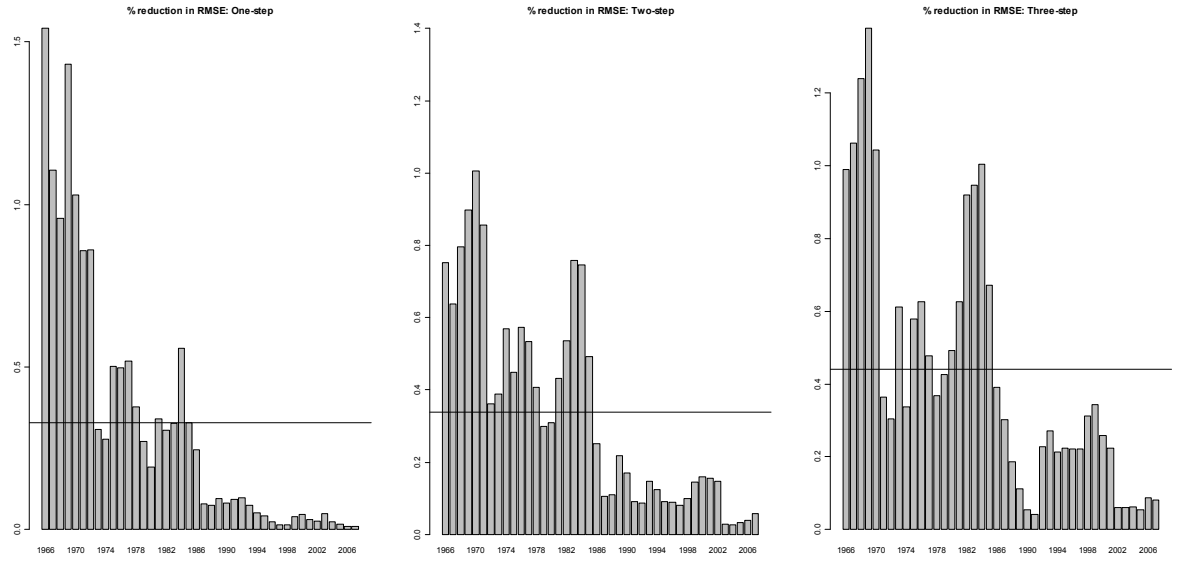

Fig. 2: Percentage reduction in RMSE for model with macro relative to the model without macro.

5. Acknowledgements

We appreciate the comments of seminar participants at Southwestern University of Finance and Economics. We would also like to thank Gan Li and Dinghai Xu for their useful comments.

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