Using Financial and Macroeconomic Indicators to Forecast Sales of Large Development and Construction Firms

Published: 29 October 2008

Volume 40, pages 310–331, (2010) Cite this article

The Journal of Real Estate Finance and Economics

Aims and scope →

Submit manuscript →

Hong Long Chen [1]

Abstract

Sales forecasting is a pivotal component of a corporation's planning and control activities. Despite the panoply of approaches to sales forecasting, relatively few published studies in forecasting address firm-specific sales forecasting model development for the construction industry. While there is evidence that events in the macroeconomy significantly affect the construction market, most published studies on construction sales forecasts using S-curve models are unable to account for the economic climate. This study proposes an approach that employs financial and macroeconomic indicators to forecast sales of large development and construction corporations. First, by using data for 37 large development and construction firms listed on the construction sector of the Taiwan Stock Exchange

between 1997 and 2006, hypothesis tests uncover useful relationships between firm sales and financial and macroeconomic indicators. Second, based on these relationships, a two-stage mathematical modeling procedure is used to develop firm-specific sales forecasting models for three of the sample firms. Finally, out-of-sample forecasting accuracy is evaluated using Theil's *U*-statistic and mean absolute percentage error (MAPE).

Notes

1. For example, Smith et al. (1994) developed a two-stage forecasting methodology based on an integrated least squares procedure for estimating the sales of a retail chain response to promotional variables such as price, promotional sales, promotional frequency, and inventory ratio. Luxhoj et al. (1996) developed a hybrid econometric–neural network model for sales forecasting of an audio manufacturing company in response to the consumer price index, long term interest rates, retail volume, optimism indexes, bulk national product for each market, and lagged explanatory variables for certain sales markets. Moe and Fader (2002) developed a duration model to forecast new music album sales before the actual launch of the album, based on advance purchase orders. Chiu and Shyu (2004) used a vector autoregression (VAR) model and a Litterman Bayesian vector autoregression (LBVAR) model for sales forecasting of portable computers, based on national consumption expenditure, the exchange rate (to US dollars), and desktop computer sales. More recently, Pantelidaki and Bunn (2005) proposed a multifunctional sales model with the diagnostic aid of artificial neural networks (ANN) models for toothpaste product sales forecasting, based on sales price, advertising, promotion, and competitors' price variables. Other similar sales forecasting studies include, but are not limited to, Arora (1979), Dubin (1998), Fader et al. (2004), Foster et al. (2004), Gelfand et al. (1998), Lee et al. (2003), Moe and Fader (2002), Parsons and Abeele (1981), Putler and Lele (2003), Steffens (2001), and Wacker and Lummus (2002).

2. For example, a low profit margin and high asset turnover are indications that the firm adopts a low-price strategy to achieve high sales.

3. The mathematical expression of the change ratio and the test hypotheses are shown in the "Hypothesis Tests and Results" subsection.

4. We did not include privately owned development and construction companies because the financial statement data for the private companies is difficult to

obtain.

5. The TSEC was funded in 1961 and began operating as a stock exchange on the 9th of February 1962. The TSEC is regulated by the Financial Supervisory Commission, a commission of the Ministry of Finance, subordinate to the Executive Yuan of Taiwan.

6. Because the quarterly data were used for assessing the potential for employing financial and macroeconomic variables as predictors for firm sales in this study, c therefore equals 4.

7. Because adding more variables does not improve the values of R-square after Model 4, the optimal models developed at steps 6 to 11 are not presented in Table 5.

8. As reported in the bottom portion of Table 5, the chi-square value of the White test (Eq. 4) is 14.37 and the associated p value is larger than 0.1, suggesting the acceptance of the null hypothesis of no heteroskedasticity in the residuals at the 0.1 level for Model 4. Furthermore, as seen in Fig. 1, the plot of the residuals versus predicted values of Model 4 reveals that no pattern exists in the plots, suggesting that specification errors are not present in the model.

9. In this study, p was assessed for 1 through 4, and the threshold p value of 0.1 was used for judging the existence of autocorrelation.

10. Kaka and Lewis's (2003) S-curve computer model has an average MPE of 4.91%. This, however, is based on the assumption that the forecast number of projects that started in year 2001 is 100% accurate. Namely, Kaka and Lewis (2003) directly used 44 projects, the actual number of projects that started in year 2001, as the input for the model to forecast sales in year 2001. Consequently, the difficulty in applying the S-curve models for company-level sales forecasting in a project-based industry, the prerequisite

of forecasting future unknown individual projects, has been erased. In reality, the use of S-curve models requires forecasting the number of projects that start in each future period, which might be even more challenging than to directly predict firm sales.

References

Abudayyeh, O. Y., & Rasdorf, W. J. (1993). Prototype integrated cost and schedule control system. *Journal of Computing in Civil Engineering*, *7*(2), 181–199. doi:10.1061/(ASCE)0887-3801(1993)7:2(181).

Article Google Scholar

Arora, R. (1979). How promotion elasticities change. *Journal of Advertising Research*, *19*(3), 57–62.

Google Scholar

Banerji, A., Dua, P., & Miller, S. M. (2006). Performance evaluation of the new Connecticut leading employment index using lead profiles and BVAR models. *Journal of Forecasting*, *25*, 415–437. doi:10.1002/for.996.

Article Google Scholar

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression Diagnostics*. New York: Wiley.

Book Google Scholar

Bodie, Z., Kane, A., & Marcus, A. J. (2002). *Investments*. New York: McGraw-Hill.

Google Scholar

Bretschneider, S., Carbone, R., & Longini, R. L. (1979). An adaptive approach to

time-series forecasting. *Decision Sciences*, *10*(2), 232–244. doi:10.1111/j.1540-5915.1979.tb00021.x.

Article Google Scholar

Carr, R. I. (1993). Cost schedule and time variances and integration. *Journal of Construction Engineering and Management*, *119*(2), 245–265. doi:10.1061/(ASCE)0733-9364(1993)119:2(245).

Article Google Scholar

Davis, D. F., Mentzer, J. T., Mccarthy, T. M., & Golicic, S. L. (2006). The evolution of sales forecasting management: a 20-year longitudinal study of forecasting practices. *Journal of Forecasting*, *25*, 303–324. doi:10.1002/for.989.

Article Google Scholar

Chen, H. L., O'Brien, W. J., & Herbsman, Z. (2005). Assessing the accuracy of cash flow models: the significance of payment conditions. *Journal of Construction Engineering and Management*, *131*(6), 669–676. doi:10.1061/(ASCE)0733-9364(2005)131:6(669).

Article Google Scholar

Chiu, Y. C., & Shyu, J. Z. (2004). Applying multivariate time series models to technological product sales forecasting. *International Journal of Technology Management*, *27*(2), 306–319. doi:10.1504/IJTM.2004.003957.

Article Google Scholar

Cholette, P. A. (1982). Prior information and ARIMA forecasting. *Journal of Forecasting*, *1*(4), 375–383. doi:10.1002/for.3980010405.

Article Google Scholar

Dropsy, V. (1996). Do macroeconomic factors help in predicting international equity risk premia? *Journal of Applied Business Research*, *12*(3), 120–132.

Google Scholar

Dua, P., & Miller, S. M. (1996). Forecasting Connecticut home sales in a BVAR framework using coincident and leading indexes. *Journal of Real Estate Finance and Economics*, *13*(3), 219–235. doi:10.1007/BF00217392.

Article Google Scholar

Dua, P., Miller, M., & Smyth, D. J. (1999). Using leading indicators to forecast U.S. home sales in a Bayesian vector autoregressive framework. *Journal of Real Estate Finance and Economics*, *18*(2), 191–205. doi:10.1023/A:1007718725609.

Article Google Scholar

Dua, P., & Smith, D. J. (1995). Forecasting U.S. home sales using BVAR models and survey data on households' buying attitudes for homes. *Journal of Forecasting*, *14*, 167–180. doi:10.1002/for.3980140303.

Article Google Scholar

Dubin, R. A. (1998). Predicting house prices using multiple listings data. *Journal of Real Estate Finance and Economics*, *17*(1), 35–59. doi:10.1023/A:1007751112669.

Article Google Scholar

Fader, P. S., Hardie, B. G. S., & Huang, C. Y. (2004). A dynamic changepoint model for new product sales forecasting. *Marketing Science*, *23*(1), 50–65. doi:10.1287/mksc.1030.0046.

Article Google Scholar

Fetterhoff, O., & O'Brien, W. (2005). Planning to get work: an evaluation of market forecasting techniques by large design and construction firms. *Proceedings of the ASCE Construction Research Congress*, 273–277.

Foster, J. A., Golder, P. N., & Tellis, G. J. (2004). Predicting sales takeoff for whirlpool's new personal valet. *Marketing Science*, *23*(2), 182–185.

Google Scholar

Freund, R. J., & Wilson, W. J. (1998). *Regression Analysis: Statistical Modeling of a Response Variable*. San Diego: Academic.

Google Scholar

Gelfand, A. E., Ghosh, S. K., Knight, J. R., & Sirmans, C. F. (1998). Spatio-temporal modeling of residential sales data. *Journal of Real Estate Finance and Economics*, *16*(3), 312–321.

Google Scholar

Helmer, R. M., & Johansson, J. K. (1977). An exposition of the Box–Jenkins transfer function analysis with an application to the advertising sales relationship. *Journal of Marketing Research*, *14*(2), 227–239. doi:10.2307/3150472.

Article Google Scholar

Hwee, N. G., & Tiogn, R. L. (2002). Model on cash flow forecasting and risk analysis for contracting firms. *International Journal of Project Management*, *20*(5), 351–363. doi:10.1016/S0263-7863(01)00037-0.

Article Google Scholar

Kaka, A. P., & Lewis, J. (2003). Development of a company-level dynamic cash flow forecasting model (DYCAFF). *Construction Management & Economics*,

21(7), 693–705. doi:10.1080/0144619032000116561.

Article Google Scholar

Kapoor, S. G., Madhok, P., & Wu, S. M. (1981). Modeling and forecasting sales data by time series analysis. *Journal of Marketing Research*, *18*(1), 94–100. doi:10.2307/3151318.

Article Google Scholar

Kenley, R. (1999). Cash farming in building and construction: a stochastic analysis. *Construction Management & Economics*, *17*(3), 393–401. doi:10.1080/014461999371592.

Article Google Scholar

Khumawala, S. B., Polhemus, N. W., & Liao, W. M. (1981). The predictability of quarterly cash flows. *Journal of Business Finance & Accounting*, *8*(4), 493–510. doi:10.1111/j.1468-5957.1981.tb00831.x.

Article Google Scholar

Kotsialos, A., Papageorgiou, M., & Poulimenos, A. (2005). Long-term sales forecasting using Holt–Winters and neural network methods. *Journal of Forecasting*, *24*, 353–368. doi:10.1002/for.943.

Article Google Scholar

Lam, M. (2004). Neural network techniques for financial performance prediction integrating fundamental and technical analysis. *Decision Support Systems*, *37*, 567–581. doi:10.1016/S0167-9236(03)00088-5.

Article Google Scholar

Lee, J., Boatwright, P., & Kamakura, W. A. (2003). A Bayesian model for prelaunch

sales forecasting of recorded music. *Management Science*, *49*(2), 179–196. doi:10.1287/mnsc.49.2.179.12744.

Article Google Scholar

Littell, R. C., & Freund, R. J. (2000). *SAS System for Regression*. North Carolina: SAS Institute.

Google Scholar

Luxhoj, J. T., Riis, J. O., & Stensballe, B. (1996). A hybrid econometric-neural network modeling approach for sales forecasting. *International Journal of Production Economics*, *43*(2–3), 175–192. doi:10.1016/0925-5273(96)00039-4.

Article Google Scholar

Moe, W. W., & Fader, P. S. (2002). Fast-track article using advance purchase orders to forecast new product sales. *Marketing Science*, *21*(3), 347–364. doi:10.1287/mksc.21.3.347.138.

Article Google Scholar

Navon, R. (1996). Company-level cash flow management. *Journal of Construction Engineering and Management*, *122*(1), 22–29. doi:10.1061/(ASCE)0733-9364(1996)122:1(22).

Article Google Scholar

Neter, J., Kutner, M. H., Nachtsheim, C. J., & Wasserman, W. (1996). *Applied Linear Statistical Models*. Boston: McGraw-Hill.

Google Scholar

Ou, J. A. (1990). The information content of non-earnings accounting numbers as earnings predictors. *Journal of Accounting Research*, *28*, 144–163.

doi:10.2307/2491220.

Article Google Scholar

Pantelidaki, S., & Bunn, D. W. (2005). Development of a multifunctional sales response model with the diagnostic aid of artificial neural network. *International Journal of Forecasting*, *24*, 505–521. doi:10.1002/for.945.

Article Google Scholar

Parsons, L. J., & Abeele, P. V. (1981). Analysis of sales call effectiveness. *Journal of Marketing Research*, *18*(1), 107–113. doi:10.2307/3151321.

Article Google Scholar

Putler, D. S., & Lele, S. (2003). An easily implemented framework for forecasting ticket sales to performing arts events. *Marketing Letters*, *14*(4), 307–320. doi:10.1023/B:MARK.0000012474.56171.e9.

Article Google Scholar

Robb, D. J., & Silver, E. A. (2002). Using composite moving averages to forecast sales. *Journal of the Operational Research Society*, *53*, 1281–1285. doi:10.1057/palgrave.jors.2601440.

Article Google Scholar

Salama, A. (2005). A note on the impact of environmental performance on financial performance. *Structural Change and Economic Dynamics*, *16*, 413–421. doi:10.1016/j.strueco.2004.04.005.

Article Google Scholar

Shumway, R. H., & Stoffer, D. S. (2000). *Time series analysis and its application*. New York: Springer-Verlag.

Google Scholar

Smith, S., Mcintyre, S. H., & Achabal, D. D. (1994). A two-stage sales forecasting procedure using discounted least squares. *Journal of Marketing Research*, *31*(1), 44–56. doi:10.2307/3151945.

Article Google Scholar

Steffens, P. R. (2001). An aggregate sales model for consumer durables incorporating a time-varying mean replacement age. *Journal of Forecasting*, *20*, 63–77. doi:10.1002/1099-131X(200101)20:1<63::AID-FOR758>3.0.CO;2-D.

Article Google Scholar

Vinod, H. D. (1973). Generalization of the Durbin–Watson statistic for higher order autoregressive process. *Communications in statistics*, *2*(2), 115–144.

Article Google Scholar

Wacker, J. G., & Lummus, R. R. (2002). Sales forecasting for strategic resource planning. *International Journal of Operations & Production Management*, *22*(9), 1014–1031. doi:10.1108/01443570210440519.

Article Google Scholar

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, *48*(4), 817–838. doi:10.2307/1912934.

Article Google Scholar

Wild, J. J. (2003). *Financial accounting*. Boston, Massachusetts: McGraw-Hill.

Google Scholar

Wild, J. J., Subramanyam, K. R., & Halsey, R. F. (2004). *Fundamentals of Financial Statement Analysis* (1st ed.). New York: MacGraw-Hill.

Google Scholar

Yin, R. K. (2003). *Case study research: design and methods*. California: Thousand Oaks.

Google Scholar

Acknowledgments

The author would like to thank James B. Kau (Editor), C. F. Sirmans (Editor), and anonymous referees for their useful comments and suggestions. The author also thanks the Taiwan National Science Council for financially supporting this research.

Author information

Authors and Affiliations

Department of Industrial Engineering and Management, I-Shou University, No. 1, Sec. 1, Syuecheng Road, Dashu Township, Kaohsiung County, 840, Taiwan

Hong Long Chen

Corresponding author

Correspondence to Hong Long Chen.

Rights and permissions

About this article

Cite this article

Chen, H.L. Using Financial and Macroeconomic Indicators to Forecast Sales of Large Development and Construction Firms. *J Real Estate Finan Econ* **40**, 310–331 (2010). https://doi.org/10.1007/s11146-008-9158-7

Published
29 October 2008

Issue Date
April 2010

DOI
https://doi.org/10.1007/s11146-008-9158-7

Keywords

Sales forecasting | Financial and macroeconomic indicators | Time series | Regression analysis

Search

Search by keyword or author

Navigation

Find a journal

Publish with us

Track your research