

Integrating Financial Statement Modeling and Sales Forecasting Using EViews

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This paper shows how to integrate pro forma financial statement analysis and sales forecasting using the EViews software package. The integration enables us to use the forecast of future sales and the associated standard errors to carry out an empirically-based Monte Carlo simulation of the future paths of all income and balance sheet items in the pro forma statements. This provides useful additional information to the financial analyst. Not only does he/she obtain expected future values for the various pro forma statement items, there are also confidence intervals that can be used to assess the uncertainty of the financial forecasts.

INTRODUCTION

In most business school programs students are exposed to financial statement modeling¹ and to introductory statistical and econometric methods, including forecasting (especially – sales forecasting).² However, there is seldom an attempt to integrate them within a unified framework. The objectives of this paper are to show how such integration can be done using the EViews econometrics package.

The paper begins by showing how to implement a simple sales-driven model of financial statements using EViews, rather than Excel. Our illustration uses a model from Simon Benninga's popular *Financial Modeling* textbook (2008, Ch.3). The EViews model is transparent and easy to audit and debug because the financial equations are written out explicitly in a MODEL object in EViews rather than being embedded in Excel's cell formulas. Although the steps can be carried out using EViews' graphical user interface, we provide a well-documented EViews program to automate the entire exercise. Thus, it should be easy for other researchers to replicate and extend the EViews model.

Next, we calibrate our EViews version of the Benninga model using historical data for Home Depot, then generate pro forma statements over the 2011-2016 time span. This projection exercise like Benninga's is deterministic not stochastic; i.e. sources of uncertainty are not explicitly modeled. To develop a stochastic generalization of the model, we estimate a simple univariate forecasting equation for Home Depot sales. The uncertainty regarding future sales captured by the standard error of the forecast in future years is used to 'drive' stochastic simulation of the entire pro forma statement model where all of the items depend directly or indirectly (via the model's ratio assumptions and accounting identities) on future sales.

By integrating sales forecasting and the financial statement model we create an empirically-based stochastic generalization of the model. The stochastic model provides a wealth of useful additional information to the financial analyst. Not only does she obtain expected future values for the various pro forma statement variables, but also the corresponding confidence intervals that can be used to assess uncertainty of the financial forecasts. We illustrate the stochastic model output with an analysis of projected sales, profits, cash balances, and outstanding debt.

Although our estimated sales equation is a simple one for illustrative purposes, the procedures outlined in this paper can be implemented with any sales forecasting equation one prefers. It may be a single equation (univariate or reduced form) or one equation in a multi-equation model – be it a vector autoregression (VAR) or structural model. Indeed, with the latter, it is straightforward to introduce several sources of uncertainty, while correctly capturing interactions among the forecasted variables. Confidence intervals would then reflect the error variances in all equations as well as their covariances.

The remainder of the paper is structured as follows. The second section describes an EViews implementation of a simple pro forma statement model from Benninga, 2008. The third section shows how to calibrate and simulate the EViews version of the financial statement model using data for Home Depot. The fourth section develops an illustrative sales forecasting equation. The fifth section explains how to integrate sales forecasting and pro forma models in order to carry out empirically-based stochastic simulation of Home Depot's financial statements. The sixth section summarizes our findings.

PRO FORMA STATEMENT MODELING IN EIEWS

Benninga (2008, Ch.3) introduces a series of sales-driven Excel models for financial statements.³ In this section, we describe the EViews implementation of his second model. In this model, as long as cash balances remain positive, CASH (which equals cash and marketable securities) is the plug⁴ and paid-in capital and outstanding long-term debt remain constant (by rolling over any maturing debt). In situations where there is a 'run down' in CASH, however, it is assumed that the firm will issue new debt as needed in order to prevent CASH from going negative. Thus, DEBT, in effect, becomes the plug when CASH drops to zero. (It would be straightforward and more realistic to set a minimum CASH threshold at a positive number rather than zero.)

Benninga sets up the model with a set of hypothesized initial figures for the income statement and balance sheet items shown in Table 1. In real-world applications, these figures would be taken from actual financial statements. For ease of reference, we have added our chosen EViews series names in the left-most column of Table 1.

Benninga lays out a simple set of equations and identities to describe the interrelationships among the income statement and balance sheet variables at each future date. These equations are shown in Table 2. Note that the sales growth rate is assumed to be constant (at 20%) over time. The model is 'sales driven' in the sense that several key variables are proportional to sales: Cost of Goods Sold, Other Current Assets, Net Fixed Assets, and Current Liabilities. As described above, CASH is the plug with DEBT unchanged as long as CASH is positive. Using the balance sheet identity, therefore, we can write CASH as:

$$CASH = \min[0, CL + DEBT(-1) + EQUITY - OCA - NFA]$$

where DEBT(-1) denotes debt in the previous period. OCA is Other Current Assets, NFA is Net Fixed Assets, CL is Current Liabilities, and EQUITY = CAPITAL + ACC_EARNINGS. See Table 1 for all variable definitions. When CASH hits zero, however, DEBT becomes the plug. Thus,⁵

$$DEBT = \max[DEBT(-1), OCA + NFA - CL - EQUITY].$$

**TABLE 1
INITIAL YEAR DATA**

EViews Series		
Name	INCOME STATEMENT	Year 0
SALES	Sales	1000.0
COGS	Cost of Goods Sold	500.0
INT_DEBT	Interest Expense on Debt	32.0
INT_CASH	Interest Earnings on Cash & Securities	6.0
DEPN	Depreciation Expense	100.0
PBT	Profit Before Taxes	374.0
TAXES	Taxes	149.6
PROFIT	After-Tax Profit	224.4
DIVIDENDS	Dividends	89.8
RET_EARNINGS	Retained Earnings	134.6
BALANCE SHEET		
CASH	Cash and Marketable Securities	80.0
OCA	Other Current Assets	150.0
FA_COST	Fixed Assets at Cost	1070.0
ACC_DEPN	Accumulated Depreciation	(300.0)
NFA	Net Fixed Assets	770.0
ASSETS	TOTAL ASSETS	1000.0
CL	Current Liabilities	80.0
DEBT	Debt Outstanding	320.0
LIAB	Total Liabilities	400.0
CAPITAL	Stock	450.0
ACC_EARNINGS	Accumulated Retained Earnings	150.0
EQUITY	Total Equity	600.0
	Total Liabilities + Equity	1000.0

To complete the model, Benninga assumes that:

- Interest expense is 10% on outstanding debt (averaged over the period)
- Interest income is 8% on the cash and marketable securities (averaged over the period)
- Depreciation expense is 10% on fixed assets at cost (averaged over the period)
- Dividend payout rate is 50 percent of after-tax earnings
- Corporate tax rate is 40 percent.

Table 2 summarizes the functional relationships in Benninga's Model.

Because many of the model equations involve variables lagged one period, denoted by (-1) after the series name, the model is, in effect, a system of first-order difference equations. Given the initial conditions (from the period prior to the start of the projections time sample), the system of equations is solved recursively going forward to obtain future-period values.

TABLE 2
FORMULAS FOR PRO-FORMA FINANCIAL STATEMENTS

Formula for Subsequent Periods	Assumptions
SALES = SALES(-1)*1.20	Constant Sales growth rate
COGS = 0.50*SALES	Sales Driven
INT_DEBT = .10*(DEBT+DEBT(-1))/2	Given percentage
INT_CASH = .08*(CASH+CASH(-1))/2	Given percentage
DEPN = .10*(FA_COST+FA_COST(-1))/2	Given percentage
PBT = SALES-COGS - INT_DEBT + INT_CASH - DEPN	Identity
TAXES = .40*PBT	Given percentage
PROFIT = PBT - TAXES	Identity
DIVIDENDS = .50*PROFIT	Given percentage
RET_EARNINGS = PROFIT - DIVIDENDS	Identity
CASH = CL+DEBT(-1)+EQUITY- OCA + NFA if positive = 0, otherwise	The "Plug"
OCA = .20*SALES	Sales Driven
FA_COST = NFA + ACC_DEPN	Identity
ACC_DEPN = ACC_DEPN(-1) + DEPN	Identity
NFA = .80*SALES	Sales Driven
ASSETS = CASH + OCA + NFA	Identity
CL = .08*SALES	Sales Driven;
DEBT = DEBT(-1) if CASH ≥ 0 = OCA + NFA - CL - EQUITY otherwise	Debt increases if needed to prevent CASH<0
LIAB = CL + DEBT	Identity
CAPITAL = CAPITAL(-1)	Stock remains constant
ACC_EARNINGS = ACC_EARNINGS(-1) + RET_EARNINGS	Identity
EQUITY = CAPITAL + ACC_EARNINGS	Identity

The Benninga model is straightforward to implement and solve using EViews. The steps, which can be carried out using the user-friendly graphical interface or using an EViews program (see Appendix), are:

- (1) Create an EViews workfile with annual frequency and a range that spans the historical data and the desired forecast or projection interval (say, five years). For the Benninga example, we use an *undated* (rather than annual) EViews workfile with six periods, one for the initial period of data (or initial conditions) and five for the pro forma projections.
- (2) Import the income and balance sheet data from Excel file. Be sure to label each series in the Excel file before importing into EViews.
- (3) Declare a MODEL object and append all of the model equations, as summarized in Table 2 above.
- (4) Solve the model and create two GROUPS with the income statement series and the balance sheet series in order to show the model 'solutions' for future periods. If desired, these pro forma statements can be exported to an Excel file for 'beautification.' Alternatively, this can be done by creating and formatting a TABLE object within EViews.

The program can easily be adapted for annual, quarterly, or monthly frequencies. Figure 1 shows the generated EViews workfile, which contains series with the initial year data, the Model object named

“model2”, the model solution series with an extension “_0” added to the end of the names, and the income statement and balance sheet tables.

FIGURE 1
EVIEWS WORKFILE FOR BENNINGA’S MODEL

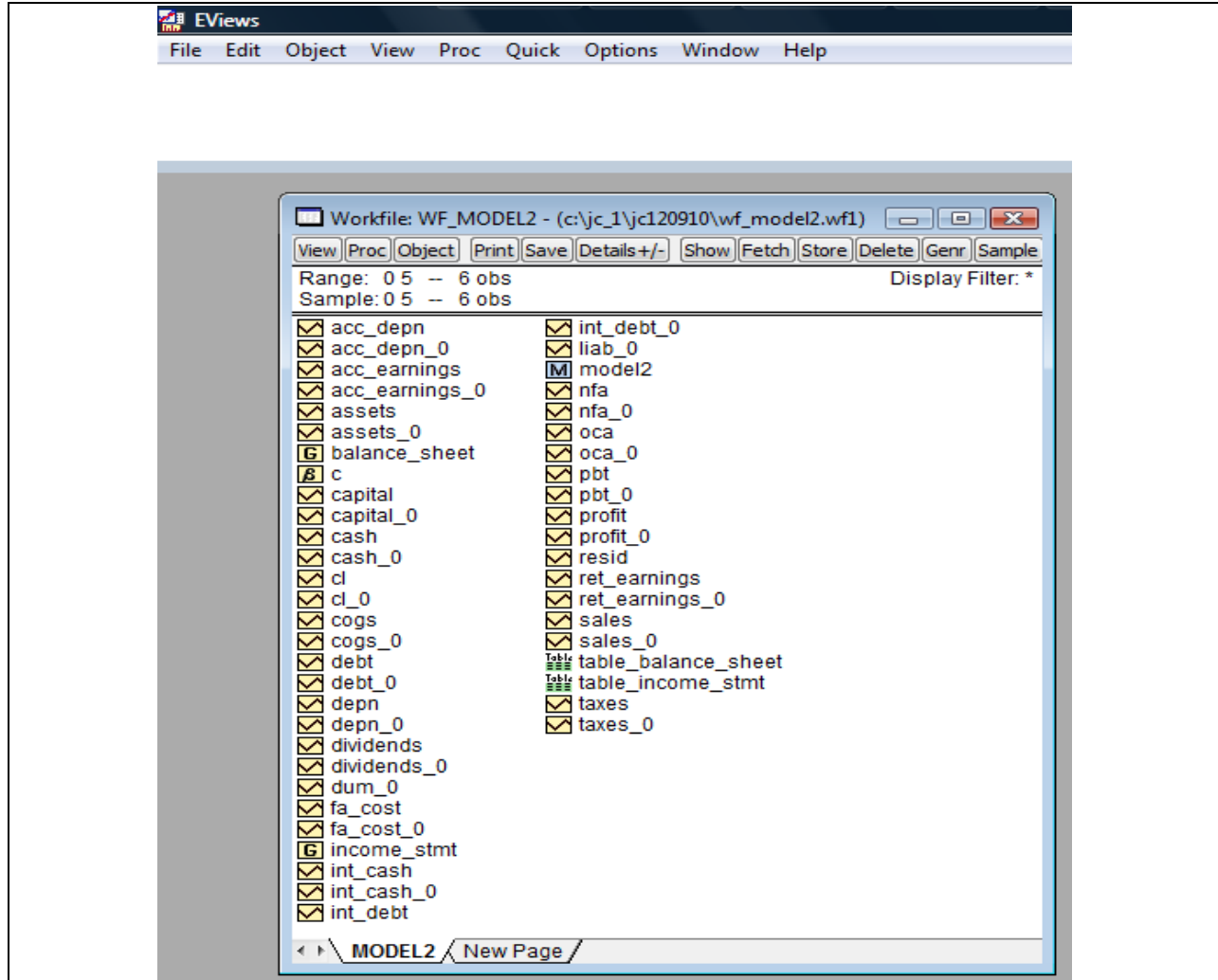


Figure 2 shows the equations as entered into the EViews MODEL object following the Table 2 structure. One of equations constructs a dummy variable (DUM) to determine the sign of CASH balances. When CASH is positive, it is the plug. If CASH can become negative, it is constrained to equal zero and DEBT increases.

FIGURE 2
BENNINGA'S MODEL IN THE EViews MODEL OBJECT

' Income Statement

SALES = 1.20 * SALES(-1)
 COGS = 0.50 * SALES
 INT_DEBT = (DEBT(-1) + DEBT) / 2 * 0.10
 INT_CASH = (CASH(-1) + CASH) / 2 * 0.08
 PBT = SALES - COGS - INT_DEBT + INT_CASH - DEP_N
 TAXES = 0.40 * PBT
 PROFIT = PBT - TAXES
 DIVIDENDS = 0.50 * PROFIT
 RET_EARNINGS = PROFIT - DIVIDENDS

' Balance Sheet

' create a dummy variable that is 1 if CASH would be negative in the absence of additional debt, and zero otherwise.

' Using EViews syntax, everything after the equal sign is treated as a logical condition. If it holds, DUM is 1; zero otherwise.

DUM = - OCA - NFA + CL + DEBT(-1) + EQUITY < 0

' define CASH as the balance sheet plug, if positive, and ZERO otherwise by creative use of the dummy:

CASH = (- OCA - NFA + CL + DEBT(-1) + EQUITY) * (1 - DUM)

OCA = 0.20 * SALES
 NFA = 0.80 * SALES
 DEP_N = 0.10 * (FA_COST(-1) + FA_COST) / 2
 ACC_DEP_N = ACC_DEP_N(-1) + DEP_N
 FA_COST = NFA + ACC_DEP_N
 ASSETS = CASH + OCA + NFA
 CL = 0.08 * SALES

' when DUM=1, cash is negative, so DEBT is the plug;

' when DUM=0, cash is positive, so debt is unchanged from the previous period

DEBT = (OCA + NFA - CL - EQUITY) * DUM + DEBT(-1) * (1 - DUM)

LIAB = DEBT + CL

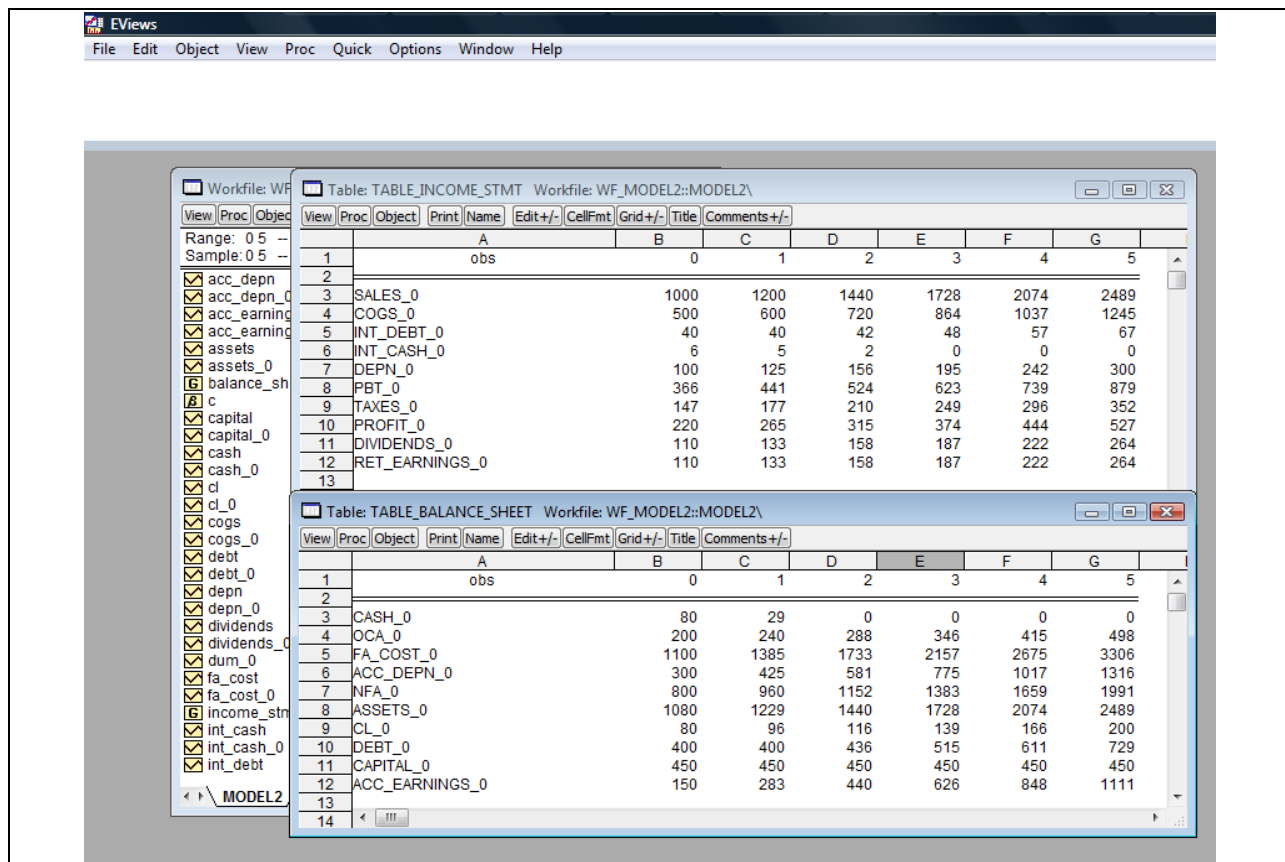
CAPITAL = CAPITAL(-1)

ACC_EARNINGS = ACC_EARNINGS(-1) + RET_EARNINGS

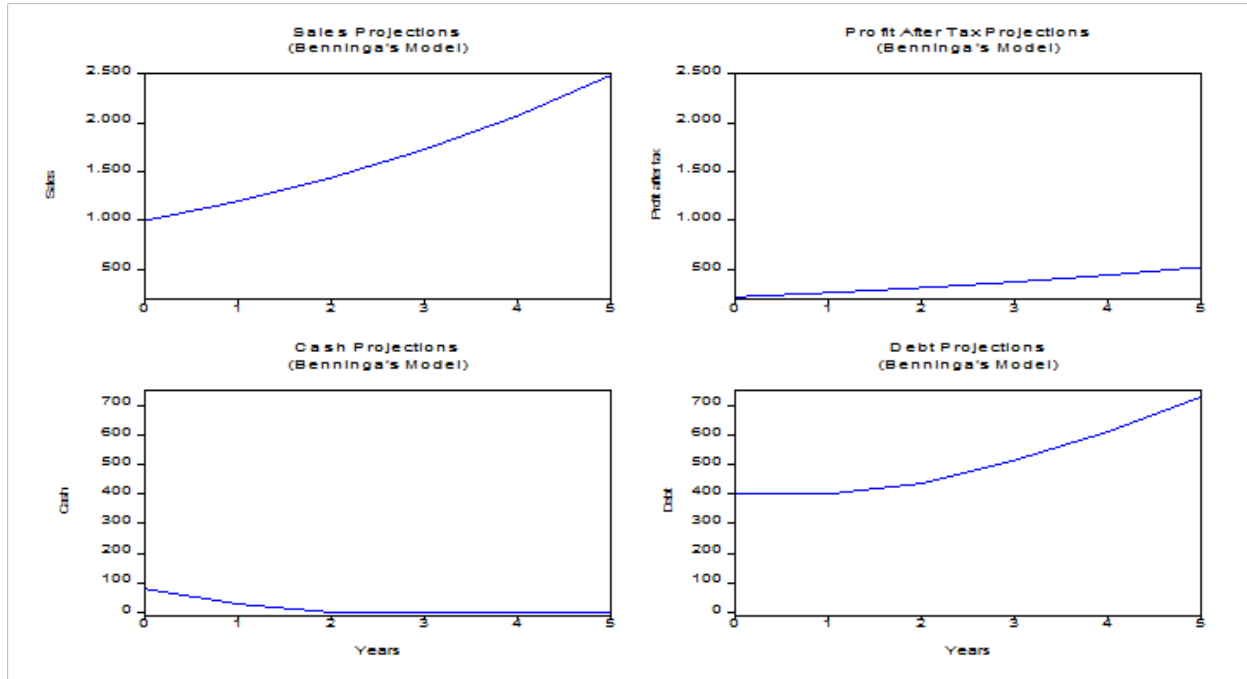
EQUITY = CAPITAL + ACC_EARNINGS

The EViews MODEL object is designed for solving first or higher-order simultaneous equation systems with leads and/or lags of various series using initial and/or terminal conditions, as appropriate. In the current application with first-order difference equations and initial conditions for year 0, the MODEL is solved from year 1 to year 5.⁶ Figure 3 shows the pro forma income statement and balance sheet variables generated by the EViews model. The values match those in Benninga's Excel pro-forma statements (Benninga, 2008, p. 120). Figure 4 shows graphs of projected sales, profit, cash, and debt. As the model assumed, sales grow at the constant rate of 20%. Profit increases over the time at the average growth rate of 19%. Cash hits the zero level by year 2 and stays at that level in the remaining years. Debt does not change in year 1 and increases from year 2. This implies that, starting in year 2, the firm has to obtain additional funding every year to finance growing assets.

FIGURE 3
EVIEWS PRO FORMA FINANCIAL STATEMENTS: BENNINGA'S MODEL



**FIGURE 4
PROJECTED SALES, PROFIT, CASH, AND DEBT**



HOME DEPOT PRO FORMA STATEMENT MODELING IN EViews

In this section we show how to calibrate and solve the EViews version of the financial statement model using historical data for Home Depot.

Based on the financial statements for the last five years, 2006-2010, the following ratios and rates were obtained:⁷

- sales growth rate = -1.38%, the average over 2006-2010
- COGS/Sales ratio = 89%, the average over 2006-2010
- interest rate on debt = 7%, the 2010 estimate
- interest rate earned on cash and cash equivalents = 1%, the 2010 estimate
- tax rate = 36%, the average over 2006-2010
- dividend payout ratio = 58%, the 2010 estimate; the average dividend payout ratio over 2006-2010 was 36%
- OCA/Sales ratio = 18%
- NFA/Sales ratio = 34%
- depreciation rate = 5%
- CL/Sales ratio = 16%.

Using these parameter values and starting values for 2010, we solved the EViews financial model for the next six years, 2011-2016.⁸ Figure 5 shows the initial and simulated balance sheets and income statements for Home Depot. Our analysis of the simulation results focuses on projections of four key items: SALES (model's "driver"), PROFIT (the income statement bottom line item), CASH (model's main plug) and DEBT (model's ancillary plug). Figure 6 presents graphs of these variables. The simulations were based on the assumption that SALES will decline over the projection period of 2011-2016. The model predicts that PROFIT will increase in 2011 but will decline thereafter. As SALES decline, so does cost of goods sold (COGS), TAXES, other current assets (OCA), net fixed assets (NFA), etc. As a result (and given the Home Depot parameter assumptions above), CASH is projected to rise over time! Hence, DEBT stays constant at the 2010 level.

FIGURE 5
HOME DEPOT PRO FORMA STATEMENTS -- SALES DECLINE SCENARIO

Range: 1985 2016
Sample: 2010 2016

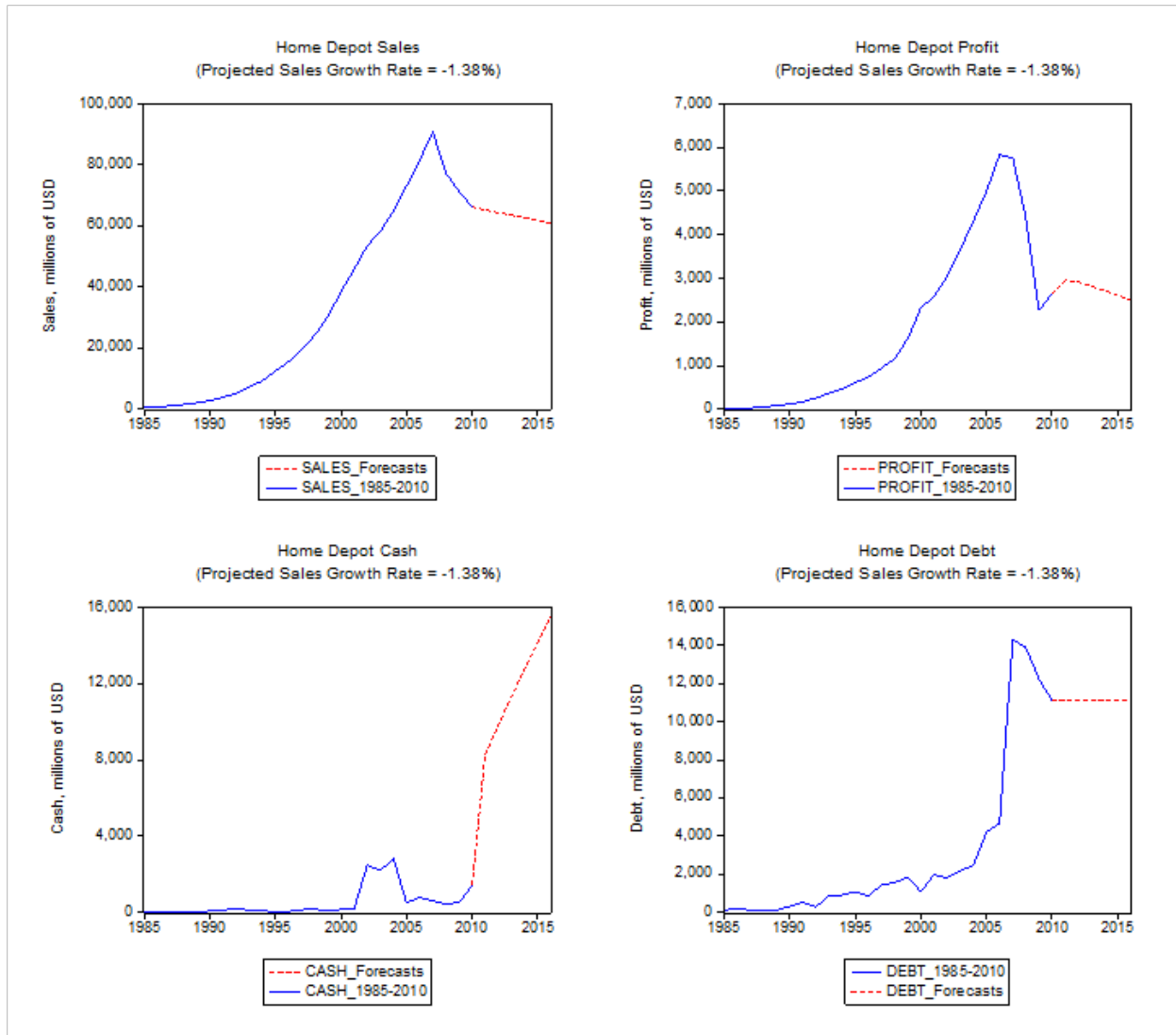
Table: TABLE_INCOME_STMT Workfile: WF_HD_020211::MODEL2_HD\

	A	B	C	D	E	F	G	H
1	obs	2010	2011	2012	2013	2014	2015	2016
2								
3	SALES_0	66176	65263	64363	63474	62599	61735	60883
4	COGS_0	59666	58084	57283	56492	55713	54944	54186
5	INT_DEBT_0	803	779	779	779	779	779	779
6	INT_CASH_0	18	49	91	106	121	135	149
7	DEPN_0	1707	1829	1829	1907	1990	2077	2168
8	PBT_0	4018	4620	4564	4403	4239	4071	3900
9	TAXES_0	1362	1664	1643	1585	1526	1466	1404
10	PROFIT_0	2656	2957	2921	2818	2713	2606	2496
11	DIVIDENDS_0	1528	1715	1694	1635	1574	1512	1448
12	RET_EARNINGS_0	1128	1242	1227	1184	1140	1095	1049

Table: TABLE_BALANCE_SHEET Workfile: WF_HD_020211::MODEL2_HD\

	A	B	C	D	E	F	G	H
1	obs	2010	2011	2012	2013	2014	2015	2016
2								
3	CASH_0	1421	8262	9812	11316	12770	14175	15530
4	OCA_0	12479	11748	11586	11426	11268	11113	10959
5	FA_COST_0	37345	35814	37336	38941	40633	42415	44293
6	ACC_DEPN_0	11795	13624	15453	17360	19349	21426	23593
7	NFA_0	25550	22190	21884	21582	21284	20990	20700
8	ASSETS_0	40877	42198	43281	44322	45321	46277	47189
9	CL_0	10363	10443	10298	10156	10016	9878	9742
10	DEBT_0	11121	11121	11121	11121	11121	11121	11121
11	CAPITAL_0	6167	6167	6167	6167	6167	6167	6167
12	ACC_EARNINGS_0	13226	14468	15695	16878	18018	19112	20160

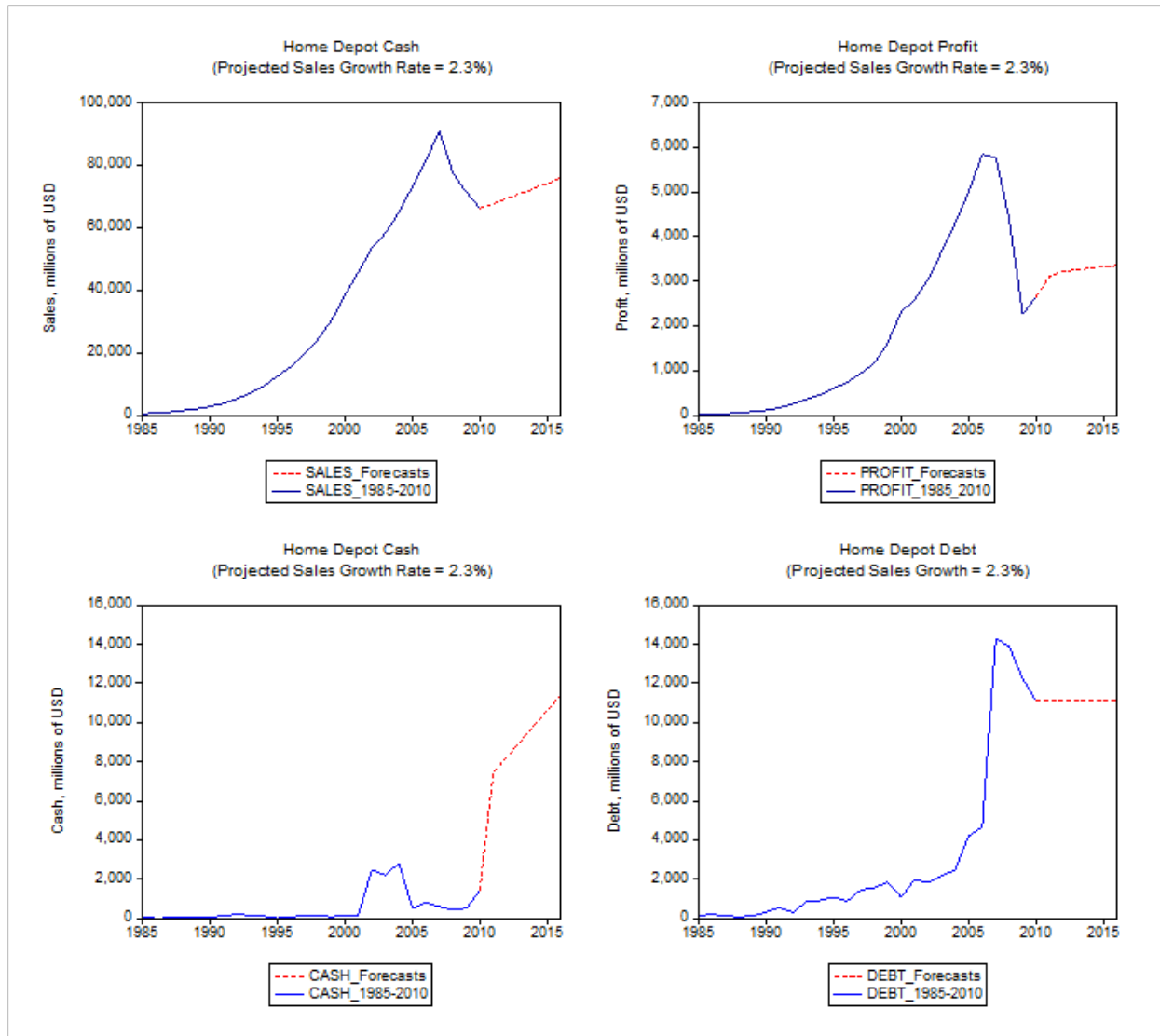
FIGURE 6
PROJECTED SALES, PROFIT, CASH, AND DEBT FOR HOME DEPOT:
SALES DECLINE SCENARIO



For comparison, we run the Home Depot model simulations assuming sales increase at the constant rate of 2.3%.⁹ The resulting graphs of SALES, PROFIT, CASH, and DEBT are shown in Figure 7. The increasing sales scenario shows that PROFIT will rise in 2011 by about 17% and from 2012 will grow at the declining rates hovering under 1%. The CASH balances are expected to increase to \$11.4 billion by 2016, what is lower than the 2016 projection for CASH (\$15.5 billion) under the sales decline scenario. The DEBT level is not expected to change.

The Home Depot cash projections in both the sales decline and sales increase scenarios show that the sales-driven model might produce ever increasing cash. That's not the always the case. The results are, of course, sensitive to the parameter assumption. For example, if we assume that sales increase at 2.3% and change only the NFA/SALES ratio assumption from 34% to 60%, then the model shows that CASH will decline from the 2010 level of \$1,421 million to zero in the first projection year 2011 and will stay at the zero level afterwards.

FIGURE 7
PROJECTED SALES, PROFIT, CASH, AND DEBT FOR HOME DEPOT:
SALES INCREASE SCENARIO



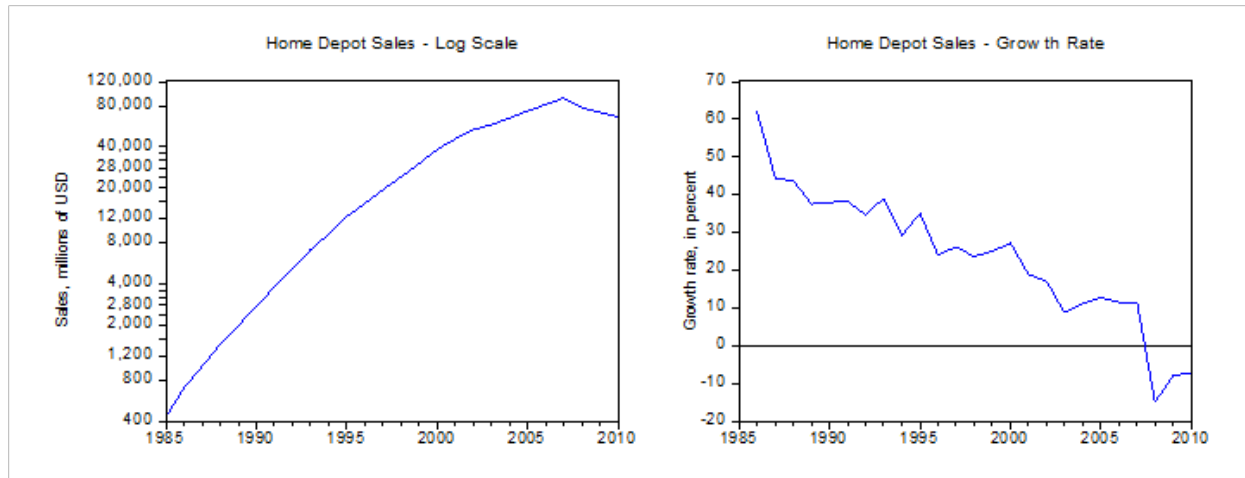
The Home Depot model in this section supposes that sales grow at the constant rate. In the next section we forecast sales assuming the variable growth.

THE SALES FORECASTING EQUATION

This section summarizes the estimation of a simple univariate sales forecasting equation for Home Depot. This equation will be incorporated into the EVIEWS model of pro forma statements in the next section.

Figure 8 shows the time plots of sales (on a log scale) and the sales growth rates from 1986 through 2010. Sales growth has declined from a rather spectacular 62% rate in 1986 to sharply negative growth in 2008-2010 (-15%, -8%, and -7%, respectively).

**FIGURE 8
HOME DEPOT SALES IN 1985-2010**



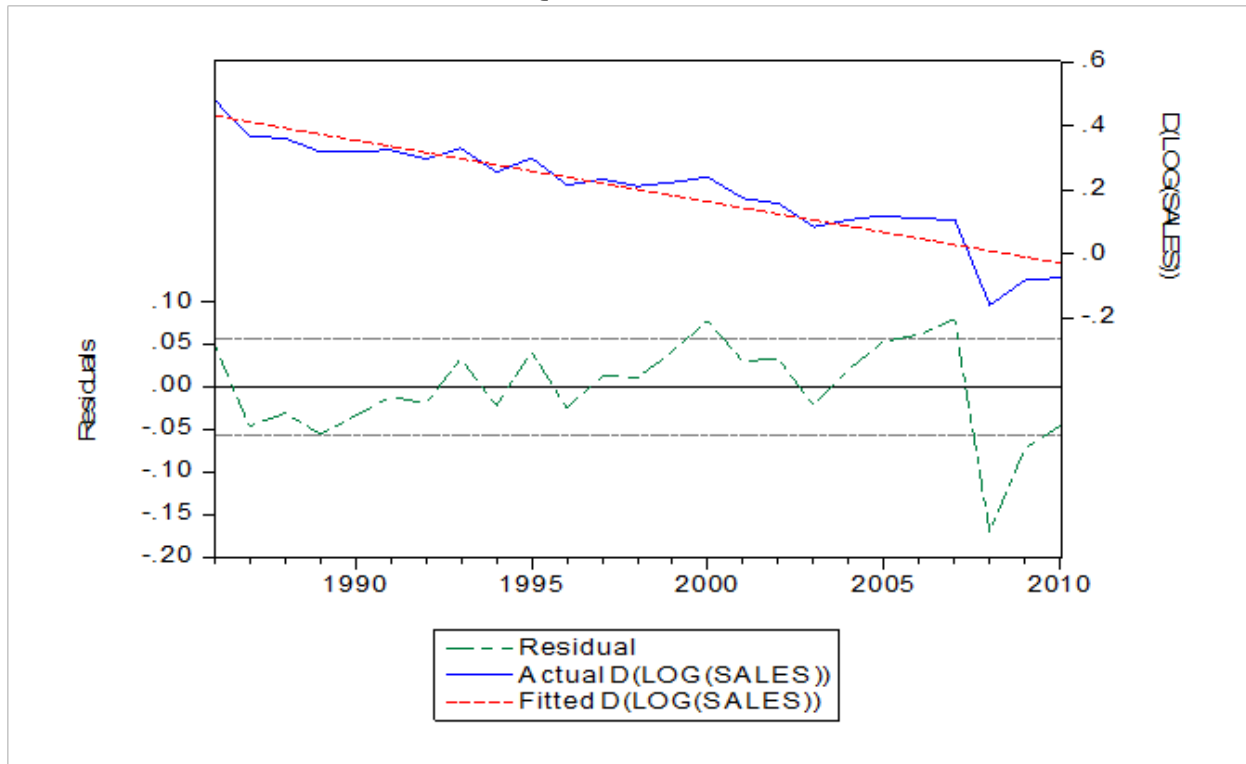
The negative growth rates are undoubtedly due, at least in part, to the U.S. recession and worldwide slowdown in 2008-2009, but the declining growth rates prior to that leave concern about longer term prospects. In this situation, univariate forecasting techniques may not provide especially accurate forecasts. Multivariate approaches may produce superior results. This, however, is not of particular importance here as our objective is to illustrate how forecasting equations – whether univariate or multivariate, single equation or multiple-equations systems – can be used to carry out empirically based stochastic simulations using EViews. Our estimated sales equation is a linear time trend model¹⁰ for the continuously compounded annual SALES *growth rate* (equal to the first difference of the natural logarithm of SALES): $LOG(SALES_t) - LOG(SALES_{t-1}) = 0.450985 - 0.019215t + \varepsilon_t$, (1) where LOG denotes the natural logarithm function, t is time, ε_t is the residual term, $LOG(SALES_t) - LOG(SALES_{t-1}) = D(LOG(SALES))$ in the EViews notations. The estimation output results are displayed in Table 3. The equation is estimated with Newey-West robust standard

**TABLE 3
ESTIMATED SALES EQUATION**

Dependent Variable: D(LOG(SALES))				
Method: Least Squares				
Date: 02/20/11 Time: 21:49				
Sample (adjusted): 1986 2010				
Included observations: 25 after adjustments				
Newey-West HAC Standard Errors & Covariance (lag truncation=2)				
	Coefficient	Std. Error	t-Statistic	Prob.
C	0.450985	0.023881	18.88463	0.0000
@TREND	-0.019215	0.002208	-8.702750	0.0000
R-squared	0.866251	Mean dependent var		0.201194
Adjusted R-squared	0.860436	S.D. dependent var		0.151942
S.E. of regression	0.056763	Akaike info criterion		-2.823245
Sum squared resid	0.074107	Schwarz criterion		-2.725735
Log likelihood	37.29056	Hannan-Quinn criter.		-2.796200
F-statistic	148.9637	Durbin-Watson stat		1.484233
Prob(F-statistic)	0.000000			

errors. The t -statistics, derived with these standard errors, are above two, what shows that the intercept term and the time coefficient are statistically significant. The adjusted R^2 value (.86) is high. It indicates that model (1) provides a good fit. Graphs of actual and fitted values of the dependent variable $D(\text{LOG}(\text{SALES}))$ and graphs of the residuals are shown in Figure 9. The correlogram of the residuals is flat, suggesting an absence of serial correlation. The Breusch-Godfrey LM test of the null hypothesis that there is no first or second-order correlation is not rejected ($\chi^2=1.41$).

FIGURE 9
SALES EQUATION RESIDUALS



INTEGRATING THE SALES FORECAST AND THE PRO FORMA STATEMENT MODEL

This section describes integration of the sales forecast and the financial statement model. First, we link the sales forecasting equation (estimated in the fourth section) with the model of financial statements (explained in the third section). Next, we use the stochastic simulation features in the EViews MODEL to forecast sales and all of the other income and balance sheet items into the future. Through Monte Carlo simulation methods (using 10,000 stochastic repetitions), the means and confidence bands for each variable at each future dates are obtained. We show the results for PROFIT and CASH balances.

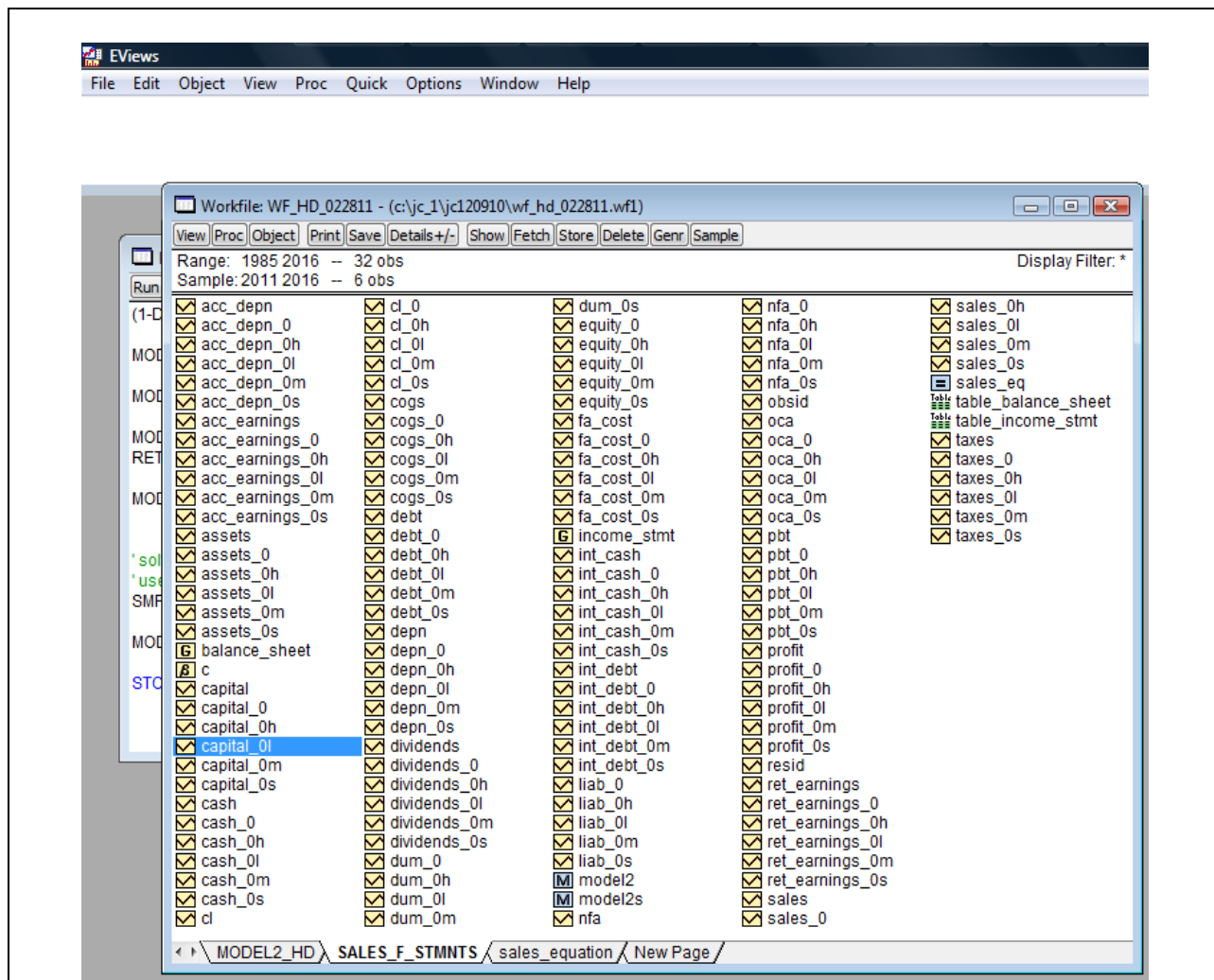
In order to integrate the sales forecast and the pro forma statement model, we replace the constant sales growth equation in the deterministic version of the Home Depot model ($SALES = 0.9862 * SALES(-1)$) with a link to the estimated sales equation in the workfile ($:SALES_EQ$). This link is a basis of stochastic simulations of pro forma statements.

We wrote a program that automates the EViews implementation of both deterministic and stochastic models for Home Depot. The program creates an annual frequency workfile with the time range 1985-2016, imports the balance sheet and the income statement for the initial year - 2010, creates and solves the deterministic model for 2011-2016, shows the projected income statement and balance sheet, and exports them into Excel files. Next, the program integrates sales forecasting and the pro forma statement model.¹¹ The steps are:

- Copy the EViews page with Benninga's model of financial statements for Home Depot to a new page within the workfile. This new page will integrate sales forecasts and pro forma financial statements
- Load a page with an estimated sales equation
- Make the integrating page the active page
- Copy the sales equation to the integrating page
- Create a stochastic model, which links sales forecasting equation with the earlier deterministic model of financial statements
- Solve the stochastic model from 2011 to 2016.

Figure 10 shows the created EViews workfile with pages for solving the deterministic model (MODEL2_HD), for integrating sales forecasts and the pro forma statement model (SALES_F_STMNTS), and estimating the sales equation. The SALES_F_STMNTS page is active.

FIGURE 10
EViews WORKFILE FOR INTEGRATING SALES FORECASTS AND PRO FORMA STATEMENT MODEL

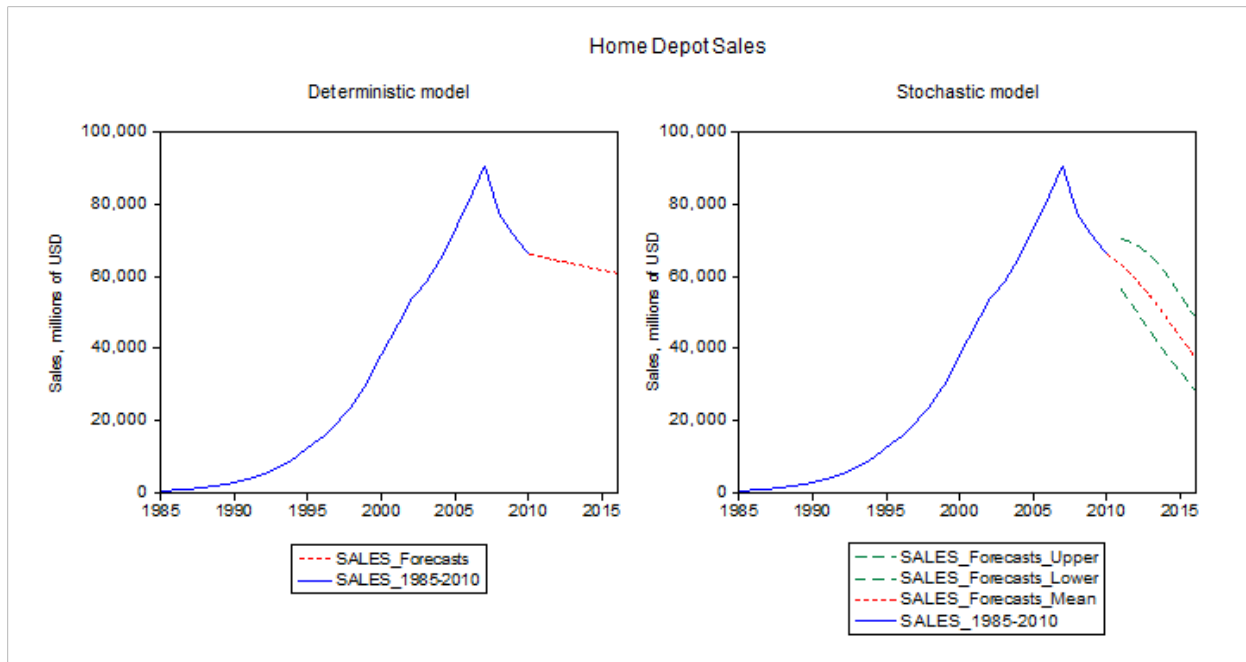


It contains the following items:

- series with the initial year data
- two Model objects (“model2” – deterministic model; “model2s” – stochastic model)
- the deterministic model solution series with an extension “_0” added to the end of the names
- the stochastic model solution series with four different name extensions:
 - “_0h” – upper forecasts, the upper 95% confidence bounds
 - “_0l” – lower forecasts, the lower 95% confidence bounds
 - “_0m” – mean forecasts
 - “_0s” – standard deviations of the mean forecasts

Solving the model with the incorporated sales equation allows us to easily produce the future SALES forecasts and their 95% (or other user selected) confidence intervals, shown in Figure 11. The model projects that SALES will decline from \$66,176 million in 2010 to \$37,491 million in 2016.

**FIGURE 11
UNIVARIATE SALES FORECASTS FOR HOME DEPOT**



We depict CASH and PROFIT forecasts generated by the stochastic model in Figures 12 and 13. Comparing to the deterministic model forecasts (derived under the assumption of the constant sales growth rate = -1.38%), the stochastic model projects a steeper increase of the CASH balances and a faster decline in PROFIT.

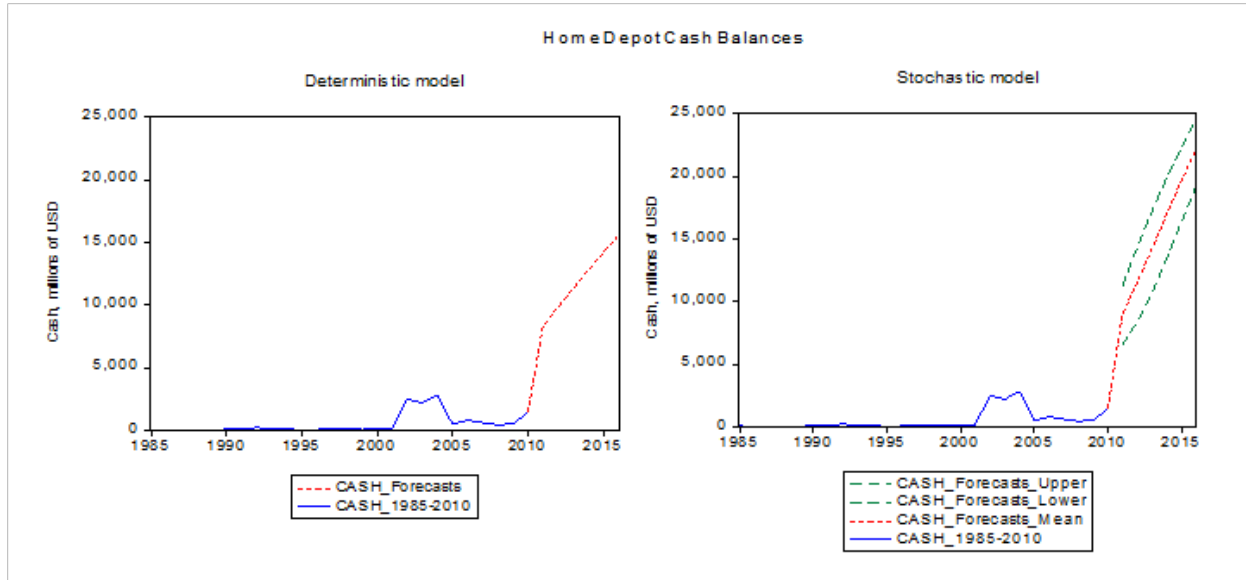
CONCLUSIONS

This paper demonstrates how to integrate pro forma financial statements with sales forecasting. The integration was performed in four steps: (i) modeling of financial statements in the EViews; (ii) estimation of a sales forecasting equation; (iii) linkage of the sales forecasting equation and the EViews model of financial statements; (iv) forecasting sales and other items in the pro forma statements and constructing confidence intervals for those forecasts.

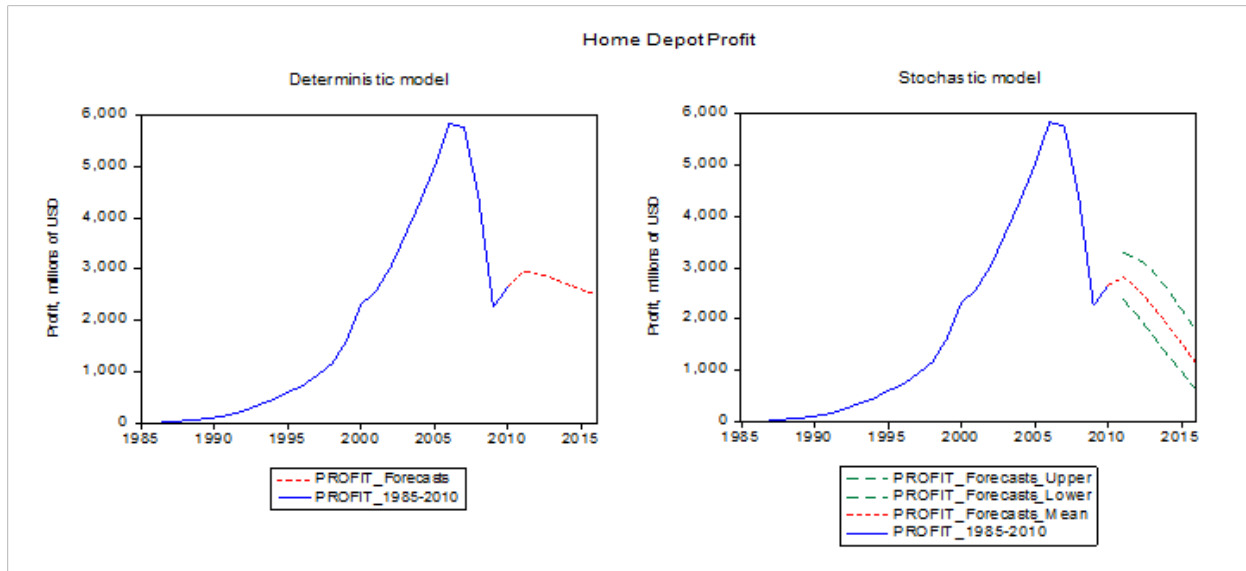
The illustration developed in this paper shows that EViews modeling of financial statements has the benefit of being more transparent and easier to audit and debug than the same financial model implemented in the Excel spreadsheet program. Advantages of the use of sales forecasting equation

include projection of the sales series with a realistic (and typically variable) growth rate, estimation of the expected values for various pro forma statement items, obtaining the confidence bands for financial forecasts. The confidence intervals can be used to assess the degree of uncertainty associated with the financial forecasts.

**FIGURE 12
HOME DEPOT CASH FORECASTS**



**FIGURE 13
HOME DEPOT PROFIT FORECASTS**



The procedures outlined in the paper can be implemented with any sales forecasting equation. It may be a single equation or one equation in a multiple equation model. It is possible to introduce several sources of uncertainty into the analysis, with accounting for correlations among the error terms. We intend to develop financial modeling with multiple sources of uncertainty in our future work¹².

ENDNOTES

1. See Benninga (2008), Charnes (2007), Holden (2009), Sengupta (2007), Winston (2008) for detailed examples of financial statement modeling.
2. See Diebold (2007) for a representative discussion of forecasting methods.
3. The sales-driven models assume that the key variables in financial statements are functions of sales.
4. The plug guarantees that assets are equal to liabilities and equity.
5. In EViews, we use a dummy variable rather than the min and max functions shown here to determine whether CASH is positive or not. This dummy is then used to determine whether CASH or DEBT, in effect, becomes the plug in any given year.
6. The model can be solved forward for as many periods as the analyst is interested in.
7. The Home Depot financial statements were downloaded from the Mergent Online database.
8. The EViews program for solving the Home Depot model is available at <http://inside.mines.edu/~jcudding/>.
9. This is Home Depot's estimate for the fiscal year ending on January 31, 2011, as reported by Associated Press on December 8, 2010.
10. We also considered quadratic time trend terms and specifications that assumed two rather than one unit roots. But they proved to be inferior to the specification reported.
11. The EViews program for integrating sales forecasting and financial statement modeling is available at <http://inside.mines.edu/~jcudding/>.
12. Aljihrish et al (2011) are considering multiple sources of uncertainty for projecting Newmont Mining Corporation's financial variables.

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APPENDIX

EViews PROGRAM FOR RUNNING BENNINGA'S MODEL

```
'=====
' 06/05/11 IK JC

' This program implements Benninga's second model of financial statements (Model 2) in EViews
' The model is described in Benninga (2008, Ch. 3)

' Model 2 assumptions:
' (i) Cash and marketable securities is the plug
' (ii) No negative cash balances
' (iii) Debt increases if  $CA + NFA > CL + Debt(-1) + Accumulated\ Retained\ Earnings$ 

' Initial year: 0
' Projected years: 1-6

' The program steps:
' 1. Create an annual WORKFILE
' 2. Import the balance sheet and income statement for the initial year - year 0
' 3. Create and solve Benninga's model of financial statements (Model 2) to generate pro forma statements
' 4. Export the generated financial statements into Excel files.
' 5. Show the generated income statement and balance sheet
'=====
' Set default directory where Excel data input files are located
CD "c:\jc_1\jc120910"

' 1. Create an undated WORKFILE
' the created workfile will contain a page named (Benninga) Model2

WFCREATE(PAGE = "Model2") MY_WORK U 0 5

' 2. Import the balance sheet and income statement for the initial year - year 0

SMPL @first @first
READ(B2,T) BS_Model2_year0.XLS 10
READ(B2,T) IS_Model2_year0.XLS 10

' 3. Create and solve Benninga's model of financial statements (Model 2) to generate pro forma statements

' Declare model object named MODEL2

MODEL MODEL2

' Declare a string and append to the model object as a comment line

%Z = " ' Income Statement "
MODEL2.APPEND {%Z}

' Add/append the income statement equations to Model 2
```

```

' The sales growth rate = 20%
MODEL2.APPEND   SALES = 1.20*SALES(-1)

' COGS/Sales ratio = 50%
MODEL2.APPEND   COGS = 0.50 * SALES

' interest rate on debt = 10%
MODEL2.APPEND   INT_DEBT = (DEBT(-1) + DEBT)/2 * 0.10

' interest rate earned on cash and cash equivalents = 8%
MODEL2.APPEND   INT_CASH = (CASH(-1) + CASH)/2 * 0.08

' Profit Before Taxes
MODEL2.APPEND   PBT = SALES - COGS - INT_DEBT + INT_CASH - DEPN

' tax rate = 40%
MODEL2.APPEND   TAXES = 0.40 * PBT

MODEL2.APPEND   PROFIT = PBT - TAXES

'the dividend payout ratio = 50%
MODEL2.APPEND   DIVIDENDS = 0.50 * PROFIT

MODEL2.APPEND   RET_EARNINGS = PROFIT - DIVIDENDS

' Declare a string and append to the model object as a comment line
%Z = " ' Balance Sheet "
MODEL2.APPEND  {%Z}

'Add the balance sheet equations to Model 2

%Z = " ' create a dummy variable that is 1 if CASH would be negative in the absence of additional debt,
and zero otherwise. "
MODEL2.APPEND  {%Z}

%Z = " ' Using EViews syntax, everything after the equal sign is treated as a logical condition. If it
holds, DUM is 1; zero otherwise. "
MODEL2.APPEND  {%Z}

MODEL2.APPEND  DUM = - OCA - NFA + CL + DEBT(-1) + EQUITY < 0

%Z = " ' define CASH as the balance sheet plug, if positive, and ZERO otherwise by creative use of the
dummy: "
MODEL2.APPEND  {%Z}

MODEL2.APPEND  CASH = (- OCA - NFA + CL + DEBT(-1) + EQUITY) * (1 - DUM)

' OCA/Sales ratio = 20%
MODEL2.APPEND  OCA = 0.20 * SALES

```

```

' NFA/Sales ratio = 80%
MODEL2.APPEND  NFA = 0.80 * SALES

' depreciation rate = 10%
MODEL2.APPEND  DEPN = 0.10 * (FA_COST(-1) + FA_COST)/2

MODEL2.APPEND  ACC_DEPN = ACC_DEPN(-1) + DEPN

MODEL2.APPEND  FA_COST = NFA + ACC_DEPN

MODEL2.APPEND  ASSETS = CASH + OCA + NFA

' CL/Sales ratio = 16%
MODEL2.APPEND  CL = 0.08 * SALES

' Debt increases if CA + NFA > CL + Debt(-1) + Accumulated Retained Earnings.

%Z = " ' when DUM=1, cash is negative, so DEBT is the plug; when DUM=0, cash is positive, so debt is
unchanged from the previous period "
MODEL2.APPEND  {%Z}

MODEL2.APPEND  DEBT = (OCA + NFA - CL - EQUITY)*DUM + DEBT(-1)*(1-DUM)

MODEL2.APPEND  LIAB = DEBT + CL

' assume the constant capital = stock
MODEL2.APPEND  CAPITAL = CAPITAL(-1)

MODEL2.APPEND  ACC_EARNINGS = ACC_EARNINGS (-1) + RET_EARNINGS

MODEL2.APPEND  EQUITY = CAPITAL + ACC_EARNINGS

' solve the model for the deterministic solution from year 1 to year 6
' use year 0 values for initial conditions, as needed.
SMPL 1 @LAST
SOLVE MODEL2

' form a group of forecasted income statement variables

GROUP INCOME_STMT SALES_0 COGS_0 INT_DEBT_0 INT_CASH_0 DEPN_0 PBT_0 TAXES_0
PROFIT_0 DIVIDENDS_0 RET_EARNINGS_0

' form a group of forecasted balance sheet variables

GROUP BALANCE_SHEET CASH_0 OCA_0 FA_COST_0 ACC_DEPN_0 NFA_0 ASSETS_0 CL_0
DEBT_0 CAPITAL_0 ACC_EARNINGS_0

' 4. Export the projected income statement and balance sheet GROUPS (transposed) into Excel files

WRITE(C2,T) IS_model.XLS INCOME_STMT

```

```

WRITE(C2,T) BS_model.XLS BALANCE_SHEET

' 5. Show the generated income statement and balance sheet (optional)

smpl 0 @last
' create and show a table of income statement variables
FREEZE(TABLE_INCOME_STMT) INCOME_STMT.SHEET(TRANSPPOSE)
TABLE_INCOME_STMT.SETFORMAT(@ALL) R.0
TABLE_INCOME_STMT.SETWIDTH(@ALL) 10
TABLE_INCOME_STMT.SETWIDTH(1) 30
TABLE_INCOME_STMT.SETJUST(R3C1:R15C1) LEFT
SHOW TABLE_INCOME_STMT

' create and show a table of balance sheet variables
FREEZE(TABLE_BALANCE_SHEET) BALANCE_SHEET.SHEET(TRANSPPOSE)
TABLE_BALANCE_SHEET.SETFORMAT(@ALL) R.0
TABLE_BALANCE_SHEET.SETWIDTH(@ALL) 10
TABLE_BALANCE_SHEET.SETWIDTH(1) 30
TABLE_BALANCE_SHEET.SETJUST(R3C1:R15C1) LEFT
SHOW TABLE_BALANCE_SHEET

STOP

```