Solomon Islands Government

MINISTRY OF
FINANCE & TREASURY

Technical Assistance 8761 – Solomon Islands Economic Modeling for Policy Support

Workshop 3: Forecasting with EViews

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Data and Workfile Documentation

- ***WS3_Data.wf1*** and ***WS3_Data.xls*** have monthly data from January 1960-March 2013.

  - ✓ ***payroll*** – employment levels, thousands of employees (source: *Bureau of Labor Statistics*)
  - ✓ ***IP*** –industrial production, index levels (source: *Board of Governors of the Federal Reserve*)
  - ✓ ***ISM*** – The Institute for Supply Management Manufacturing Index, Index level (source: S*t. Louis' FRED Database*).
  - ✓ ***Tbill 3M***– 3-month US Treasury rate (source: *Board of Governors of the Federal Reserve*

Data and Workfile Documentation (cont'd)

- The spreadsheet produced here shows the data series at the end of the workfile range.
- Note that historical data are available for all data series up until March 2013.
- From *2013m04* until the end of the workfile range, we have provided forecasts for series ***IP***, ***ISM***, ***TBill3m***.
- We will create a few equations to forecast the ***payroll*** series using EViews.

Group: UNTITLED Workfile: DATA::Untitled\

View | Proc | Object | Print | Name | Freeze | Default | Sort | Edit+/- | Smpl+/- | Com

	PAYROLL	IP	ISM	TBILL3M
2012M09	134374	96.95490	51.60000	0.11
2012M10	135241	96.84090	51.70000	0.10
2012M11	135636	98.03210	49.90000	0.09
2012M12	135560	98.11270	50.20000	0.07
2013M01	132704	98.03450	53.10000	0.07
2013M02	133752	99.07310	54.20000	0.10
2013M03	134562	99.47650	51.30000	0.09
2013M04	NA	99.67545	51.66667	0.09
2013M05	NA	99.87480	51.46389	0.09
2013M06	NA	100.0746	51.37755	0.09
2013M07	NA	100.2747	51.47568	0.09
2013M08	NA	100.4753	51.55698	0.09
2013M09	NA	100.6762	51.62840	0.09
2013M10	NA	100.8776	51.63076	0.09
2013M11	NA	101.0793	51.62499	0.09
2013M12	NA	101.2815	51.76874	0.09
2014M01	NA	101.4840	51.89947	0.09
2014M02	NA	101.6870	51.79943	0.09
2014M03	NA	101.8904	51.59938	0.09
2014M04	NA	102.0942	51.62433	0.09
2014M05	NA	102.2983	51.62080	0.09
2014M06	NA	102.5029	51.63388	0.09
2014M07	NA	102.7079	51.65524	0.09
2014M08	NA	102.9134	51.67020	0.09
2014M09	NA	103.1192	51.67963	0.09
2014M10	NA	103.3254	51.68390	0.09
2014M11	NA	103.5321	51.68833	0.09
2014M12	NA	103.7391	51.69361	0.09

Forecasting

- EViews offers a powerful and easy-to-use forecasting tool that allows you to obtain forecasts from your estimated models.
- Of course, the accuracy of the forecasts depends on the model used to produce the forecasts: EViews simply handles the mechanics of producing the forecasts.
- This tutorial explains the basic procedures for forecasting from a single equation. The tutorial assumes knowledge of estimating equations in EViews.
- The main topics of this tutorial are:
  - ✓ Forecast Basics (Static vs. Dynamic, Forecast Evaluation, Errors and Variances)
    - ✓With exogenous variables
    - ✓With lagged dependent variables
    - ✓With lagged dependent variables and ARMA terms
  - ✓ Forecasting with Auto-series

Forecasting with Exogenous Variables
Example 1

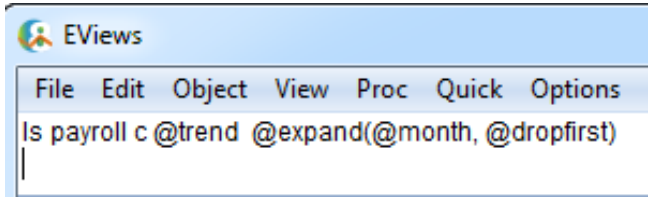
- Suppose we want to forecast the level of non-farm payroll employment for the period from *2014m04 to 2014m12*.
- To accomplish this task, we first need to specify and estimate a model. Let's model the payroll level as a linear function of a time trend and seasonal factors.

Example 1: Estimation

1. Type in the command window:

```
ls payroll c @trend @expand(@month, @dropfirst)
```

2. Press **Enter** (save this equation as ***eq01***).

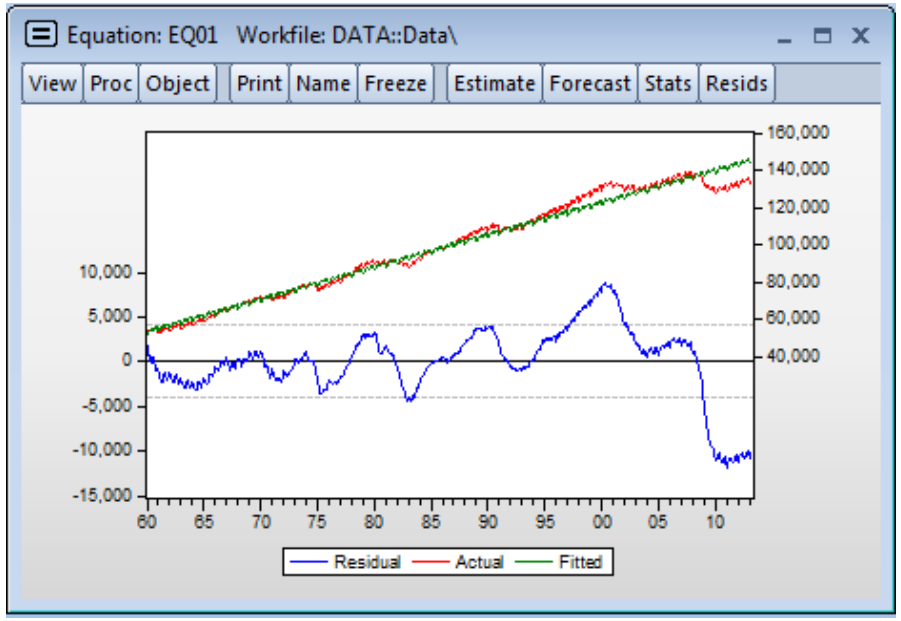


Note:** This equation is saved as ***eq01 in ***WS3_Results.wf1*** workfile.

Note that command `@expand(@month)` creates 12 dummy variables, one for each month of the year. These are the seasonal factors. Because we have included a constant, we need to exclude one of the dummy variables in order not to fall in the dummy variable trap. Here we have chosen to exclude January, by using the option `@dropfirst`.

Forecasting with Exogenous Variables Example 1 (cont'd)

- Estimation output is shown here. Note that EViews has estimated the model over the period *1960m01 to 2013m03*, for which we have ***payroll*** data.
- We also plot the actual and fitted values of the model (shown below), by pressing **View → Actual, Fitted, Residual → Actual Fitted Residual Graph**.



Equation: EQ01 Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/11/13 Time: 19:25
Sample (adjusted): 1960M01 2013M03
Included observations: 639 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	51730.04	615.7437	84.01228	0.0000
@TREND	144.4909	0.867579	166.5450	0.0000
@MONTH=2	214.7869	778.4927	0.275901	0.7827
@MONTH=3	674.2405	778.4941	0.866083	0.3868
@MONTH=4	1476.381	782.1600	1.887569	0.0595
@MONTH=5	2010.607	782.1576	2.570590	0.0104
@MONTH=6	2482.814	782.1562	3.174320	0.0016
@MONTH=7	1426.984	782.1557	1.824424	0.0686
@MONTH=8	1446.229	782.1562	1.849028	0.0649
@MONTH=9	1941.945	782.1576	2.482806	0.0133
@MONTH=10	2282.907	782.1600	2.918721	0.0036
@MONTH=11	2355.756	782.1634	3.011846	0.0027
@MONTH=12	2278.605	782.1677	2.913192	0.0037

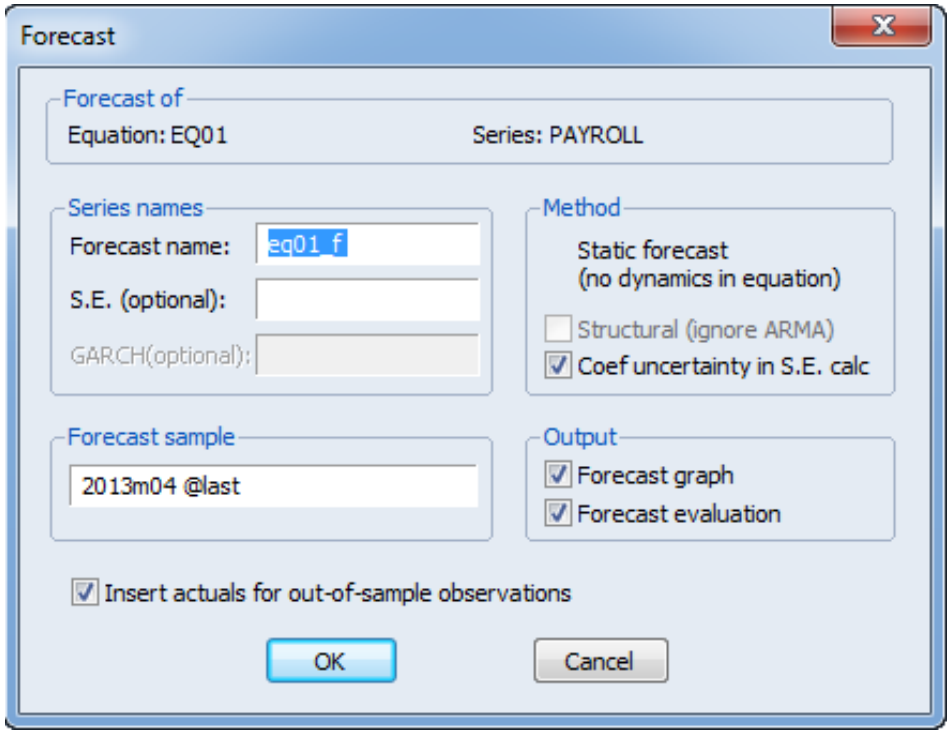
R-squared	0.977956	Mean dependent var	99366.01
Adjusted R-squared	0.977534	S.D. dependent var	26988.01
S.E. of regression	4045.164	Akaike info criterion	19.46857
Sum squared resid	1.02E+10	Schwarz criterion	19.55930
Log likelihood	-6207.207	Hannan-Quinn criter.	19.50379
F-statistic	2314.346	Durbin-Watson stat	0.006324
Prob(F-statistic)	0.000000		

Forecasting with Exogenous Variables
Example 1: Forecasting

- Now, let's produce a forecast for the ***payroll*** series based on our model.
- For this, all we have to do is press th Forecast button in the equation toolbar.

Example 1: Forecasting

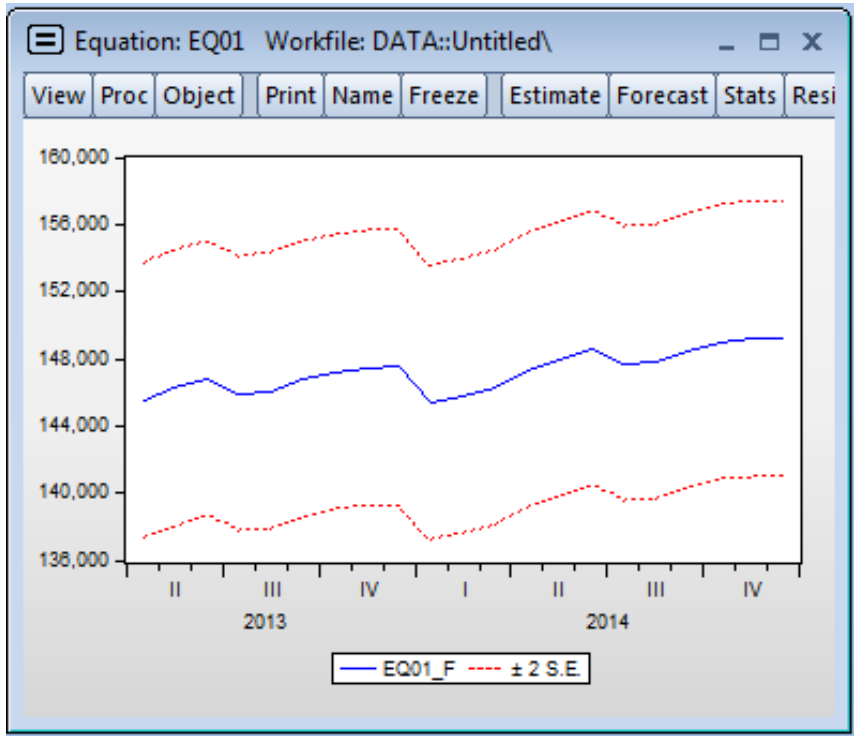
1. Open ***eq01***. On the equation box toolbar, press the button. The Forecast dialog box opens up.
2. Under ***Series name***, specify a name for the forecast series. EViews suggests a name (*payrollf*) but this series will be overwritten every time a new model is estimated. Let's save our series as ***eq01_f***.
3. Under ***Forecast sample***, select the sample over which the forecast will be carried out. Here we type, ***2013m04 @last.***
4. Check "**Insert actuals for out-of-sample observations**."
5. Under ***Method***, notice that EViews indicates this is a **Static** forecast (no dynamics in the equation) (more details later).
6. Under Output, check **Forecast graph** and **Forecast evaluation**.
7. Click **OK**.



Forecasting with Exogenous Variables
Example 1: Forecasting (cont'd)

- The *Forecast Output* is shown here.
- Notice that EViews shows the series ***Eq01_f*** over the forecast sample, together with 2 standard error bands.

Note:** This output is saved as ***graph01 in ***WS3_Results.wf1*** workfile.



Forecasting with Exogenous Variables
Example 1: Forecasting (cont'd)

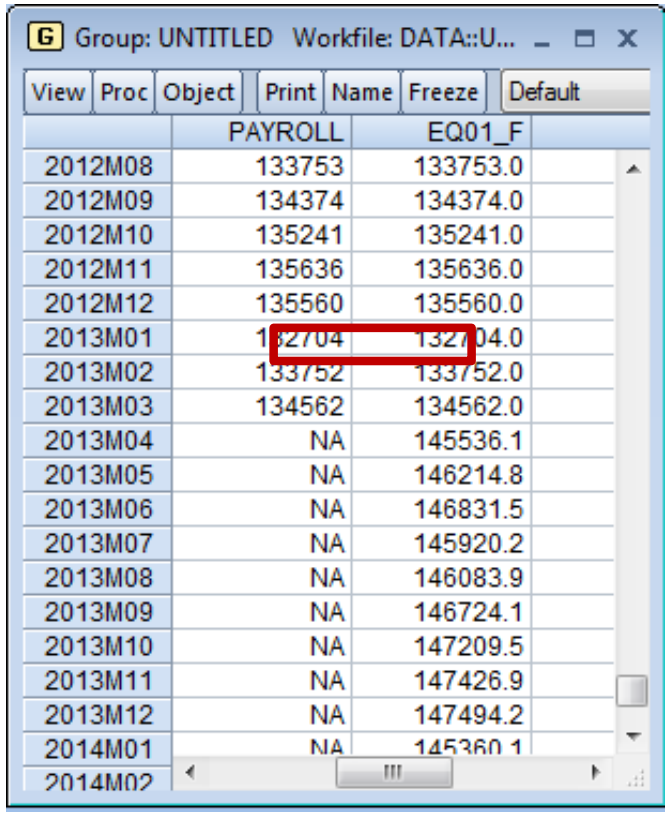
- Note also that there is now a new series ***eq01_f*** saved in the workfile. Let's open this series and the original ***payroll*** series as a group to inspect them more closely.
- Notice that the two series are identical when looking at the historical data. This is because we elected to check the box "**Insert actuals for out-of-sample observations"** which instructs EViews to use actual payroll data for the out-of-forecast sample.
- However, the ***eq01_f*** series contains actual forecasts of the payroll series for future periods. How does EViews compute these values?
- Recall that the explanatory variables in this model are ***@trend*** and seasonal factors. EViews computes the forecast for April 2013 as follows:

✓ *$@trend_{April\ 2013}$ = 639; @trend coefficient=144.4909*

✓ *@month=4; @month=4 coefficient 1,476.381.*

✓ *constant=51,730.04*

✓ *$eq01\_f_{\ April\ 2013}$= 51,730.04+144.4909*639+1,476.381*1*
=145,536.076



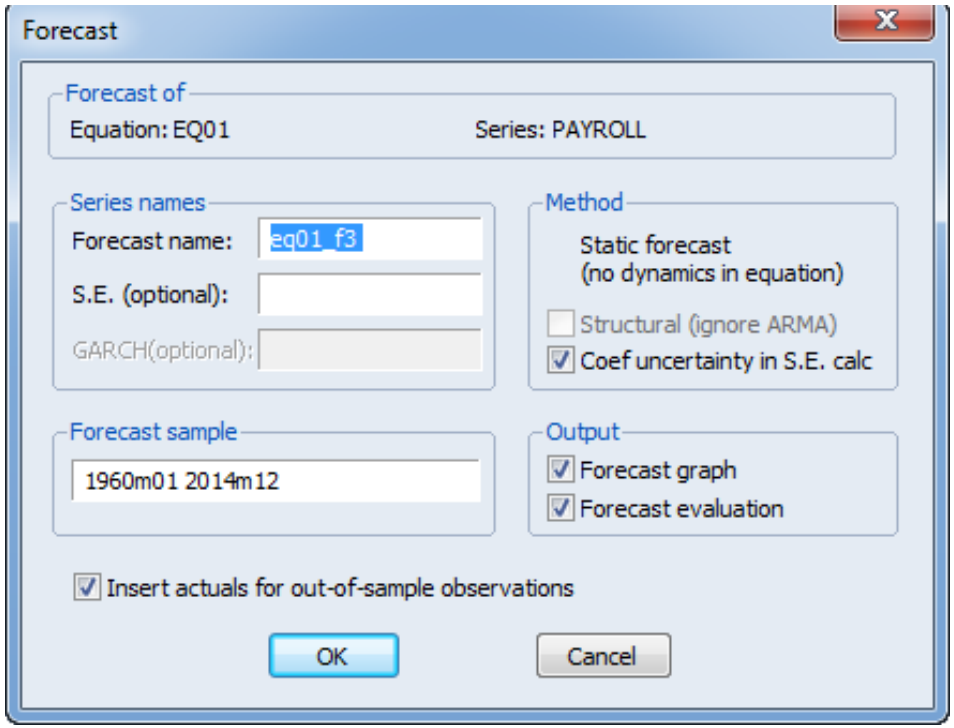
	PAYROLL	EQ01_F
2012M08	133753	133753.0
2012M09	134374	134374.0
2012M10	135241	135241.0
2012M11	135636	135636.0
2012M12	135560	135560.0
2013M01	132704	132704.0
2013M02	133752	133752.0
2013M03	134562	134562.0
2013M04	NA	145536.1
2013M05	NA	146214.8
2013M06	NA	146831.5
2013M07	NA	145920.2
2013M08	NA	146083.9
2013M09	NA	146724.1
2013M10	NA	147209.5
2013M11	NA	147426.9
2013M12	NA	147494.2
2014M01	NA	145360.1
2014M02		

Forecasting with Exogenous Variables: Example 1: Forecast Sample Changes

- What would happen if we set the forecast sample to be the entire range of the workfile?

Example 1: Forecast Sample Changes

1. Open ***eq01*** and press the Forecast button. The ***Forecast*** dialog box opens up.
2. Under ***Series name,*** name the new forecasted series ***eq01_f3***.
3. Set all the other options as we did before (check **Forecast graph** and **Forecast evaluation,** check "**Insert actuals for out-of-sample observations**."
4. Under ***Forecast Sample***, set the sample to the entire workfile range (***1960m01 2014m12***).
5. Click **OK**.



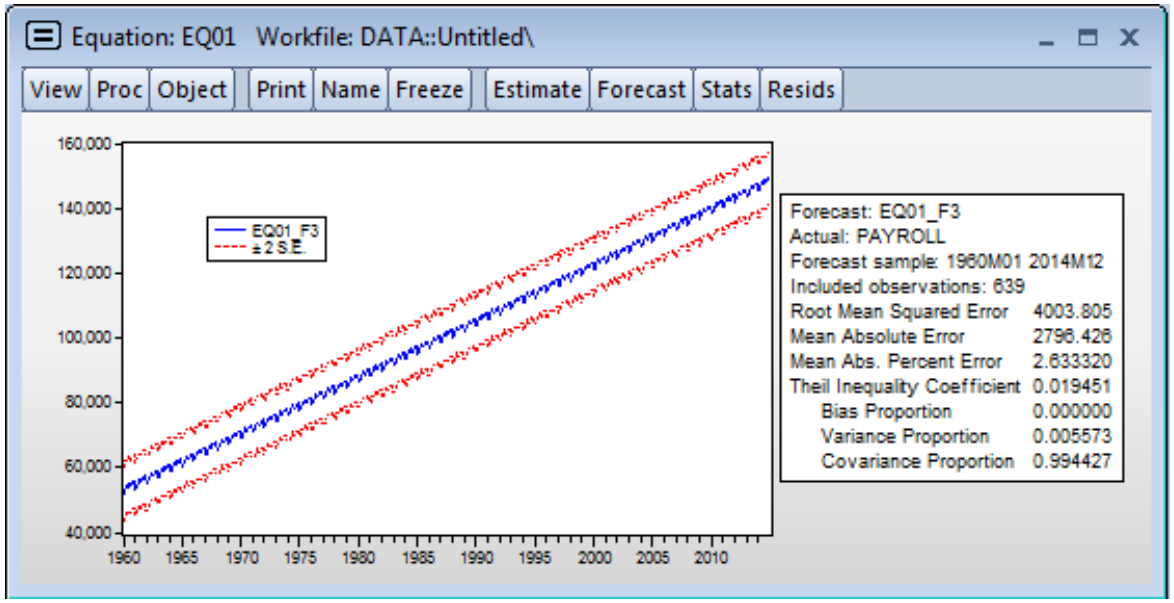
Forecasting with Exogenous Variables
Example 1: Forecast Evaluation

- The *Forecast Output* is shown here. Notice that EViews has computed ***eq01_f3*** and the corresponding standard error bands over the entire sample. Notice also that, in addition to the graph, EViews has produced a small table: this is the ***Forecast Evaluation*** table.

✓ Although, we had checked the **Forecast evaluation** box in the previous illustrations, EViews was unable to produce an output when the forecast sample was set for future periods (*2013m04 to 2014m012*).

✓ This is because EViews could not check how well the forecasting model works since the ***payroll*** data beyond *2013m03* is missing. We would have to wait until a future date when ***payroll*** data becomes available in order to compare our forecasts with what actually happens.

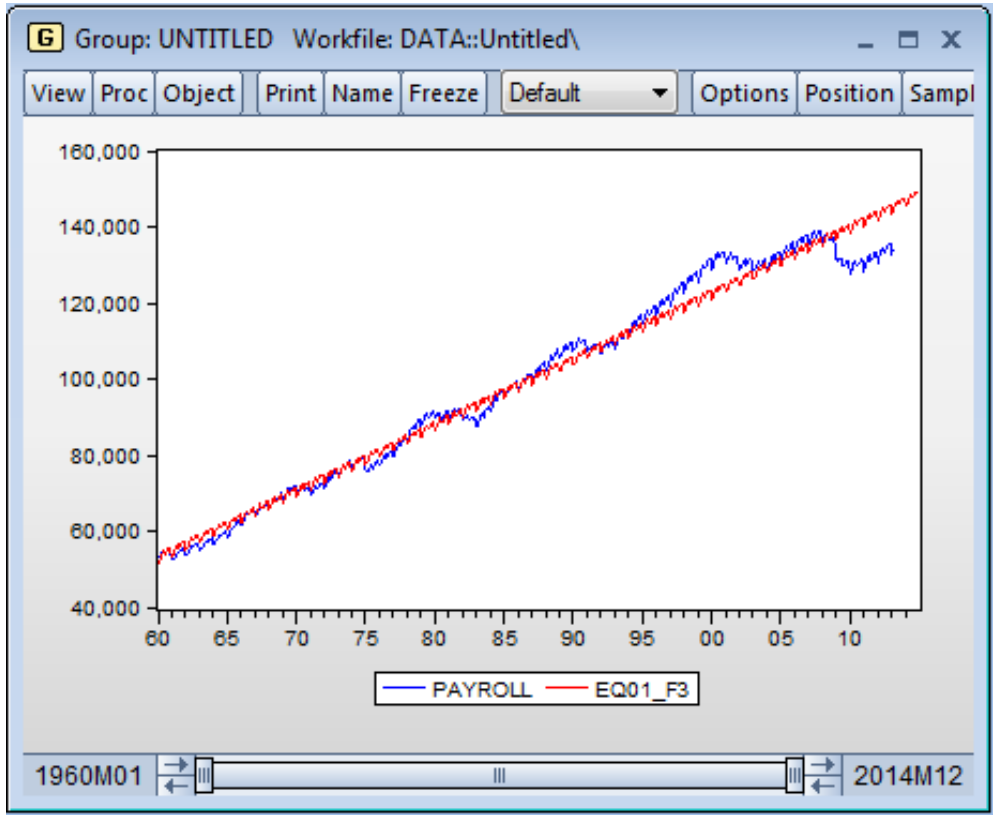
Note:** This output is saved as ***graph02 in ***WS3_Results.wf1*** workfile.



✓ When we set the forecast sample to the entire workfile range (or a sample that includes actual historical data), it is possible to check for forecast accuracy. EViews compares the forecasted (predicted) values from the model (over the period *1960m01 to 2013m03*) to the actual data and computes the forecast evaluation table.

Forecasting with Exogenous Variables
Example 1: Forecast Evaluation (cont'd)

- We can inspect in more detail the differences between the actual ***payroll*** series and the forecasted ***eq01_f3*** series. We can open them as a group and plot them together.
- As seen from the graph, values differ over the historical range (*1960m01 to 2013m03)* because ***eq01_f3*** series comes from the fitted values of ***eq01***, whereas the ***payroll*** series contains actual data.
- Of course, the ***eq01_f3*** series is also longer because it includes the future (predicted values) over the period *2013m04 to 2014m12.*



Forecasting with Exogenous Variables
In-Sample vs. Out-of-Sample Forecasts

- Notice that the *Forecast evaluation* in the previous example, simply compares the predicted values from the model to the actual data over the "historical" period (*1960m01 to 2013m03*).
- Note also that our model was estimated over the same period (*1960m01 to 2013m03*). In a sense, the "forecast" evaluation was carried out *in-sample* and not *out-of-sample*.
- In fact, since we don't have "actual" payroll data over the *2013m03 to 2014m12* period (the "true" forecast period), it is impossible for us to see how well our model performs *out-of-sample*.
- This is problematic because the history of forecasting is replete with cases when models work well *in-sample* but perform extremely poorly *out-of-sample*.
- A common practice to address this issue is to reserve part of the data by not including it in the estimation sample, effectively pretending that the history ends sooner and the reserved data is part of the future (part of forecasts).
- We can then produce forecasts over the reserved sample and perform forecast evaluation by comparing the *out-of-sample* forecast values to the actual history.

Forecasting with Exogenous Variables
Example 2: Out-of-Sample Forecasts

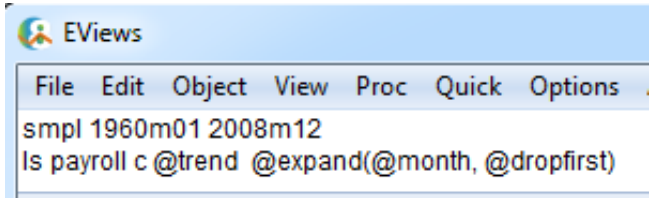
- Let's carry out Example 1 by breaking down the sample as follows:
  - ✓ Estimation Sample: *1960m01 to 2008m12*
  - ✓ Forecast Sample: *2009m1 to 2014m12*

Example 2: Estimation

1. Type in the command window:

```
smpl 1960m01 2008m12
ls payroll c @trend
@expand(@month,@dropfirst)
```

2. Press **Enter** after each command line (the second command should be typed in one line). Save this equation as ***eq02***.



Equation: EQ02 Workfile: RESULTS::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/18/13 Time: 03:29
Sample: 1960M01 2008M12
Included observations: 588

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	49929.74	351.5773	142.0164	0.0000
@TREND	154.2915	0.537060	287.2889	0.0000
@MONTH=2	180.2595	446.5039	0.403713	0.6866
@MONTH=3	623.8864	446.5049	1.397267	0.1629
@MONTH=4	1219.126	446.5065	2.730365	0.0065
@MONTH=5	1740.161	446.5088	3.897260	0.0001
@MONTH=6	2237.318	446.5117	5.010660	0.0000
@MONTH=7	1207.496	446.5152	2.704266	0.0070
@MONTH=8	1218.041	446.5194	2.727857	0.0066
@MONTH=9	1710.933	446.5243	3.831669	0.0001
@MONTH=10	2013.172	446.5297	4.508484	0.0000
@MONTH=11	2071.942	446.5359	4.640035	0.0000
@MONTH=12	2012.691	446.5427	4.507277	0.0000

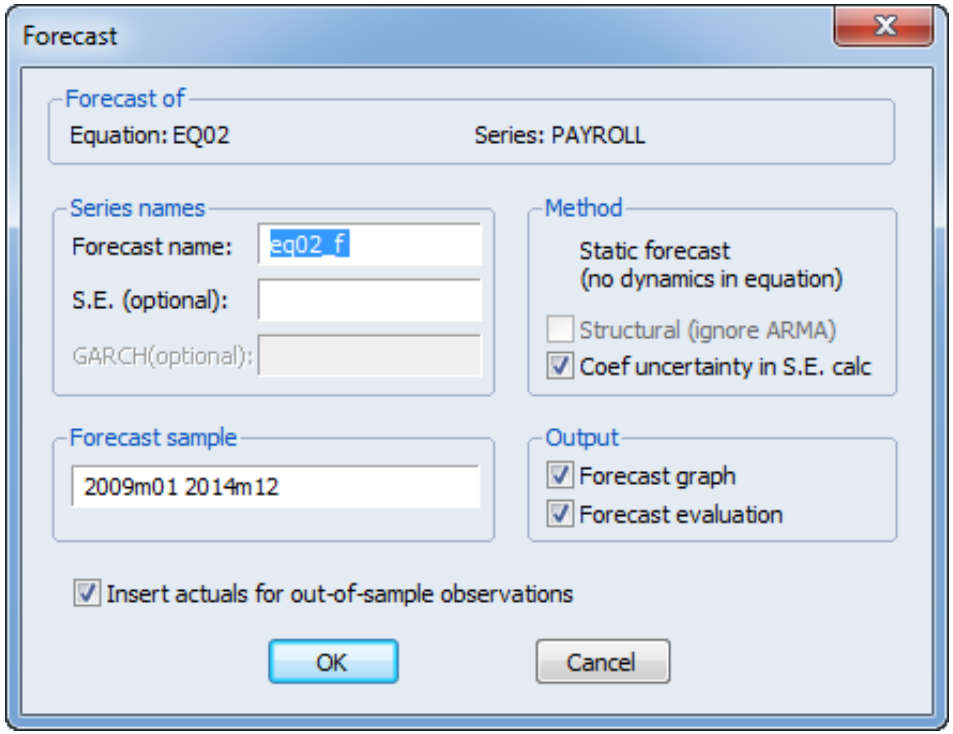
R-squared	0.993096	Mean dependent var	96567.22
Adjusted R-squared	0.992952	S.D. dependent var	26324.79
S.E. of regression	2210.080	Akaike info criterion	18.26131
Sum squared resid	2.81E+09	Schwarz criterion	18.35807
Log likelihood	-5355.824	Hannan-Quinn criter.	18.29901
F-statistic	6892.264	Durbin-Watson stat	0.019212
Prob(F-statistic)	0.000000		

Forecasting with Exogenous Variables
Example 2: Out-of-Sample Forecasts (cont'd)

- Now, let's produce a forecast for the ***payroll*** series using the forecast sample.

Example 2: Forecasting

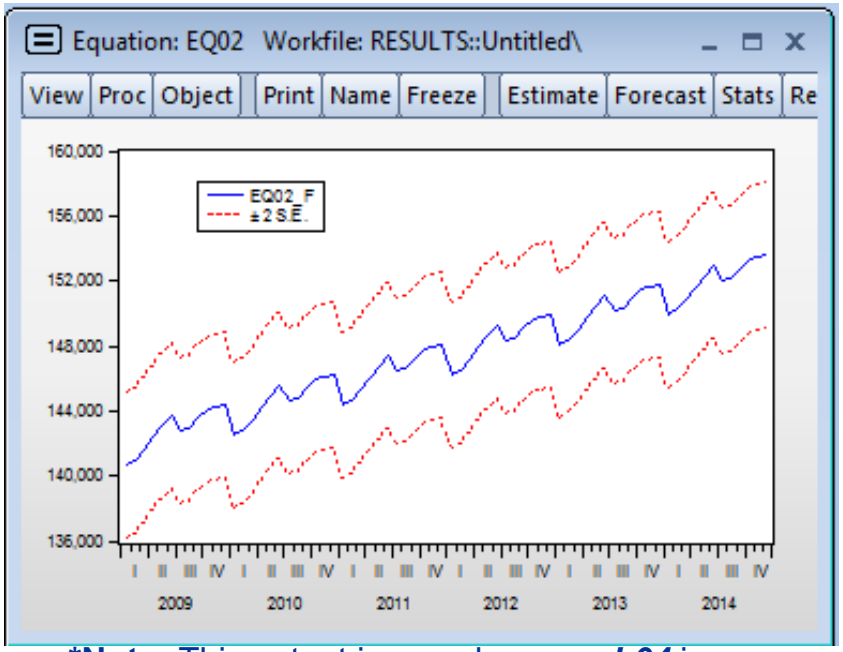
1. Open ***eq02***. On the equation box toolbar, press the Forecast button. The ***Forecast*** dialog box opens up.
2. Under **Series name,** name the series ***eq02_f***.
3. Under the **Forecast sample**, type the forecast sample (here, ***2009m1 2014m12*).**
4. Set all the other options as we did previously (check **Forecast graph, Forecast evaluation,** and **Insert actuals for out-of-sample observations**).
5. Click **OK**.



Forecasting with Exogenous Variables Example 2: Out-of-Sample Forecasts (cont'd)

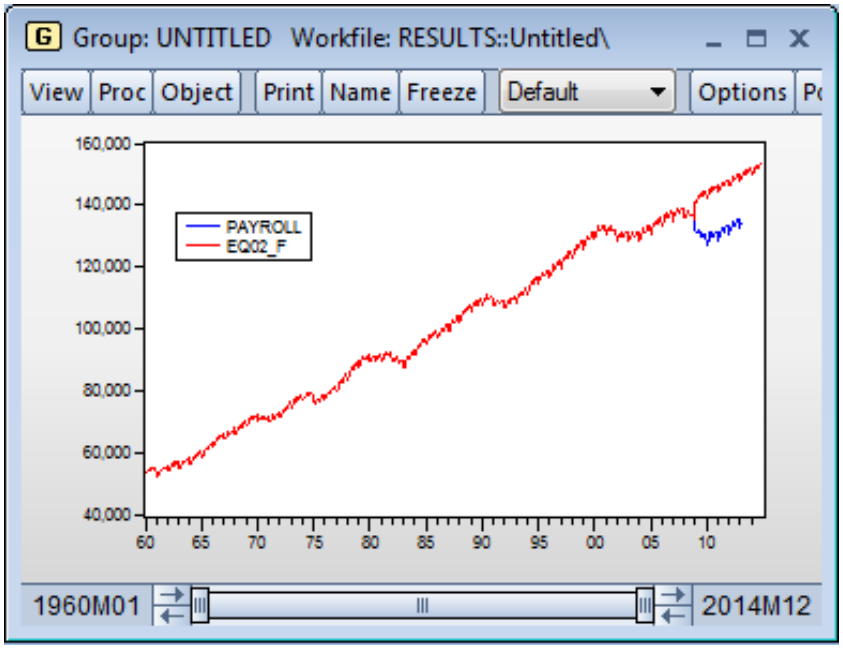
- The *Forecast Output* is shown here (note that we have removed the forecast evaluation table, which we discuss next).
- For comparison purposes, we have also shown a graph of the ***payroll*** and ***eq02_f*** series. Notice that since we selected to "***Insert actuals for out-of-sample observations***" the series are identical over the estimation sample (*1960m1 to 2008m12)*.

Forecast Graph



Note:** This output is saved as ***graph04 in ***WS3_Results.wf1*** workfile.

Payroll vs eq02_f



Note:** This output is saved as ***graph05 in ***WS3_Results.wf1*** workfile.

Forecasting with Exogenous Variables
Example 2: Forecast Evaluation Details

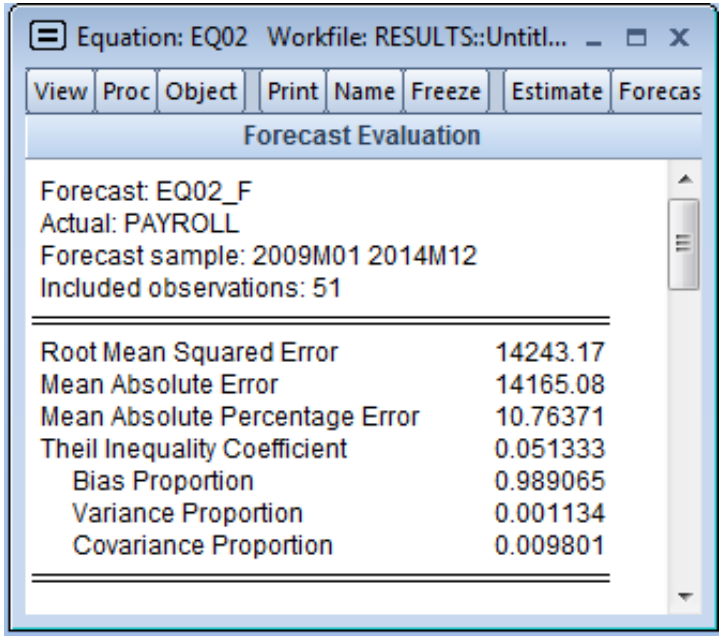
- Let's take a closer look at the *Forecast Evaluation* Table shown here.

Forecast Evaluation

- ✓ First, notice that the forecast evaluation is saved in two formats. If you check the box (**Forecast graph**), the forecast evaluation table is included along with the forecast graph (the first table shown here is copied from this option). If you uncheck **Forecast graph**, the **Forecast evaluation** is shown in a separate table (the second table shown here).
- ✓ EViews indicates the number of observations used to perform the forecast evaluation. Here we have 51 periods, which span the period from *2009m01 to 2013m03*. Note that for the remaining period (*2013m03 to 2014m12*), EViews does not carry out a forecast evaluation because the values of the dependent variable (***payroll***) are missing.

Forecast: EQ02_F
Actual: PAYROLL
Forecast sample: 2009M01 2014M12
Included observations: 51

Root Mean Squared Error	14243.17
Mean Absolute Error	14165.08
Mean Abs. Percent Error	10.76371
Theil Inequality Coefficient	0.051333
Bias Proportion	0.989065
Variance Proportion	0.001134
Covariance Proportion	0.009801



Note:** This output is saved as ***table01 in ***WS3_Results.wf1*** workfile.

Forecasting with Exogenous Variables
Example 2: Forecast Evaluation Details (cont'd)

Forecast Evaluation (cont'd)

The reported forecast statistics indicate that our forecasting model does not perform well out-of-sample.

- ✓ The **Root Mean Squared Error** (*RMSE*) is the standard deviation of the forecast errors. This is quite large when compared to the standard deviation of ***payroll*** series.
- ✓ Note that **RMSE** and **Mean Absolute Error** depend on the scale of the dependent variable, while the next two statistics (**Mean Abs. Percent Error** and **Theil Inequality Coefficient**) are scale invariant. The *Theil Coefficient* lies between 0 and 1, with 0 indicating a perfect fit.
- ✓ **Bias Proportion** – indicates how far is the mean of the forecast from the mean of the actual series.
- ✓ **Variance Proportion** – indicates how far is the variance of the forecasts from the variance of the actual series.
- ✓ **Covariance Proportion** – measures the remaining unsystematic forecasting errors.
- ✓ If the forecasts are "good" the bias and variance proportions should be small (which is not the case here).
- ✓ Note that the Bias, Variance and Covariance Proportions add up to 1 (they are given as proportions out of 1).

Forecast: EQ02_F	
Actual: PAYROLL	
Forecast sample: 2009M01 2014M12	
Included observations: 51	
Root Mean Squared Error	14243.17
Mean Absolute Error	14165.08
Mean Abs. Percent Error	10.76371
Theil Inequality Coefficient	0.051333
Bias Proportion	0.989065
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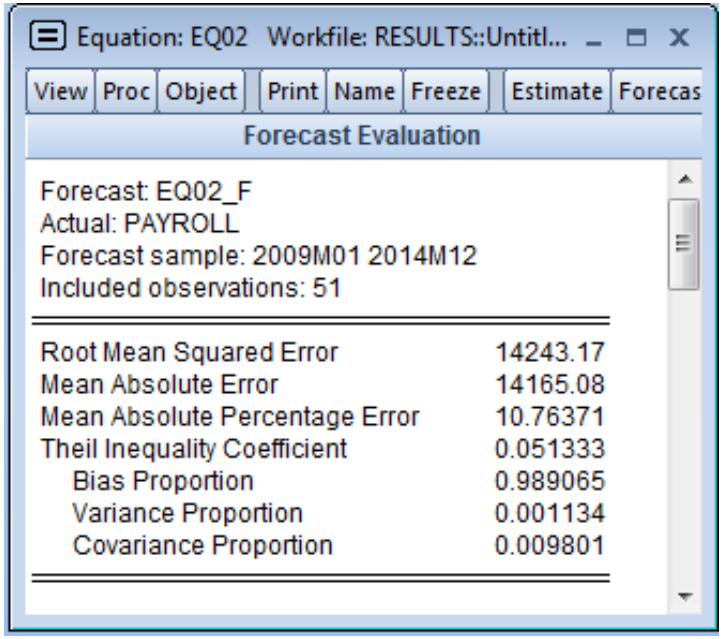
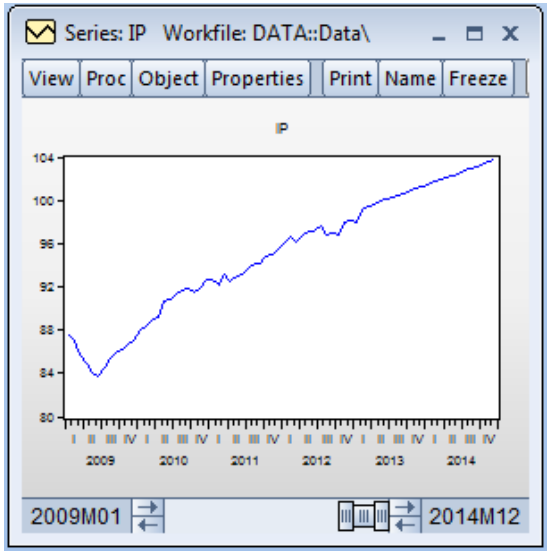
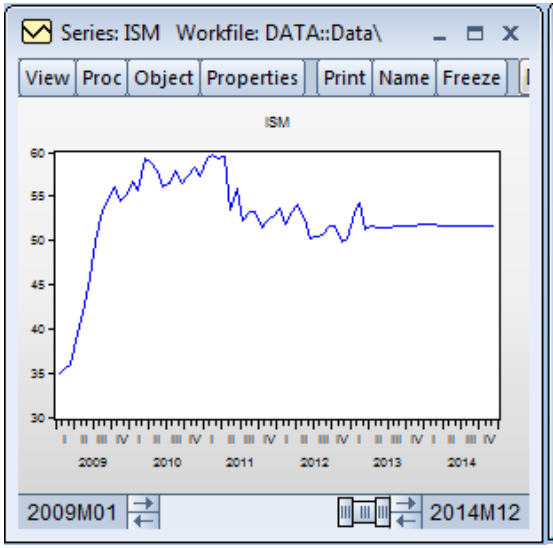
Covariance Proportion	0.009801

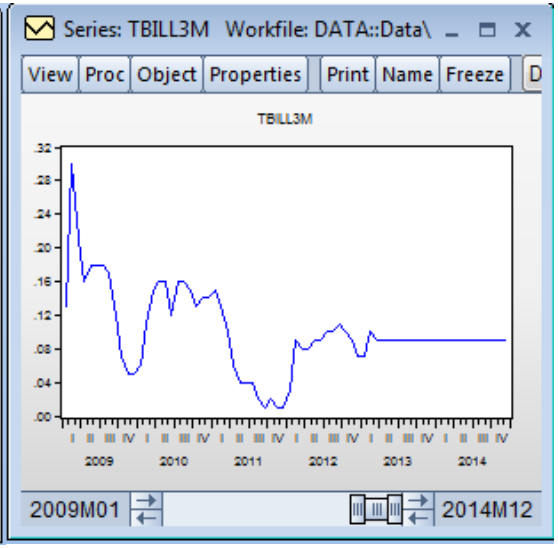


Forecasting with Exogenous Variables
Example 3: Forecasted Explanatory Variables

- In order to be able to produce an *out-of-sample* forecast, we need to know the future values for all explanatory (right-hand-side) variables.
- This was easy enough so far, because we used ***@trend*** and seasonal factors to forecast our dependent variable. EViews easily produces "forecasts" for trend variable, and seasonal factors are set as ***@month=1***, ***@month=2***, etc.
- However, for most explanatory variables, we need to provide values over the forecast period.
  - For example, suppose we want to forecast ***payroll*** using ***ip***, ***ism*** and ***tbill3m*** as additional explanatory variables. As shown previously (and in the graphs below), we have provided data for the explanatory variables over the forecast period (*2009m01 to 2014m12*).







Forecasting with Exogenous Variables
Example 3

- Let's define the sample objects by typing in the command window:

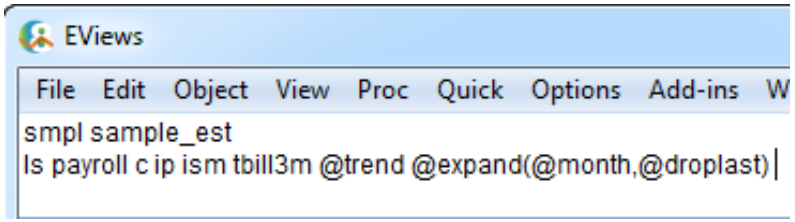
```
sample sample_est @first 2008m12
sample sample_for 2009m01 @last
```

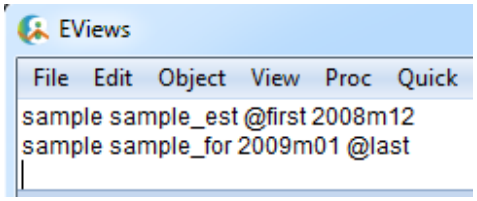
Example 3: Estimation

1. Type in the command window:

```
smpl sample_est
ls payroll c ip ism tbill3m
@trend @expand(@month,@droplast)
```

2. Press **Enter** after each command line (the second command should be typed in one line).





Note:** This equation is saved as ***eq03 in ***WS3_Results.wf1*** workfile.

Equation: EQ03 Workfile: RESULTS::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/18/13 Time: 03:51
Sample: 1960M01 2008M12
Included observations: 588

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	46247.71	780.3023	59.26898	0.0000
IP	315.6302	17.77020	17.76177	0.0000
ISM	-39.48883	11.44827	-3.449326	0.0006
TBILL3M	259.7414	28.10514	9.241776	0.0000
@TREND	113.5073	2.356990	48.15775	0.0000
@MONTH=1	-2055.488	354.9367	-5.791140	0.0000
@MONTH=2	-1888.549	354.9575	-5.320493	0.0000
@MONTH=3	-1457.196	354.9266	-4.105626	0.0000
@MONTH=4	-837.5068	354.9124	-2.359756	0.0186
@MONTH=5	-323.2735	354.9157	-0.910846	0.3628
@MONTH=6	197.4716	354.9057	0.556406	0.5782
@MONTH=7	-838.4017	354.8982	-2.362372	0.0185
@MONTH=8	-832.2146	354.9055	-2.344891	0.0194
@MONTH=9	-300.5624	354.8907	-0.846915	0.3974
@MONTH=10	2.720788	354.8861	0.007667	0.9939
@MONTH=11	50.96002	354.8917	0.143593	0.8859

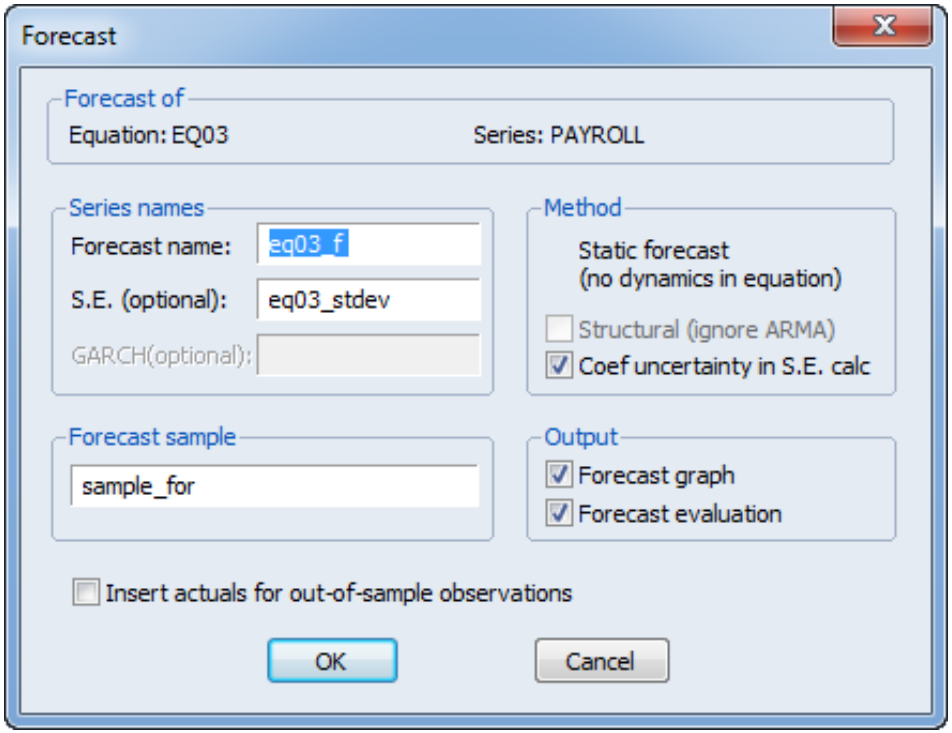
R-squared	0.995661	Mean dependent var	96567.22
Adjusted R-squared	0.995547	S.D. dependent var	26324.79
S.E. of regression	1756.590	Akaike info criterion	17.80697
Sum squared resid	1.76E+09	Schwarz criterion	17.92606
Log likelihood	-5219.249	Hannan-Quinn criter.	17.85337
F-statistic	8750.800	Durbin-Watson stat	0.028888
Prob(F-statistic)	0.000000		

Forecasting with Exogenous Variables
Example 3: Forecasting

- Now, let's produce a forecast for the ***payroll*** series with this model.

Example 3: Forecasting

1. Open ***eq03***. On the equation box toolbar, press the Forecast button. The ***Forecast*** dialog box opens up.
2. Under **Series names,** type the name of the forecasted series ***eq03_f*** in the ***Forecast name*** field.
3. Under **Series names**, ***S.E. (optional)*** field, type the name of standard errors series. This creates and saves a new series ***eq03_stdev***.
4. Under **Forecast sample**, type the forecast sample ***sample_for***.
5. Set all the other options as follows: check **Forecast graph, Forecast evaluation,** and uncheck **Insert actuals for out-of-sample observations**.
6. Click **OK**.

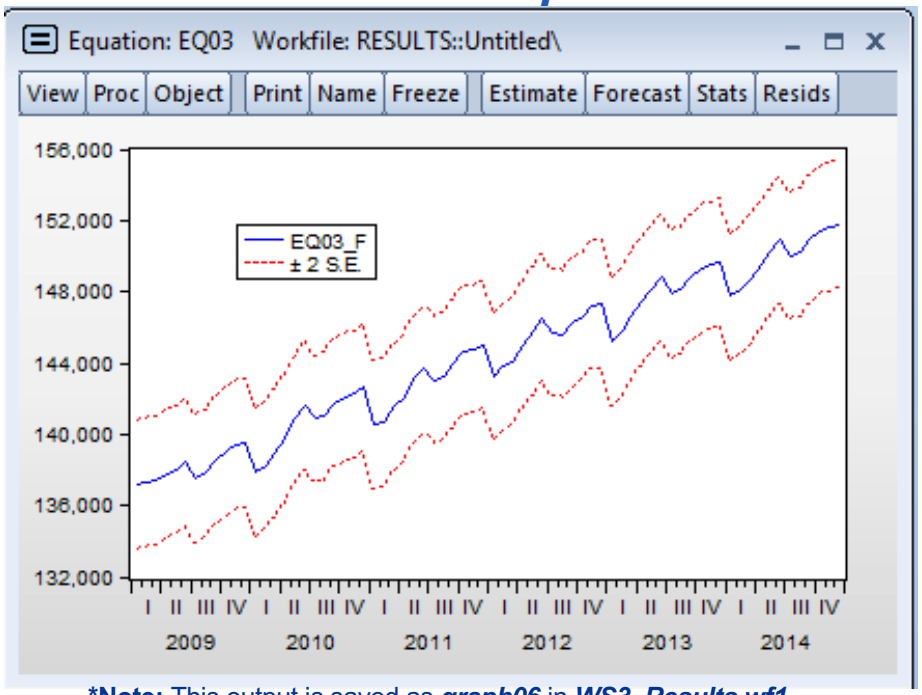


Forecasting with Exogenous Variables
Example 3: Forecasting (cont'd)

- The *Forecast Output* is shown here (note that we have removed the forecast evaluation table, which we discuss below).
- We can also plot the actual forecast series against the forecast and the two standard error bands by typing in the command window:

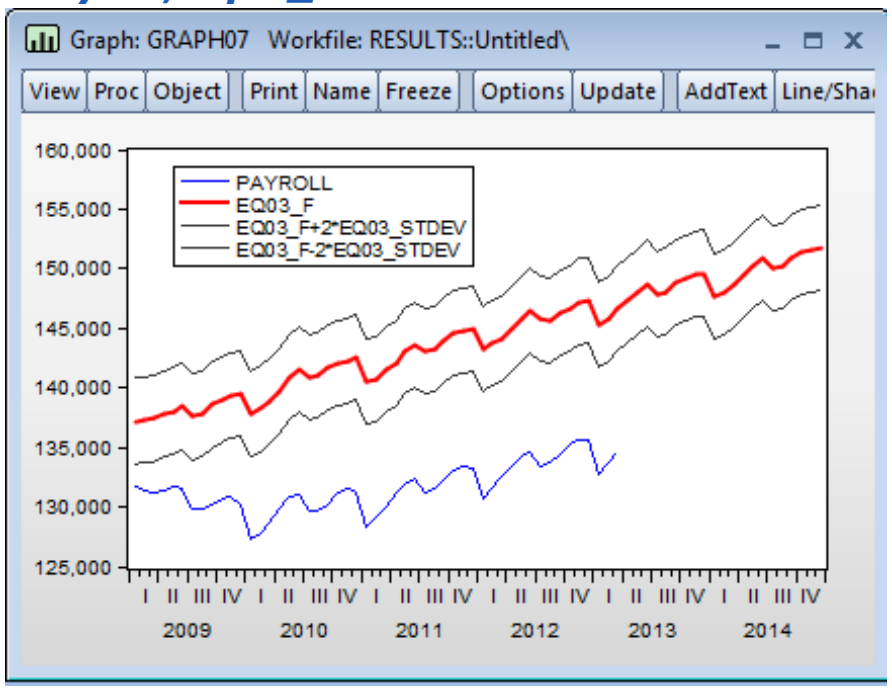
```
smpl 2009m01 @last
plot payroll eq03_f eq03_f+2*eq03_stdev eq03_f-2*eq03_stdev
```

Forecast Graph



Note:** This output is saved as ***graph06 in ***WS3_Results.wf1*** workfile.

Payroll, eq03_f and Confidence Bands



Note:** This output is saved as ***graph07 in ***WS3_Results.wf1*** workfile.

Forecasting with Exogenous Variables
Example 3: Forecast Evaluation

- The *Forecast Evaluation* output from this model is shown here. As you can see, the Bias Proportion is still large, indicating that the forecast is not "very good."
- Nonetheless, this model performs considerably better than ***eq02*** (*RMSE* is lower than ***eq02***, the *Mean Absolute Percentage Error* is lower, and even the *Bias Proportion* is lower).

Table: TABLE02 Workfile: RESULTS::Untitled\

View | Proc | Object | Print | Name | Edit+/- | CellFmt | Grid+/- | Title

Forecast Evaluation

	A	B
1	Forecast: EQ03_F	
2	Actual: PAYROLL	
3	Forecast sample: 2009M01 2014M12	
4	Included observations: 51	
5		
6	Root Mean Squared Error	10651.80
7	Mean Absolute Error	10475.15
8	Mean Absolute Percentage Error	7.953332
9	Theil Inequality Coefficient	0.038905
10	Bias Proportion	0.967107
11	Variance Proportion	0.012068
12	Covariance Proportion	0.020825
13		
14		
15		

Note:** This output is saved as ***table02 in ***WS3_Results.wf1*** workfile.

Forecasting with Lagged Dependent Variables

Forecasting with Lagged Dependent Variables

- Oftentimes, time series models used for forecasting include a lagged dependent variable.
- The presence of a lagged dependent variable complicates forecasting because there is an issue as to how to evaluate the dependent variable that appears on the right-hand side of the equation.
- EViews offers two ways to deal with lagged dependent variables:
  - ✓ Dynamic Forecasting
  - ✓ Static Forecasting
- Dynamic forecasting uses the forecasted value of the lagged dependent variable.
- Static forecasting uses the actual value of the lagged dependent variable (if it is available).
- For out of sample forecasting, dynamic forecasting is usually the only possible approach (due to the lack of actual data, static forecasting is impossible).

Forecasting with Lagged Dependent Variables: Example 4

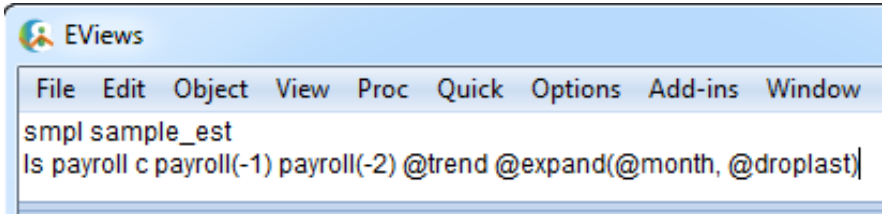
Example 4: Estimation

1. Let's first specify a model with lagged dependent variable on the right-hand side of the equation. Type in the command window:

```
smpl sample_est
ls payroll c payroll(-1) payroll(-2) @trend @expand(@month, @droplast)
```

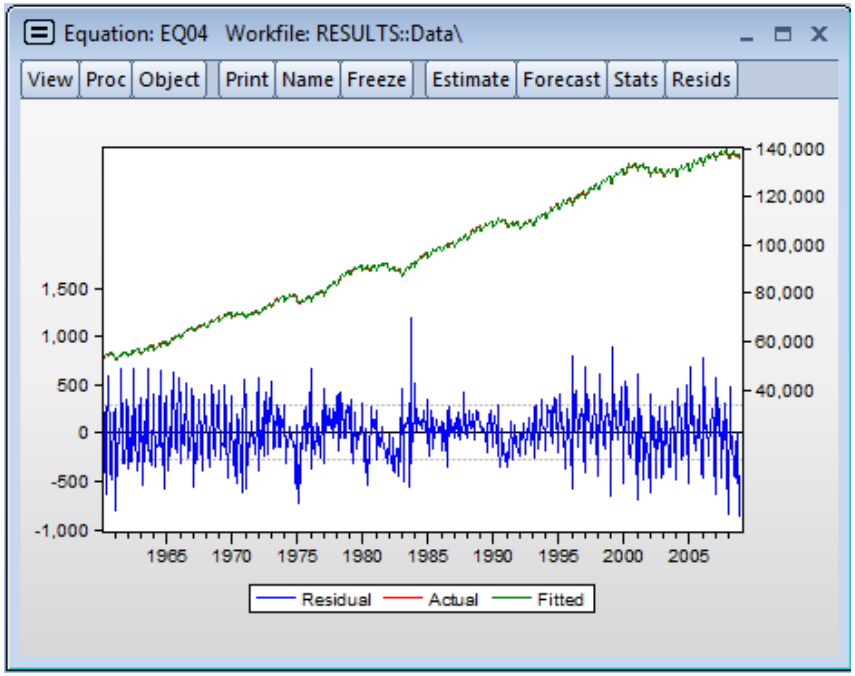
2. Press **Enter**.

Note:** This equation is saved as ***eq04 in ***WS3_Results.wf1*** workfile.



Forecasting with Lagged Dependent Variables: Example 4 (cont'd)

- We also plot the actual and the fitted values of the model (shown below), by pressing **View → Actual, Fitted, Residual → Actual Fitted Residual Graph**. The model seems to perform better now (the fit appears better) when a lagged dependent variable is included.



Equation: EQ04 Workfile: RESULTS::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/16/13 Time: 15:13
Sample (adjusted): 1960M03 2008M12
Included observations: 586 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	350.6336	285.8700	1.226549	0.2205
PAYROLL(-1)	1.313667	0.040186	32.68988	0.0000
PAYROLL(-2)	-0.319591	0.040372	-7.916247	0.0000
@TREND	0.858637	0.847096	1.013624	0.3112
@MONTH=1	-2146.080	57.94138	-37.03882	0.0000
@MONTH=2	967.4137	108.8173	8.890259	0.0000
@MONTH=3	452.3463	58.72441	7.702868	0.0000
@MONTH=4	522.4720	60.29956	8.664607	0.0000
@MONTH=5	403.3954	61.79192	6.528287	0.0000
@MONTH=6	406.3747	60.54366	6.712094	0.0000
@MONTH=7	-1109.973	60.14951	-18.45357	0.0000
@MONTH=8	412.3580	72.24708	5.707608	0.0000
@MONTH=9	562.3306	57.71580	9.743096	0.0000
@MONTH=10	220.4988	60.21070	3.662121	0.0003
@MONTH=11	39.80625	58.34976	0.682201	0.4954

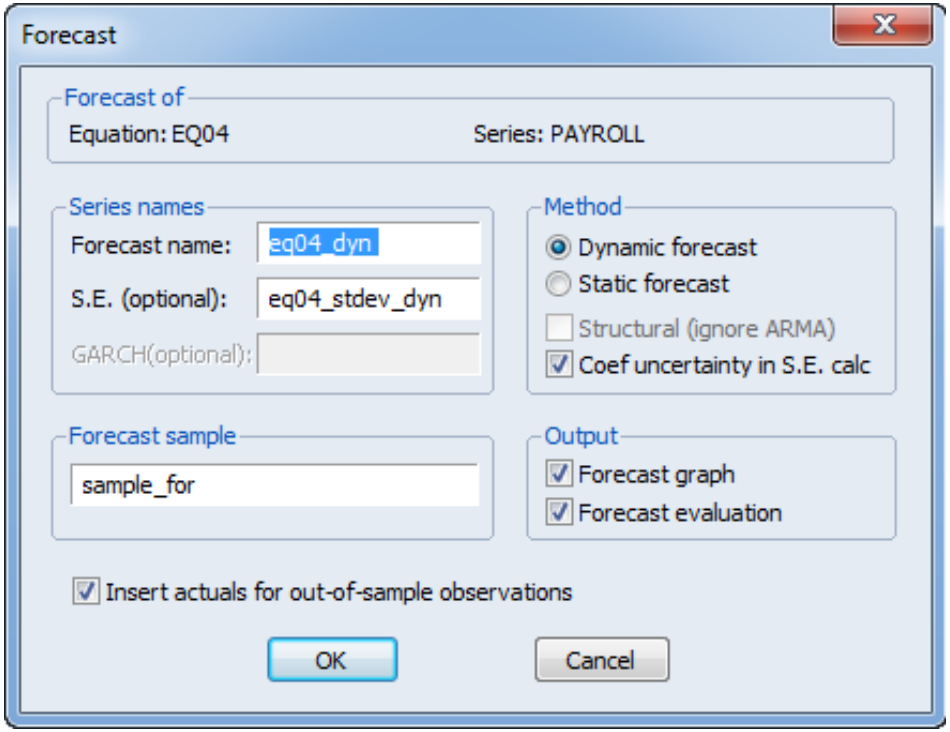
R-squared	0.999885	Mean dependent var	96714.42
Adjusted R-squared	0.999882	S.D. dependent var	26248.47
S.E. of regression	284.6586	Akaike info criterion	14.16572
Sum squared resid	46268440	Schwarz criterion	14.27767
Log likelihood	-4135.557	Hannan-Quinn criter.	14.20935
F-statistic	355252.4	Durbin-Watson stat	1.955294
Prob(F-statistic)	0.000000		

Forecasting with Lagged Dependent Variables Example 4: Dynamic Forecast

- Now, let's produce a *Dynamic Forecast* for the ***payroll*** series based on our model.

Example 4: Dynamic Forecast

1. Open ***eq04***. On the equation box toolbar, press the Forecast button. The ***Forecast*** dialog box opens up.
2. Under **Series names,** name the series ***eq04_dyn*** in ***Forecast name*** field. Under ***S.E. (optional)*** field, type the name of standard errors series ***eq04_stdev_dyn***.
3. Under **Forecast sample**, type the forecast sample ***sample_for***. Set all the other options as follows: check **Forecast graph, Forecast evaluation,** and check **Insert actuals for out-of-sample observations**.
4. Notice that under ***Method***, you now can choose between **Dynamic Forecast** and **Static Forecast**. Let's choose **Dynamic Forecast** here.
5. Click **OK**.

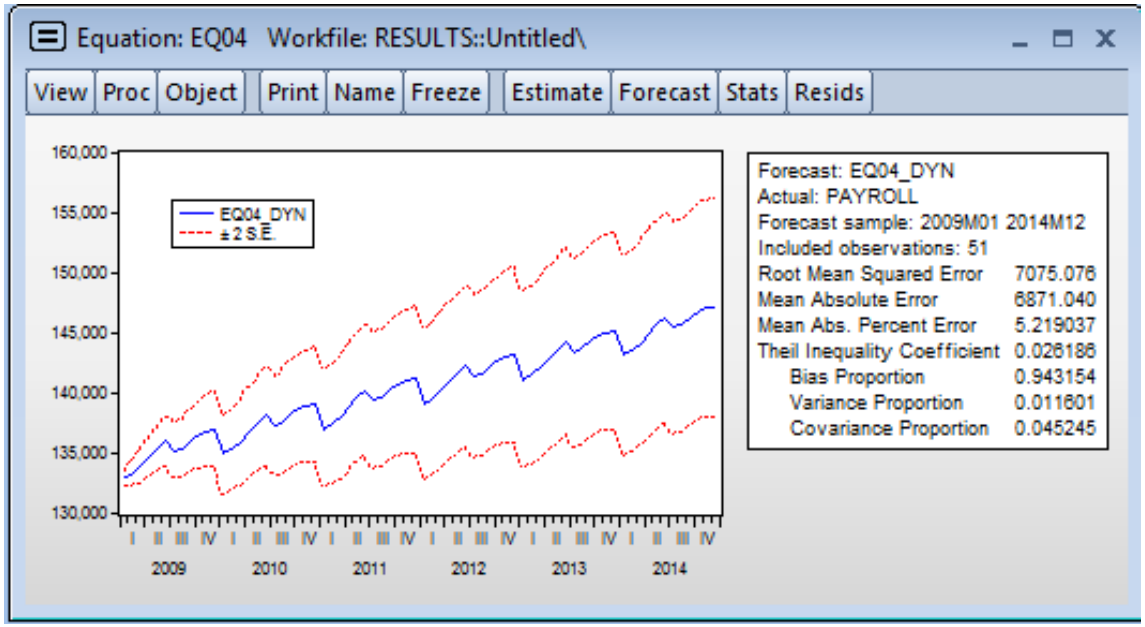


Forecasting with Lagged Dependent Variables Example 4: Dynamic Forecast (cont'd)

- The *Forecast Output* is shown here. Notice that EViews produces forecast values for payroll series over the entire forecast sample: *2009m1 to 2014m12*.
- You can also see that the confidence error bands widen dramatically towards the end of the forecast sample. This is because dynamic forecasting uses the forecast values of the lagged dependent variables. The forecast errors tend to compound over time resulting in larger error bands the further out we are in the forecast sample.

How are Dynamic Forecasts Performed?

- ✓ The first forecasted value (*2009m01*) uses the actual value of *2008m12* (***payroll(-1))*** and the actual value of *2008m11* (***payroll (-2)***).
- ✓ The second forecasted value (*2009m02*) uses the forecasted value of *2009m01* (***payroll (-1***); estimated previously) and the actual value of *2008m12* (***payroll(-2)***).
- ✓ The third forecasted value (*2009m03*) uses the forecasted value of *2009m02* (***payroll (-1);*** estimated in step 2) and the forecasted value of ***2009m01*** (***payroll(-2);*** estimated in step 1).



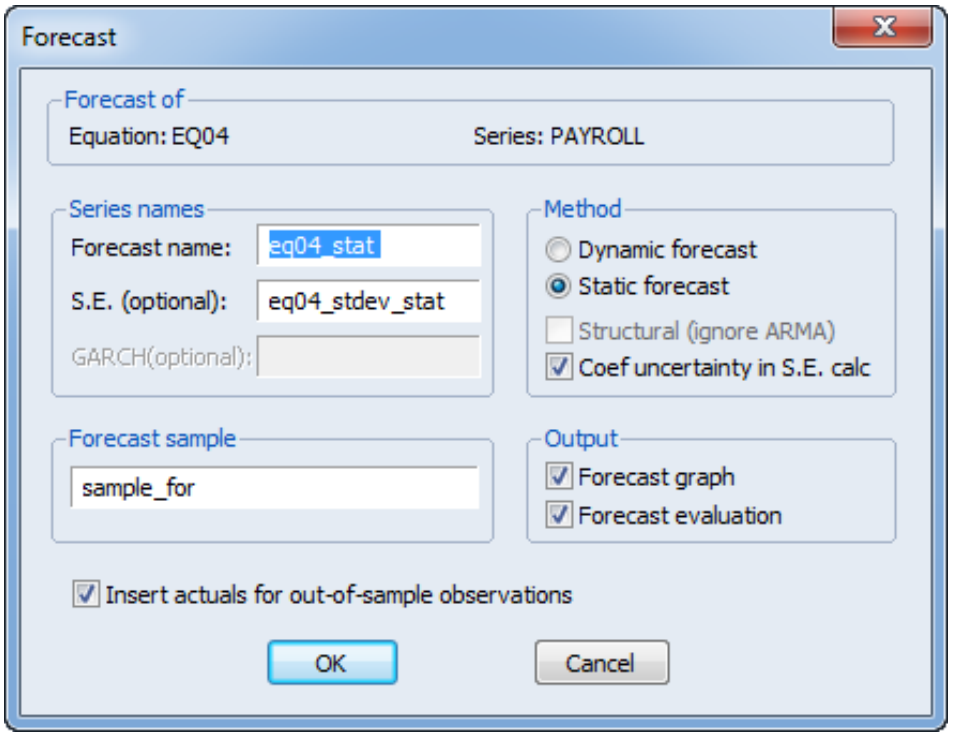
Note:** This output is saved as ***graph09 in ***WS3_Results.wf1*** workfile.

Forecasting with Lagged Dependent Variables Example 4: Static Forecast

- Let's now produce a *Static Forecast* of the ***payroll*** series based on the same model.

Example 4a: Static Forecast

1. Open ***eq04***. Follow steps 1-3 as in the previous example (naming the forecast series ***eq04_stat*** and its standard deviation ***eq04_stdev_stat***).
2. Under ***Method***, select ***Static Forecast***.
3. Click **OK**.

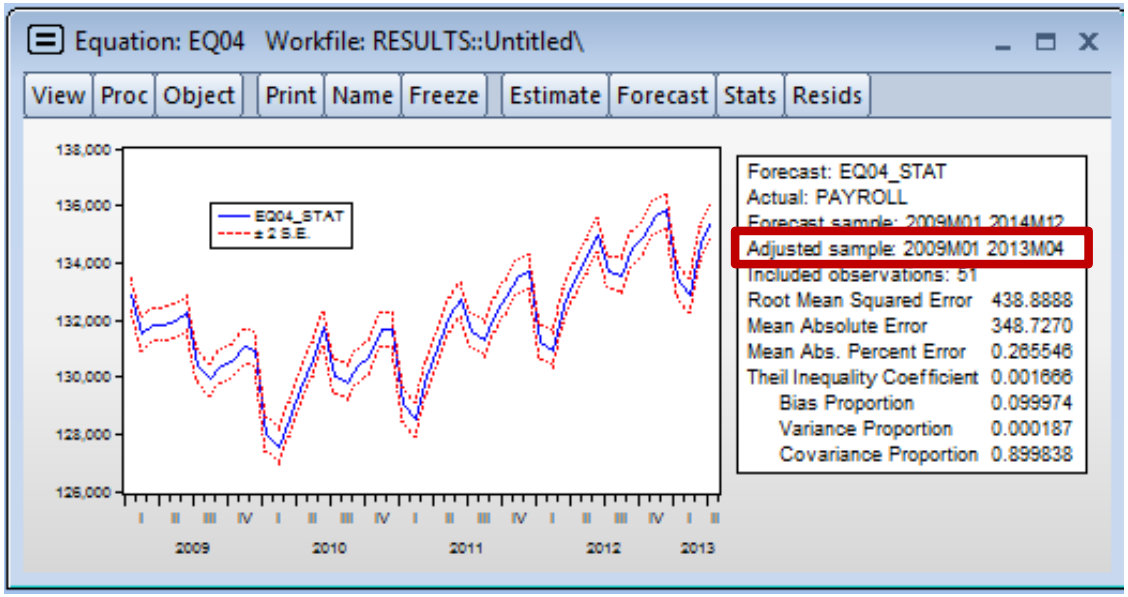


Forecasting with Lagged Dependent Variables Example 4: Static Forecast (cont'd)

- The *Forecast Output* is shown here. A few things stand out.
- First, notice that the forecast sample is adjusted to include the period only from *2009m01 to 2013m04* and not the entire forecast sample (*2009m01 to 2014m12*).
- This is because static forecasts are one-step ahead forecasts only. They use actual values of lagged dependent variables in order to perform the forecast. Since we have actual data for ***payroll*** series only up until *2013m03*, EViews can only produce forecasts for the period from *2009m01 to 2013m04* .

How are Static Forecasts Performed?

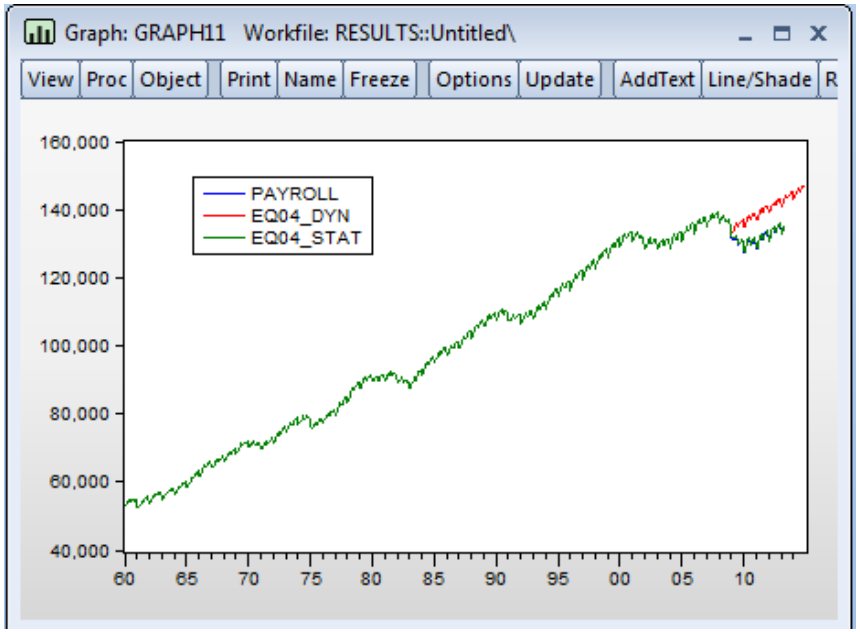
- ✓ The first forecasted value (*2009m01*) uses the actual value of *2008m12* (***payroll(-1))*** and the actual value of *2009m11* (***payroll (-2)***).
- ✓ The second forecasted value (*2009m02*) uses the actual value of *2009m01* (***payroll (-1)***) and the actual value of *2008m12* (***payroll(-2)***).
- ✓ The third forecasted value (*2009m03*) uses the actual value of *2009m02* (***payroll (-1)***) and the actual value of *2009m01* (***payroll(-2)***).



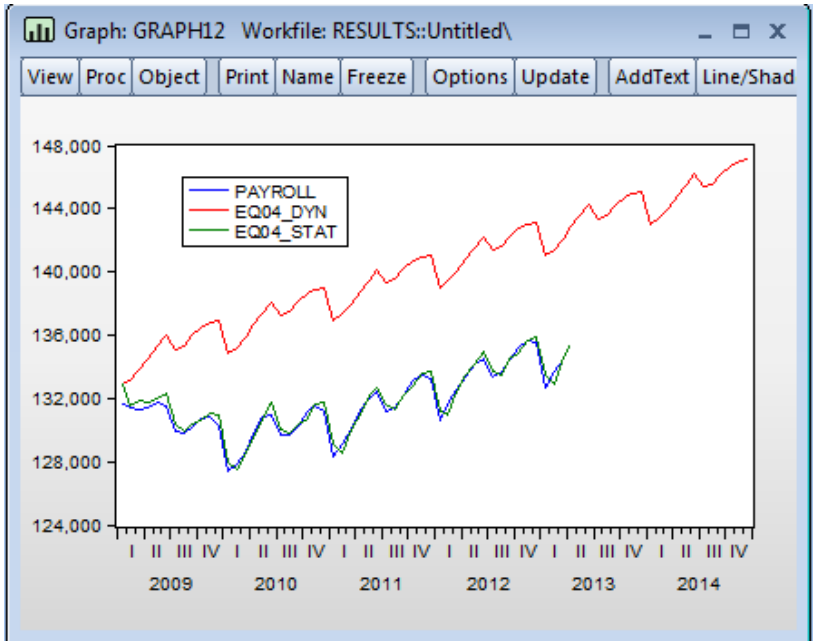
Note:** This output is saved as ***graph10 in ***WS3_Results.wf1*** workfile.

Forecasting with Lagged Dependent Variables Example 4: Dynamic vs Static

- Let's compare the two forecasts more directly. For this, open series ***payroll***, ***eq04_dyn*** and ***eq94_stat*** as a group and plot the series against each other (you can change the sample by typing `smpl @all` in the command line to get the entire sample and `smpl sample_for` for the forecast sample).
  - ✓ The static forecast performs much better than the dynamic forecast because it uses actual instead of the forecasted lagged values over the forecast period.
  - ✓ The historical values are the same because we checked **Insert actuals for out-of-sample observations** in both cases.



Note:** This output is saved as ***graph11 in ***WS3_Results.wf1*** workfile.



Note:** This output is saved as ***graph12 in ***WS3_Results.wf1*** workfile.

Forecasting with ARMA Errors

Forecasting with AR terms Example 6

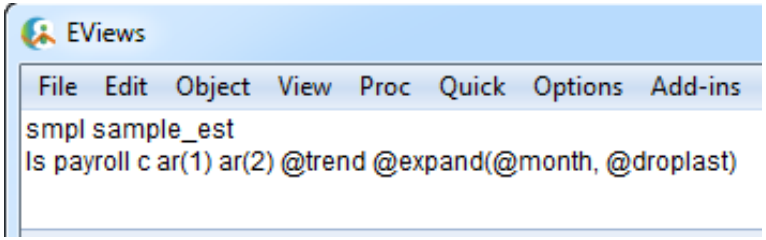
- Models with ARMA terms are also widely used in forecasting.
- The presence ARMA terms involve some additional complexities in forecasting, which we highlight in this section.

Example 6: Estimation with AR terms

1. Let's first specify a model with two AR terms. Type in the command window:

```
smpl sample_est
ls payroll c ar(1) ar(2) @trend
@expand(@month, @droplast)
```

2. Press **Enter (**the second command should be typed in one line).



Note:** This equation is saved as ***eq06 in ***WS3_Results.wf1*** workfile.

Equation: EQ06 Workfile: RESULTS::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/16/13 Time: 18:35
Sample (adjusted): 1960M03 2008M12
Included observations: 586 after adjustments
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	53731.74	5812.165	9.244704	0.0000
@TREND	144.9469	14.68585	9.869836	0.0000
@MONTH=1	-2224.625	39.83555	-55.84522	0.0000
@MONTH=2	-2020.431	61.43612	-32.88670	0.0000
@MONTH=3	-1556.285	75.62571	-20.57878	0.0000
@MONTH=4	-941.6838	84.65292	-11.12406	0.0000
@MONTH=5	-401.7163	89.68691	-4.479097	0.0000
@MONTH=6	114.1796	91.27033	1.251004	0.2114
@MONTH=7	-897.0218	89.55955	-10.01592	0.0000
@MONTH=8	-867.9483	84.39099	-10.28485	0.0000
@MONTH=9	-356.6119	75.22939	-4.740327	0.0000
@MONTH=10	-36.00929	60.97680	-0.590541	0.5551
@MONTH=11	41.04470	39.50188	1.039057	0.2992
AR(1)	1.313667	0.040186	32.68988	0.0000
AR(2)	-0.319591	0.040372	-7.916247	0.0000

R-squared	0.999885	Mean dependent var	96714.42
Adjusted R-squared	0.999882	S.D. dependent var	26248.47
S.E. of regression	284.6586	Akaike info criterion	14.16572
Sum squared resid	46268440	Schwarz criterion	14.27767
Log likelihood	-4135.557	Hannan-Quinn criter.	14.20935
F-statistic	355252.4	Durbin-Watson stat	1.955294
Prob(F-statistic)	0.000000		

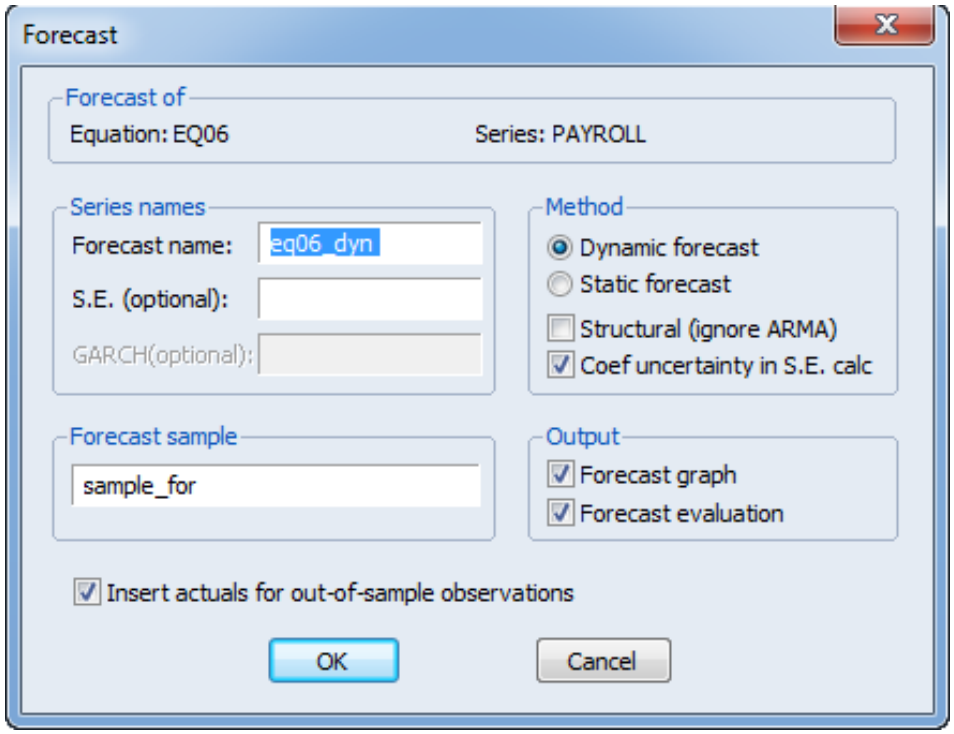
Inverted AR Roots	.99	.32

Forecasting with AR Terms
Example 6: Forecasting with AR terms

- Let's produce *dynamic* and *static* forecast for the *AR(2)* model we just estimated.

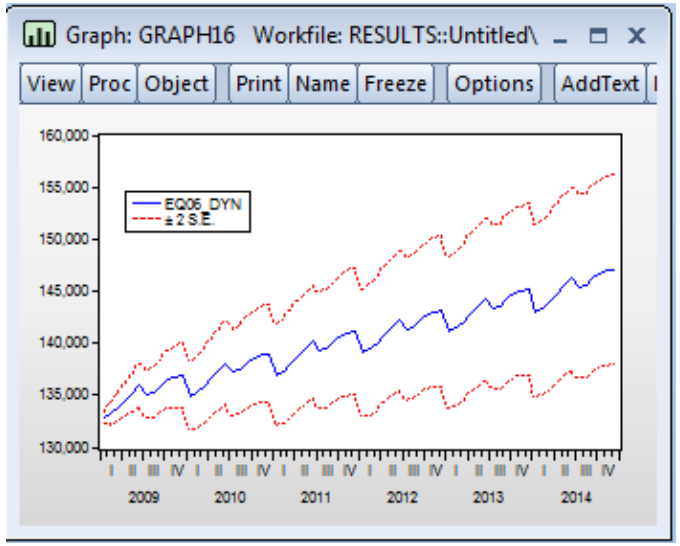
Example 6: Forecasting with AR terms

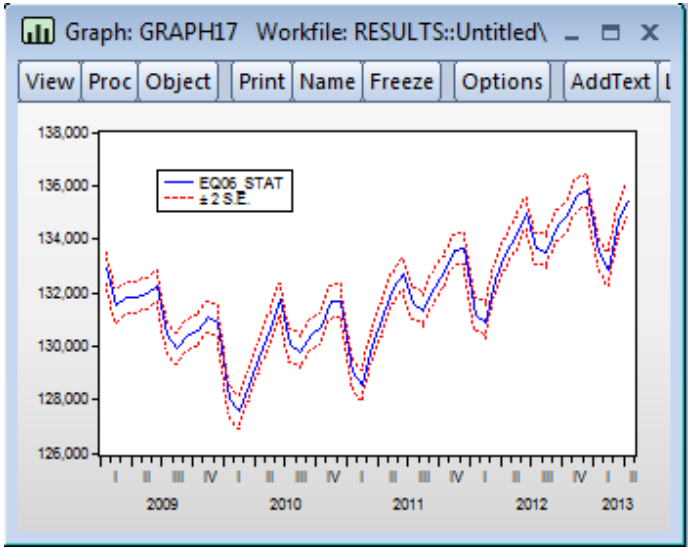
1. Open ***eq06*** and click the Forecast button. As usual, the ***Forecast*** dialog box opens up. Name the series ***eq06_dyn*** for the dynamic series and ***eq06_stat*** for the static forecast series.
2. Under ***Forecast Sample*** set the sample to ***sample_for.*** Under ***Method***, select **Dynamic forecast** (for the dynamic series), and **Static forecast** (for the static series). Set the rest of the parameters as shown here.
3. Click **OK**.



Forecasting with AR Terms
Example 6: Forecasting with AR terms (cont'd)

- The *Forecast Output* for both methods is shown here. To produce forecasts with *AR* terms, EViews adds forecasts of the residuals to the forecasts of the structural model (structural model is based solely on explanatory variables).
- As expected, the static forecast (bottom graph) goes up to *2013m04*, and performs better than the dynamic forecast.
- In the dynamic forecast (top graph), the lagged residuals are forecasted dynamically. This means that future values of lagged residuals are formed using the forecasted values of the dependent variable.
- In contrast, the static forecast uses actual lagged residuals and actual values for the dependent variable to produce forecasts.



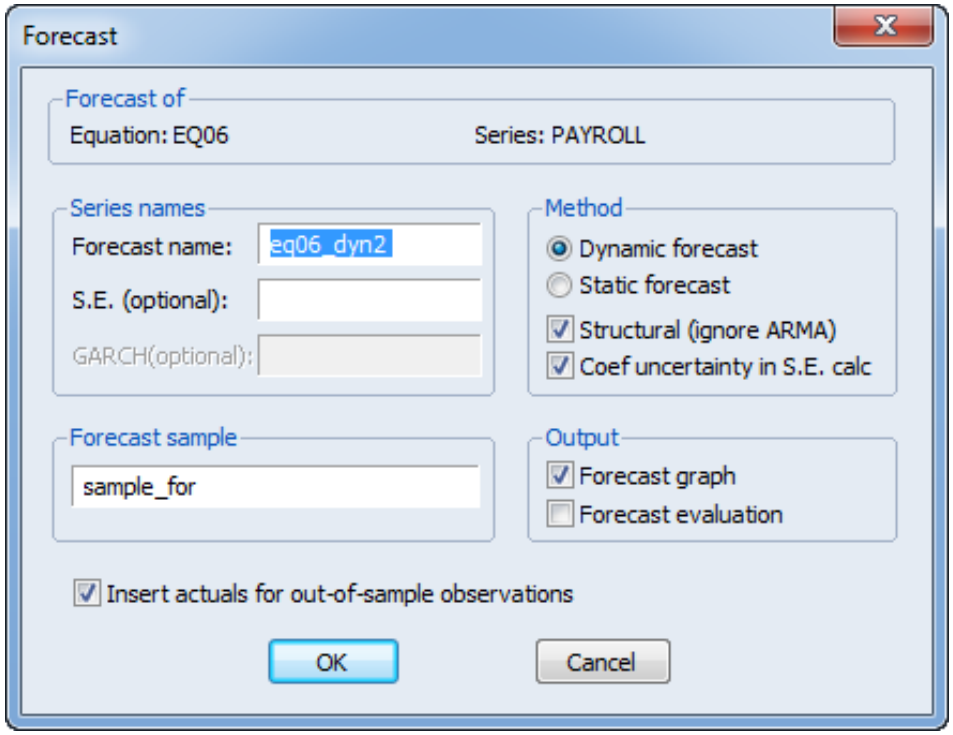


Forecasting with AR Terms
Example 6: Forecasting with AR terms (cont'd)

- There are cases when you may wish to assume that the ARMA errors are zero.
- For this, we can select the **Structural (ignore ARMA)** box under ***Method***.

Example 6a: Forecasting with AR terms

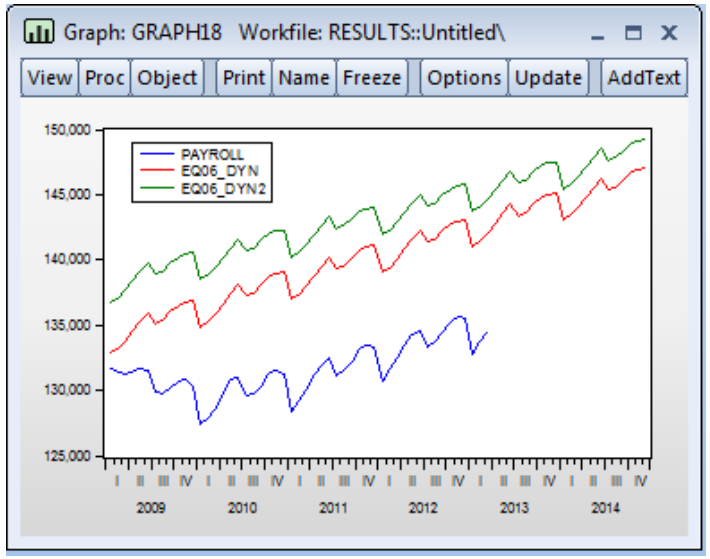
1. Open ***eq06*** and click the Forecast button. As usual, the ***Forecast*** dialog box opens up. Name the series ***eq06_dyn2*** for the dynamic series and ***eq06_stat2*** for the static forecast series.
2. Under ***Forecast Sample*** set the sample to ***sample_for.*** Under ***Method***, select **Dynamic forecast** (for the dynamic series), and **Static forecast** (for the static series). Set the rest of the parameters as shown here.
3. Check **Structure (ignore ARMA)** box under ***Method***.
4. Click **OK**.

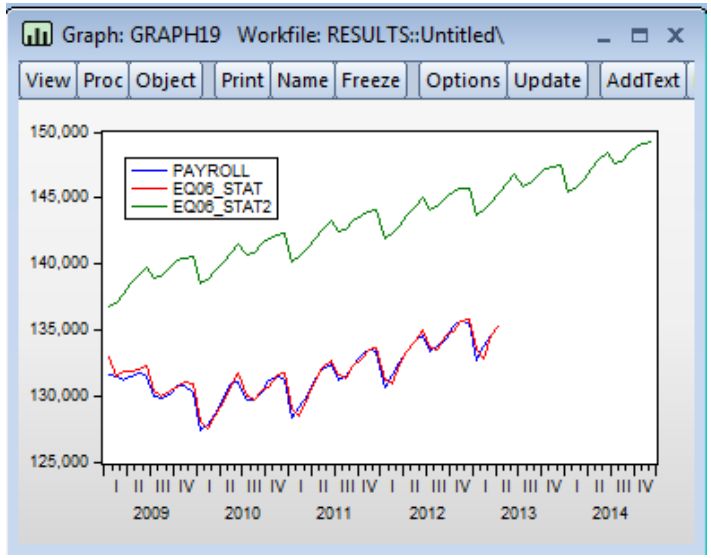


Forecasting with AR Terms

Example 6: Forecasting with AR terms (cont'd)

- The graphs shown here plot the forecasted values for both methods (dynamic and static) when ARMA terms are included (***eq06_dyn*** or ***eq06_stat***) or ignored (***eq06_dyn2*** or ***eq06_stat2***).
  - First, it is important to note that the static and dynamic forecasts obtained by ignoring ARMA terms are identical (you can see this by plotting ***eq06_dyn2*** against ***eq06_stat2***; not shown here)**.** This is expected, since static and dynamic forecasts differ only if there are lagged dependent variables or ARMA terms. If we choose to ignore the ARMA terms, there are no differences between the two.
  - Note also that the static forecasts when ARMA terms are ignored are provided for the entire forecast period (bottom graph). This was possible since we know the values of all exogenous variables over the entire forecast sample.
  - For both dynamic and static forecasts, ignoring ARMA terms produces "worse" forecasts than when ARMA terms are included.





Forecasting with MA terms Example 8

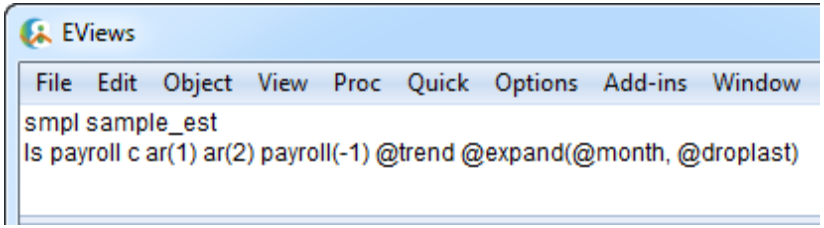
- It is just as easy in EViews to produce forecasts from models with MA errors.

Example 8: Estimation with MA terms

1. Let's first specify a model with one MA term. Type in the command window:

```
smpl sample_est
ls payroll c ma(1) @trend
@expand(@month, @droplast)
```

2. Press **Enter (**the second command should be typed in one line).



Note:** This equation is saved as ***eq08 in ***WS3_Results.wf1*** workfile.

Equation: EQ08 Workfile: RESULTS::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: PAYROLL
Method: Least Squares
Date: 05/16/13 Time: 21:04
Sample: 1960M01 2008M12
Included observations: 588
Convergence achieved after 19 iterations
MA Backcast: 1959M12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	51959.63	285.7438	181.8400	0.0000
@TREND	154.2556	0.558085	276.4018	0.0000
@MONTH=1	-2119.135	233.1706	-9.088345	0.0000
@MONTH=2	-1839.254	328.5032	-5.598892	0.0000
@MONTH=3	-1395.590	328.4956	-4.248428	0.0000
@MONTH=4	-800.3147	328.4872	-2.436365	0.0151
@MONTH=5	-279.2437	328.4813	-0.850105	0.3956
@MONTH=6	217.9496	328.4750	0.663520	0.5073
@MONTH=7	-811.8366	328.4708	-2.471564	0.0137
@MONTH=8	-801.2555	328.4665	-2.439383	0.0150
@MONTH=9	-308.3274	328.4641	-0.938694	0.3483
@MONTH=10	-6.053834	328.4618	-0.018431	0.9853
@MONTH=11	52.71863	232.7258	0.226527	0.8209
MA(1)	0.906054	0.017504	51.76229	0.0000

R-squared	0.997950	Mean dependent var	96567.22
Adjusted R-squared	0.997904	S.D. dependent var	26324.79
S.E. of regression	1205.300	Akaike info criterion	17.05037
Sum squared resid	8.34E+08	Schwarz criterion	17.15457
Log likelihood	-4998.808	Hannan-Quinn criter.	17.09097
F-statistic	21495.27	Durbin-Watson stat	0.269435
Prob(F-statistic)	0.000000		

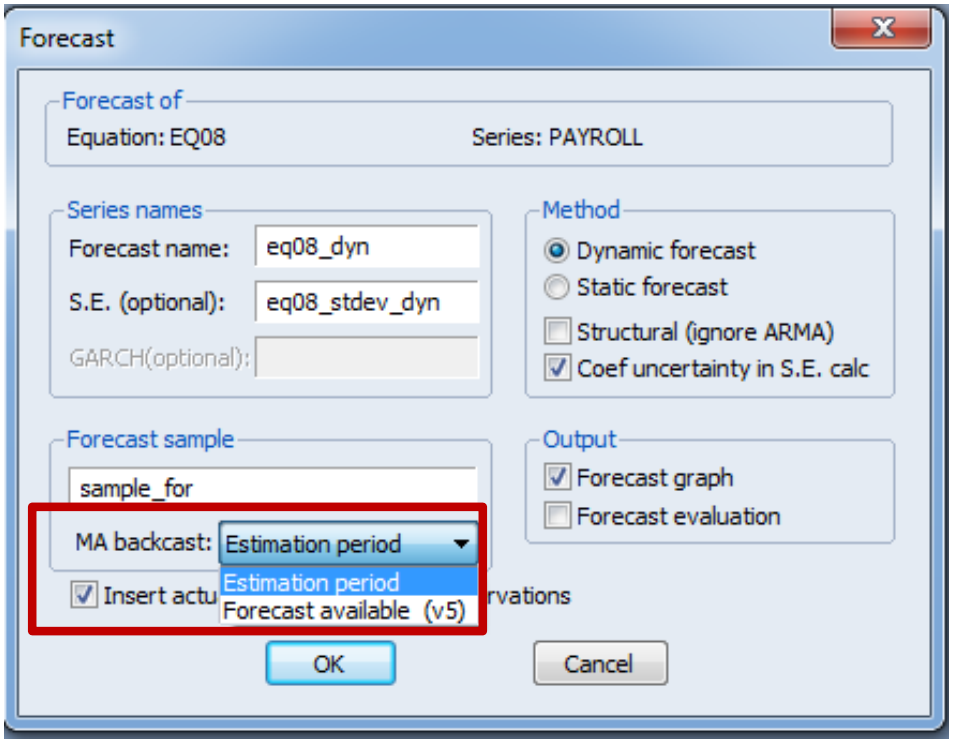
Inverted MA Roots	-.91

Forecasting with MA Terms
Example 8: Forecasting

- Let's produce dynamic and static forecast for the MA(1) model we just estimated.

Example 8: Forecasting with MA terms

1. Open ***eq08*** and click the Forecast button. As usual, the ***Forecast*** dialog box opens up. Name the series ***eq08_dyn*** and ***eq08_stdev_dyn*** for the dynamic series and ***eq08_stat*** and ***eq08_stdev_stat*** for the static forecast series.
2. Under ***Forecast Sample*** set the sample to ***sample_for.***
3. Note that a new field ***MA backcast*** appears. Here you can choose either of two options: **Estimation period** (the default) and **Forecast available (v5)**. Let's choose **Estimation period**.
4. Click **OK**.



Forecasting with MA Terms
A Few (technical) Notes

- A few notes before we show the results:

- The **Estimation period** method for *MA backcasting* uses data for the estimation sample to compute backcast estimates.
  - ✓ Innovations beyond the estimation sample are set to 0. EViews then uses the unconditional residuals to obtain the pre-estimation sample residuals.

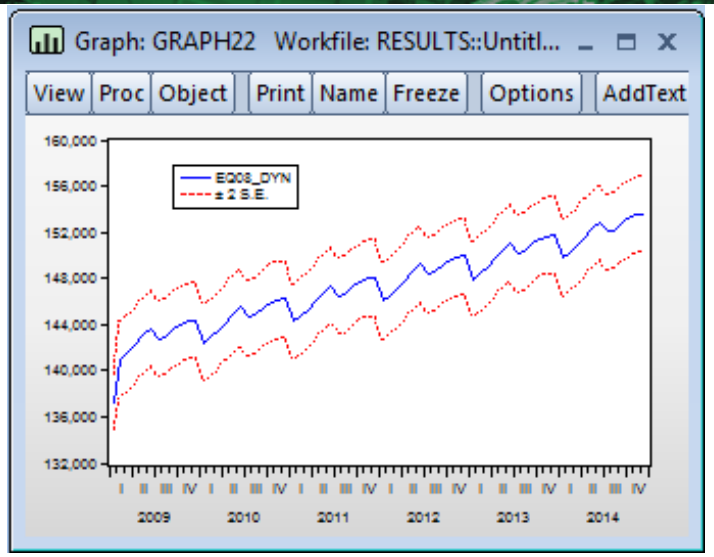
- The **Forecast available (v5)** method for *MA backcasting*, proceeds with different approaches for dynamic and static forecasting.
  - ✓Dynamic forecasting – EViews applies the backcasting procedure using data from the beginning of the estimation sample to either the beginning of the forecast period or the end of the estimation sample (whichever comes first).
  - ✓Static forecasting – EViews applies the backcasting procedure using data from the beginning of the estimation sample to the end of the forecast period.

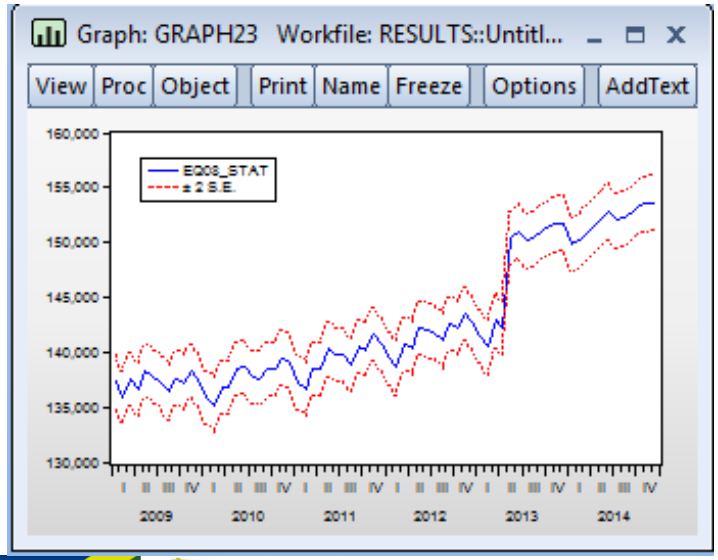
Forecasting with MA Terms
A Few (technical) Notes (cont'd)

- After obtaining the MA backcast estimates of the pre-estimation residuals (using either **Estimation period** or **Forecast available (v5)**), forward recursion is used to obtain values for the pre-forecast sample innovations.
  - ✓ Dynamic forecasting – We only need to obtain innovation values for the *q* periods (where *q* denotes the order of the MA process) prior to the start of the forecast sample. All subsequent innovations are set to 0. In the current example of MA(1) error terms, we need only obtain innovation values 1 period prior to the start of the forecast sample.
  - ✓ Static forecasting – The forward recursion is carried out through the end of the forecast period.

Forecasting with MA Terms Example 8 (cont'd)

- The *Forecast Output* for both methods are shown here.
- Because the forward recursion for static forecasts are performed through the end of the forecast period, EViews is able to produce *Static* forecasts that cover the entire forecast sample (*2013m04 to 2014m12*).
- Moreover, beyond *2013m04*, forecasts from *Dynamic* and *Static* model are identical (this is because the forward recursion used to obtain the pre-forecast sample innovations produces same innovations after the end of the historical in *2013m03*).





Forecasting with Auto-Series

Forecasting with Auto-Series Example 9

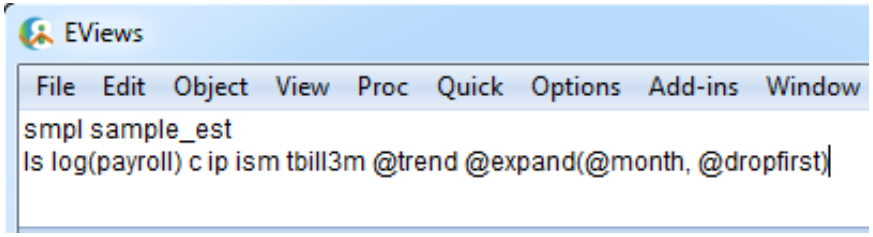
- One of the most useful features in EViews is the ability to estimate and forecast from equations that are specified using expressions or auto-series.
- Issues with auto-series normally arise when the dependent variable is specified using an expression. In this section we illustrate through a number of examples how EViews performs forecasts in these cases.

Example 9: Auto-Series and Forecasting

1. Type in the command window:

```
smpl sample_est
ls log(payroll) c ip ism tbill3m
@trend @expand(@month, @dropfirst)
```

2. Press **Enter (**the second command should be typed in one line).



Note:** This equation is saved as ***eq09 in ***WS3_Results.wf1*** workfile.

Equation: EQ09 Workfile: RESULTS::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LOG(PAYROLL)
Method: Least Squares
Date: 05/17/13 Time: 22:45
Sample: 1960M01 2008M12
Included observations: 588

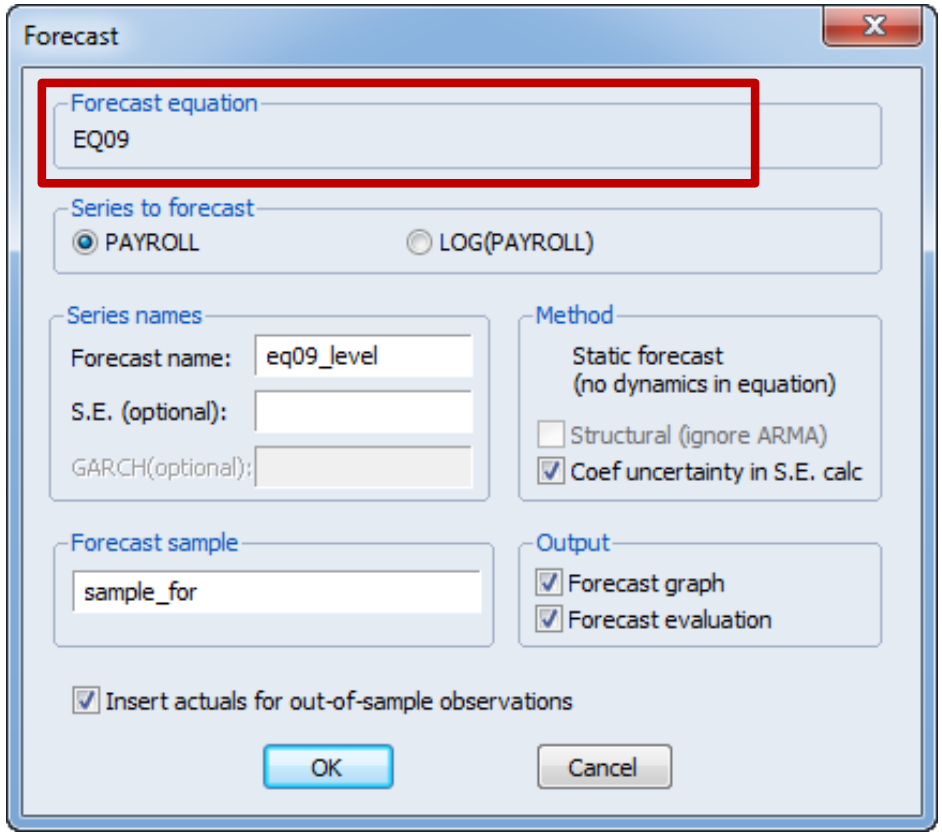
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.85320	0.013090	829.0919	0.0000
IP	-0.000617	0.000297	-2.075527	0.0384
ISM	0.000491	0.000191	2.567076	0.0105
TBILL3M	0.010382	0.000470	22.09804	0.0000
@TREND	0.001785	3.94E-05	45.29164	0.0000
@MONTH=2	0.001275	0.005933	0.214923	0.8299
@MONTH=3	0.005878	0.005933	0.990795	0.3222
@MONTH=4	0.013154	0.005933	2.217132	0.0270
@MONTH=5	0.018746	0.005933	3.159434	0.0017
@MONTH=6	0.025001	0.005933	4.213729	0.0000
@MONTH=7	0.013596	0.005933	2.291579	0.0223
@MONTH=8	0.013336	0.005933	2.247903	0.0250
@MONTH=9	0.018946	0.005933	3.193356	0.0015
@MONTH=10	0.022273	0.005933	3.753950	0.0002
@MONTH=11	0.022866	0.005934	3.853503	0.0001
@MONTH=12	0.022652	0.005933	3.817689	0.0001

R-squared	0.989836	Mean dependent var	11.43828
Adjusted R-squared	0.989570	S.D. dependent var	0.287524
S.E. of regression	0.029365	Akaike info criterion	-4.191215
Sum squared resid	0.493227	Schwarz criterion	-4.072120
Log likelihood	1248.217	Hannan-Quinn criter.	-4.144812
F-statistic	3713.721	Durbin-Watson stat	0.035645
Prob(F-statistic)	0.000000		

Forecasting with Auto-Series Example 9 (cont'd)

- Now let's press the Forecast button. The ***Forecast*** dialog box offers a couple of options now which we have not seen before.

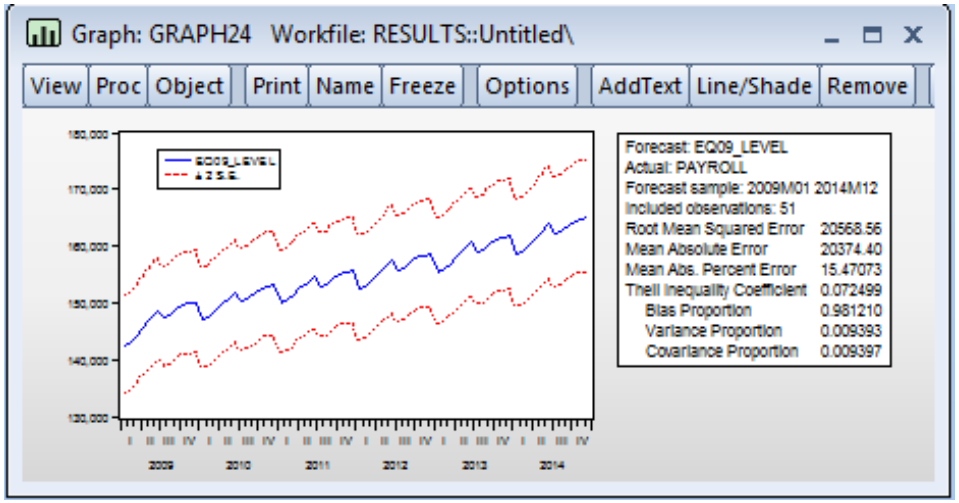
1. Open ***eq09*** and click the Forecast button. As usual, the ***Forecast*** dialog box opens up.
2. Notice here that at the top of the dialog box there is a new section: ***Series to forecast***. Here you can choose to forecast either the underlying series (***payroll***) or the auto-series (***log(payroll)***). Let's do both, first forecasting levels and then logs (we name the level forecast ***eq09_level*** and the log ***eq09_log***).
3. Notice that since this equation does not have a dynamic structure, only the *Static* method is available.
4. Click **OK**.



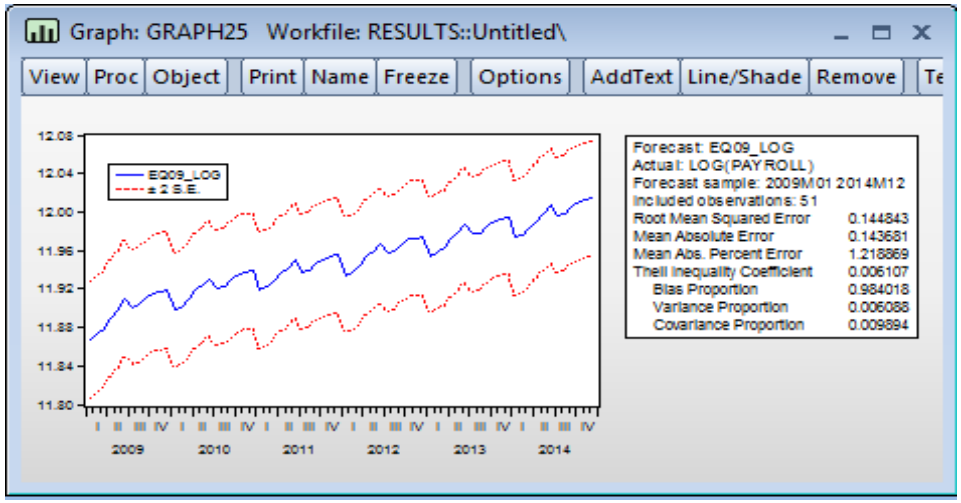
Forecasting with Auto-Series Example 9 (cont'd)

- The *Forecast Output* for both level and log forecasts is shown here.

Forecast of Levels



Forecast of Log(Payroll)



Note:** This output is saved as ***graph24 in ***WS3_Results.wf1*** workfile.

Note:** This output is saved as ***graph25 in ***WS3_Results.wf1*** workfile.

Forecasting with Auto-Series Example 10

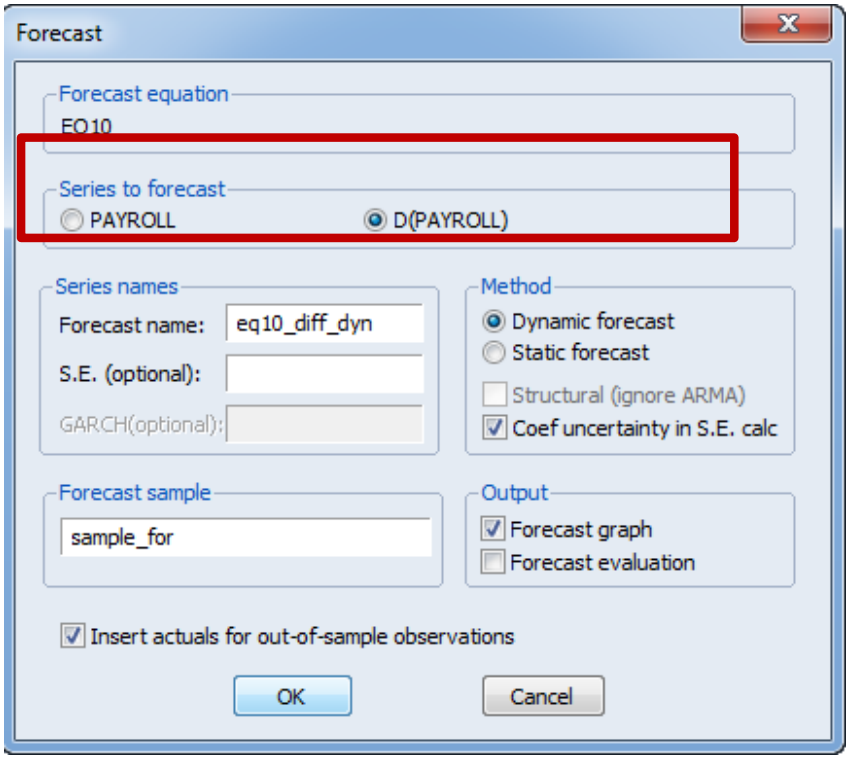
- We can just as easily estimate first differences using auto-series.

Example 10: Auto-Series and Forecasting

1. Type in the command window:

```
smpl sample_est
ls d(payroll) c ism tbill3m
@expand(@month, @droplast)
```

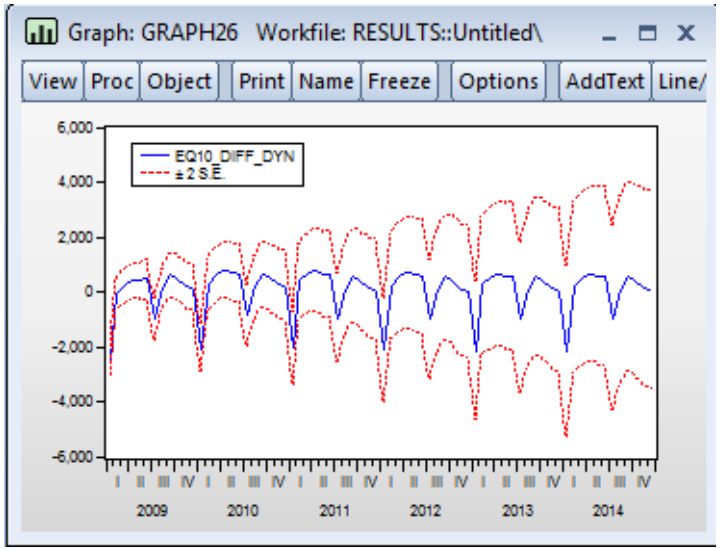
2. Press **Enter (**the second command should be typed in one line). Save this as ***eq10***.
3. Open ***eq10*** and click the Forecast button. Notice that in the ***Series to forecast*** section you can choose to forecast either the underlying series (***payroll***) or the auto-series (***d(payroll)***). Let's try to forecast the first differences.
4. It is important to note that now the ***Dynamic forecast*** option is available; EViews is able to determine that the forecast equation has dynamic elements (we have saved the dynamic forecasts as ***eq10_diff_dyn*** and static forecasts as ***eq10_diff_stat***).
5. Click **OK**.

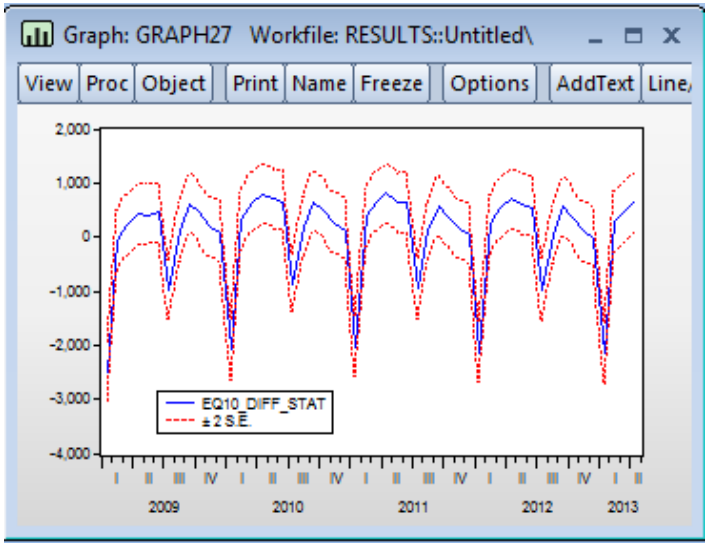


Note:** This equation is saved as ***eq10 in ***WS3_Results.wf1*** workfile.

Forecasting with Auto-Series Example 10 (cont'd)

- The *Forecast Output* for both *Dynamic* and *Static* methods are shown here.
- Note that the forecasts for both methods are the same, since the equation is not truly "dynamic" (the lagged dependent variable is not a right-hand-side variable). As expected, static forecasts end in *2013m04*, whereas dynamic forecasts are provided for the entire forecast sample.
- The standard deviation differ however. The dynamic forecast standard errors take into account the forecast uncertainty from the lagged values of the ***payroll*** series, whereas the static forecast does not since it uses actual values of the ***payroll*** series (more on standard errors below).





Forecasting with Auto-Series Example 11

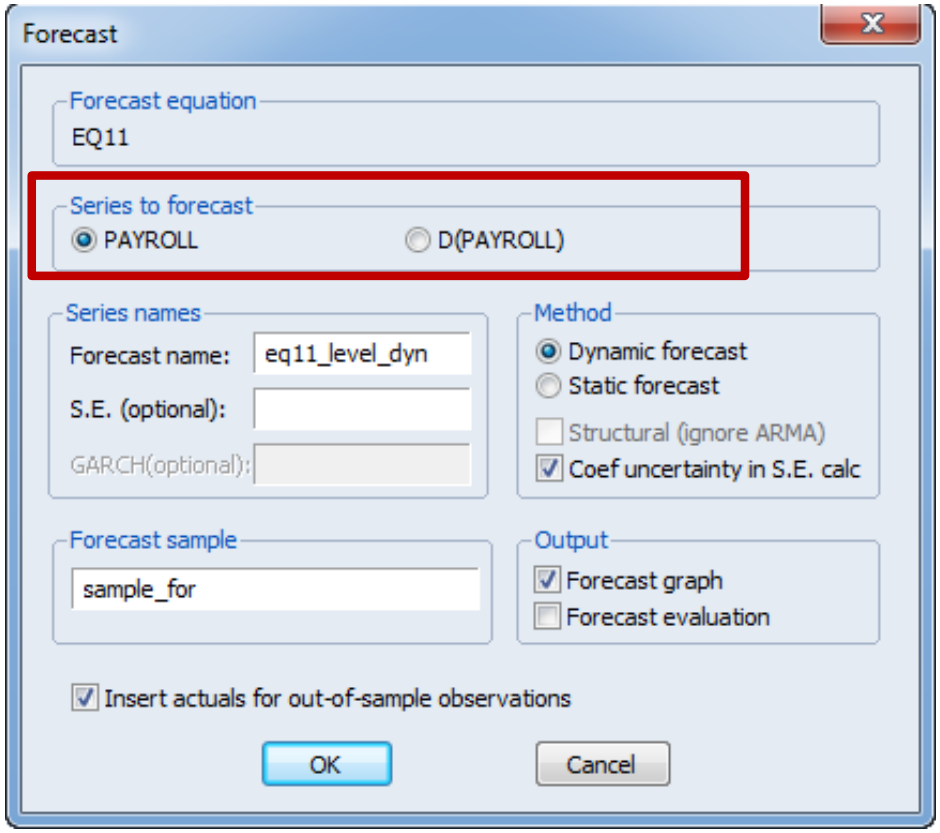
- Static and Dynamic Forecasts differ however when we include a lagged dependent variable.

Example 11: Auto-Series and Forecasting

1. Type in the command window:

```
smpl sample_est
ls d(payroll) c d(payroll(-1)) ism
tbill3m @expand(@month, @droplast)
```

2. Press **Enter (**the second command should be typed in one line). Save this as ***eq11***. Note this equation is similar to the previous example with the exception that here we have a lagged dependent variable.
3. Open ***eq11*** and click the Forecast button. Proceed as previously, producing to compute dynamic and static forecasts. Let's try to forecast both levels (***payroll***) and first differences (***d(payroll)***)(we have named levels as ***eq11_level_dyn*** and ***eq11_level_stat*** and differences as ***eq11_diff_dyn*** and ***eq11_diff_stat***).
4. Click **OK**.

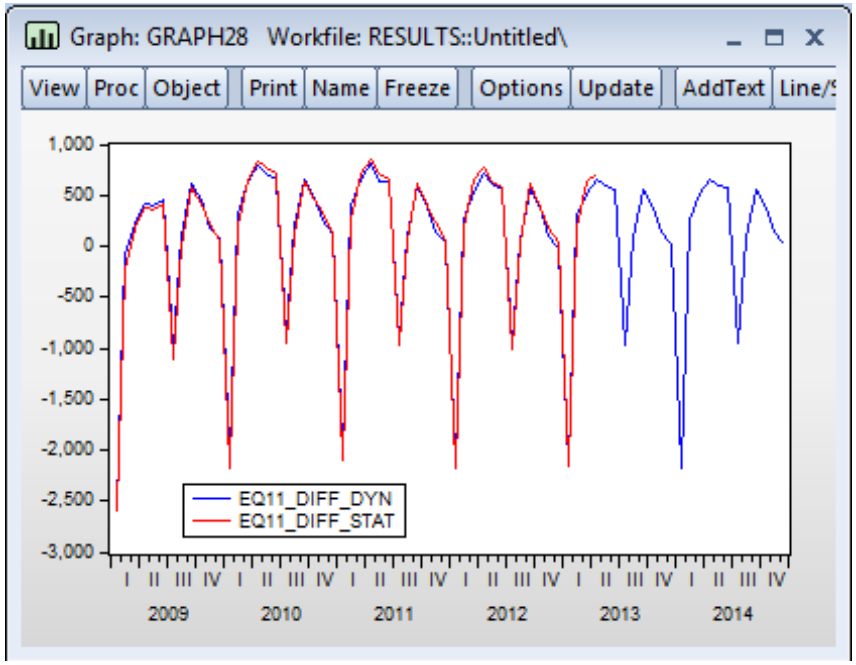


Note:** This equation is saved as ***eq11 in ***WS3_Results.wf1*** workfile.

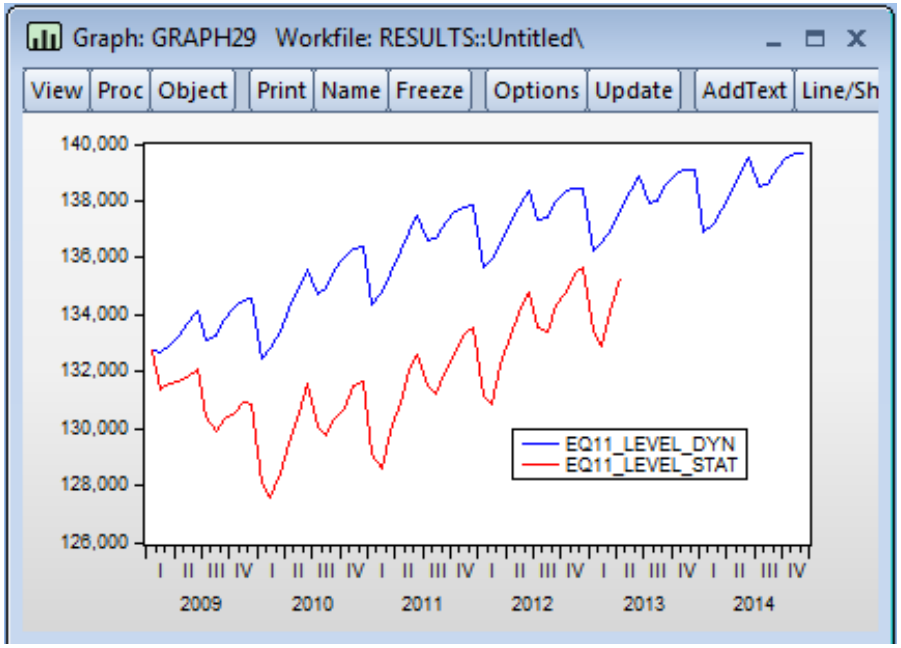
Forecasting with Auto-Series Example 11 (cont'd)

- The graph for dynamic and static forecasts is shown here (both for first differences and levels). They differ, because the dynamic forecast uses forecasted values of ***payroll*** whereas the static forecast uses the actual values of the series.
- Standard errors for the dynamic forecast (not shown here) are also larger, because they take into account the forecast uncertainty from the lagged value of ***payroll***.

Forecast of Differences



Forecast of Levels



Forecasting with Auto-Series Example 11a

- If the model includes a lagged dependent variable, it matters for forecasting purposes whether the dependent variable is an auto-series or not.
- Let's re-estimate the previous example (***eq11***) when the dependent variable is not an auto-series.

Example 11a: Auto-Series and Forecasting

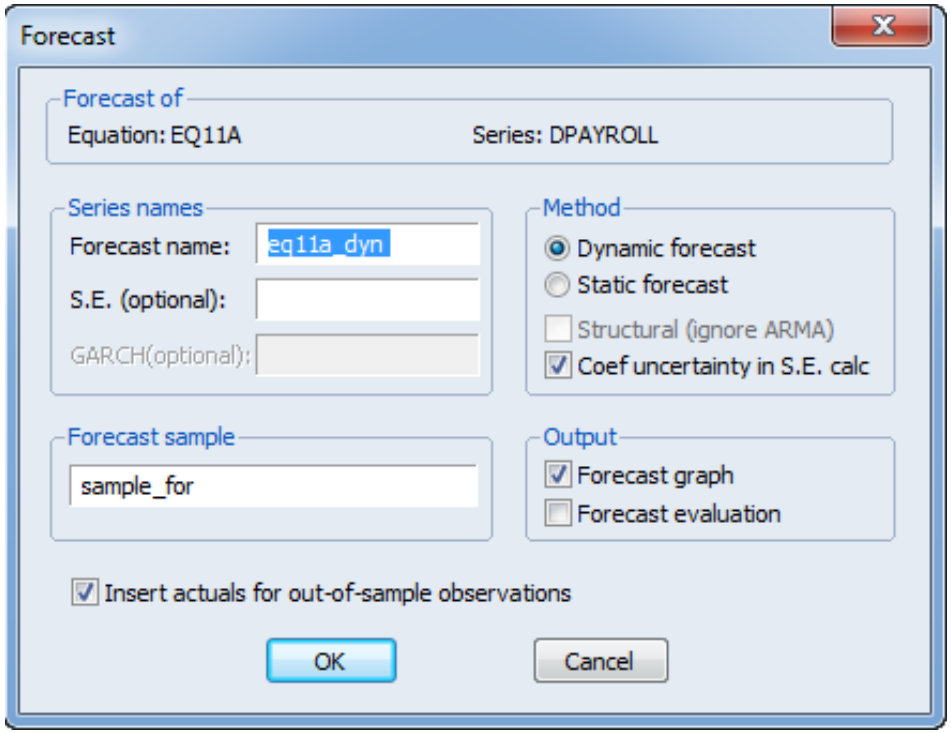
1. Type in the command window:

```
smpl sample_est
series dpayroll=d(payroll)
ls dpayroll c dpayroll(-1) ism
tbill3m @expand(@month, @droplast)
```

2. Press **Enter (**the second command should be typed in one line). Save this as ***eq11a***. Notice that the output from this regression is identical to ***eq11***. However, when we forecasts, the dynamic and static forecasts will differ from those produced with ***eq11***.

3. Open ***eq11a*** and click the Forecast button. Notice that now EViews treats ***DPAYROLL*** as an ordinary series and is unable to forecast the underlying data (***payroll***).

3. Click **OK**.

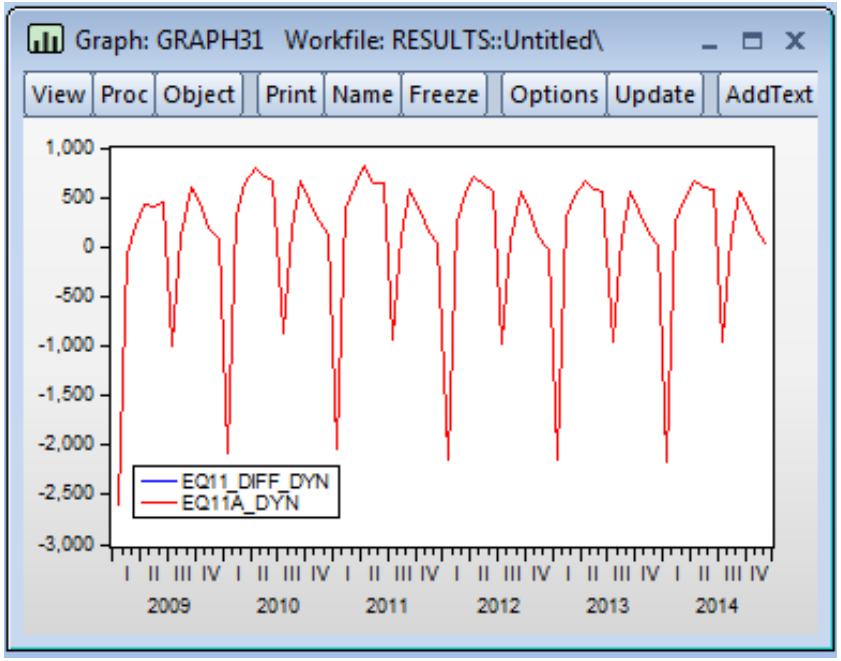


Note:** This equation is saved as ***eq11a in ***WS3_Results.wf1*** workfile.

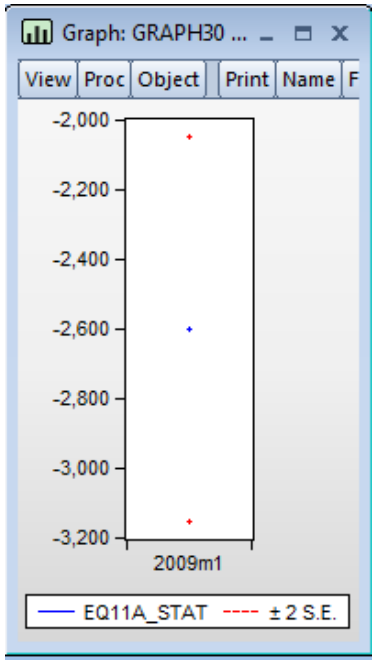
Forecasting with Auto-Series Example 11a (cont'd)

- The graphs of dynamic forecasts from ***eq11*** and ***eq11a*** are identical (as shown here).
  - ✓ However, the static forecasts differ: for ***eq11a***, EViews is able to produce the one-step-ahead forecast for one period only: *2009m01*. This is because ***dpayroll*** was derived from ***d(payroll)*** over the estimation period (ending in *2008m12*).
  - ✓ In contrast, in ***eq11***, EViews knows that ***d(payroll)*** is a transformation of ***payroll***, so it uses actual values of ***payroll*** (which are known up until *2013m03)* to compute the static forecast.

Dynamic Forecasts eq11 and eq11a



Static Forecasts



Forecasting with Auto-Series Example 12

- You can use more complicated expressions and EViews will be able to forecast the underlying series if is able to normalize the dependent variable expression.

Example 12: Auto-Series and Forecasting

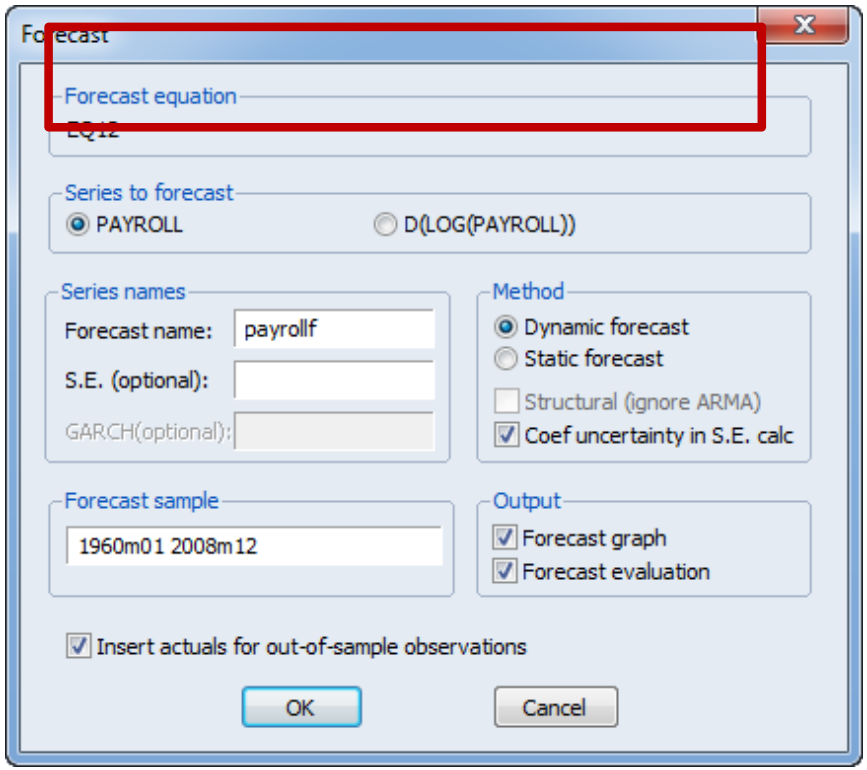
1. Type in the command window:

```
smpl sample_est
ls d(log(payroll)) c d(log(payroll(-1)))
ism tbill3m @expand(@month, @droplast)
```

2. Press **Enter (**the second command should be typed in one line). Save this as eq12.

3. Open ***eq12*** and click the Forecast button. Notice that EViews understands that payroll is the underlying data series and offers to forecast either the underlying series or (***d(log(payroll))***).

3. Click **OK**.



Note:** This equation is saved as ***eq12 in ***WS3_Results.wf1*** workfile.

Forecasting with Auto-Series Example 13

- If the dependent variable is an auto-series derived from two or more series, EViews will offer to provide forecasts of the level of the first series.

Example 13: Auto-Series and Forecasting

1. Type in the command window:

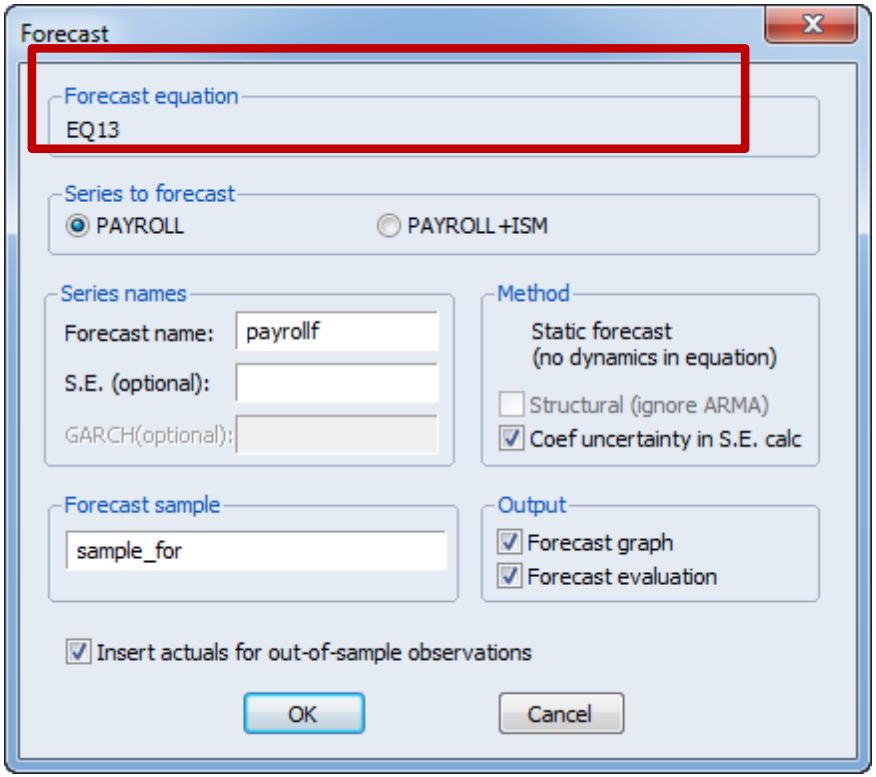
```
smpl sample_est
ls (payroll+ism) c @trend ism(-1)
```

2. Press **Enter.** Save this as Forecast.

3. Open ***eq13*** and click the button.

   Notice that EViews offers to forecasts either the first series of the sum (***payroll***) or the sum (***payroll+ism***). It is important to note that even though a lag of ***ism*** is used as right-hand-side variable, EViews does not offer an option for **Dynamic forecast**. If however, ***payroll(-1)*** was included as a right-hand-side variable, the **Dynamic option** would be available (that's because EViews solves for the first series in the expression).

4. Click **OK**.



Note:** This equation is saved as ***eq13 in ***WS3_Results.wf1*** workfile.

Forecasting with Auto-Series Example 14

- If EViews is unable to normalize the expression for the dependent variable, it will offer to forecast the entire expression (and not the underlying series).

Example 14: Auto-Series and Forecasting

1. Type in the command window:

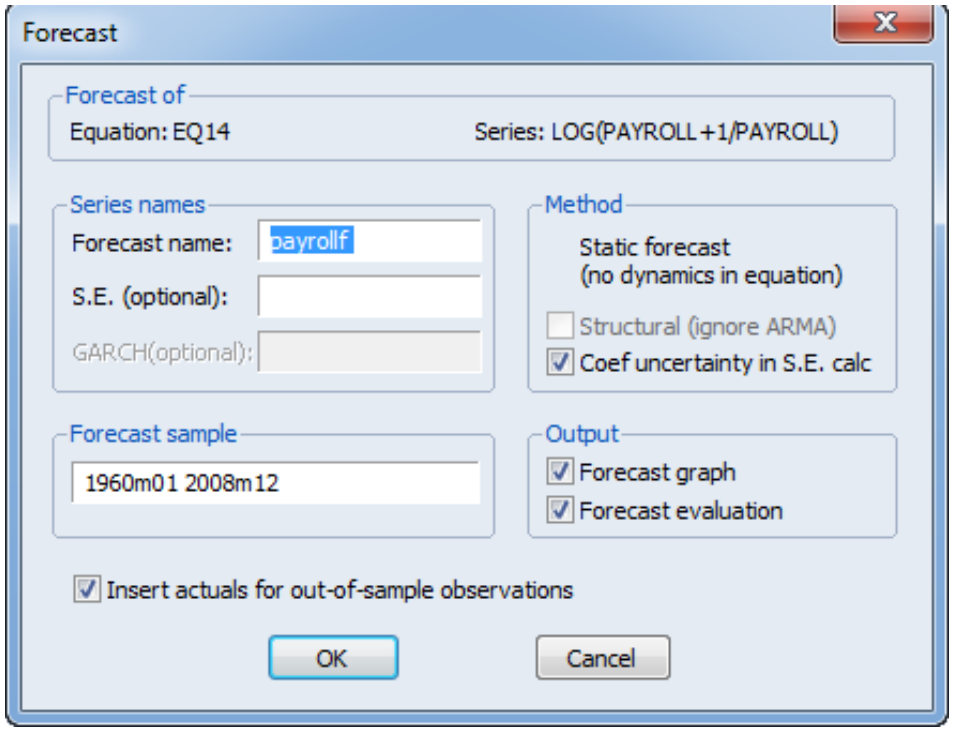
```
smpl sample_est
ls log(payroll+1/payroll) c @trend
payroll(-1)
```

2. Press **Enter (**the second command should be typed in one line). Save this equation as ***eq14***.

3. Open ***eq14*** and click the Forecast button.

   Notice that EViews now offers to forecasts only the complex expression, since it is unable to solve and normalize for ***payroll***. Note also that only static forecasts are available since EViews is unable to solve for lagged values of ***payroll*** on the right-hand-side.

4. Click **OK**.



Note:** This equation is saved as ***eq14 in ***WS3_Results.wf1*** workfile.