

Estimating Asset Pricing Models by GMM using EViews

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Summary: This manual explains how to create equation systems with the EViews software and to use it for implementing the econometric models discussed in the lecture "Financial Econometrics". The data set used for this example (`cochrane_deciles_from_lecture.wf1`) can be downloaded from the lecture web page.

General Explanation of the Eviews object "SYSTEM":

EViews allows the user to specify a system of several equations which can then be used for estimating unknown parameters used in the equations. In general, there is no limitation of how many equations can be entered. To illustrate the procedures necessary to execute equation system estimations, we will focus on estimating a basic consumption-based version of asset pricing models as an example.

Let

$$\mathbb{E}_T(u_t(b)) = \mathbb{E} \left(\beta \left(\frac{c_{t+1}}{c_t} \right)^\gamma R_t^i - 1 \right) = 0 \quad (1)$$

define our consumption-based model (CBM) which is estimated with its sample counterpart

$$\mathbb{E}_T(u_t(b)) = \frac{1}{T} \sum_{t=1}^T \left(\beta \left(\frac{c_{t+1}}{c_t} \right)^\gamma R_t^i - 1 \right) = 0 \quad (2)$$

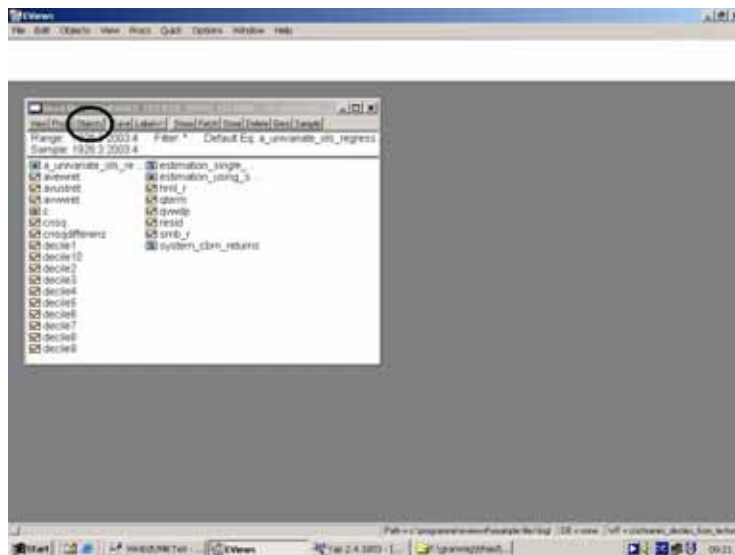
$\left(\frac{c_{t+1}}{c_t} \right)$ denotes consumption growth between period t and $t + 1$ (The values of this fraction have been computed for you. They are contained in the series `cnsqdifferenz`¹).

R_t^i denotes the returns of decile i over the sample period for 10 tests assets (NYSR decile portfolios ; in our data set named `decile1` to `decile10`). β and γ denote the unknown parameters which are to be estimated.

¹You can easily compute the fraction yourself. The fraction is formed by dividing the consumption level in period $t + 1$ by the consumption level in t . The series `cnsq` contains the consumption levels in t . EViews allows to create lags or leads in series (backward and forward in time). Simply use the series name, followed by the lag or lead enclosed in parentheses. Lags are specified as negative numbers and leads as positive numbers. For example, `cnsq(1)` will yield a series with a one period lead - just the thing we need to compute the fraction. Consequently, using `cnsqdifferenz` or `(cnsq(1)/cnsq)` instead will yield the same estimation results.

Specification

When you have your work file open in EViews, click on the **Objects** button in the upper section of the opened work file.



Then, select **New Object...** A window will pop up which allows you to choose between different objects you may want to create, e.g. **graphs**, or defining a new **series**. At the moment, however, we are interested in a new **System** in order to implement our CBM. So choose **System**, give it a proper name (e.g. **CBM**) and proceed by clicking **Ok**.

The blank **System** window will appear. Here, you have to enter your system specification, i.e. you have to tell EViews which equations are to be estimated. In our GMM environment, we will have to specify the moment conditions as given in equation 1. This is quite straight-forward: As EViews will treat every equation entered as being an expected value, you just have to enter the expression inside the expected value operator.

Thus, you have to type

```
c(1)*cnsqdifferenz^-c(2)*decile1-1=0
c(1)*cnsqdifferenz^-c(2)*decile2-1=0
c(1)*cnsqdifferenz^-c(2)*decile3-1=0
c(1)*cnsqdifferenz^-c(2)*decile4-1=0
c(1)*cnsqdifferenz^-c(2)*decile5-1=0
c(1)*cnsqdifferenz^-c(2)*decile6-1=0
c(1)*cnsqdifferenz^-c(2)*decile7-1=0
c(1)*cnsqdifferenz^-c(2)*decile8-1=0
c(1)*cnsqdifferenz^-c(2)*decile9-1=0
c(1)*cnsqdifferenz^-c(2)*decile10-1=0
```

for the 10 moment conditions which are given in our model.

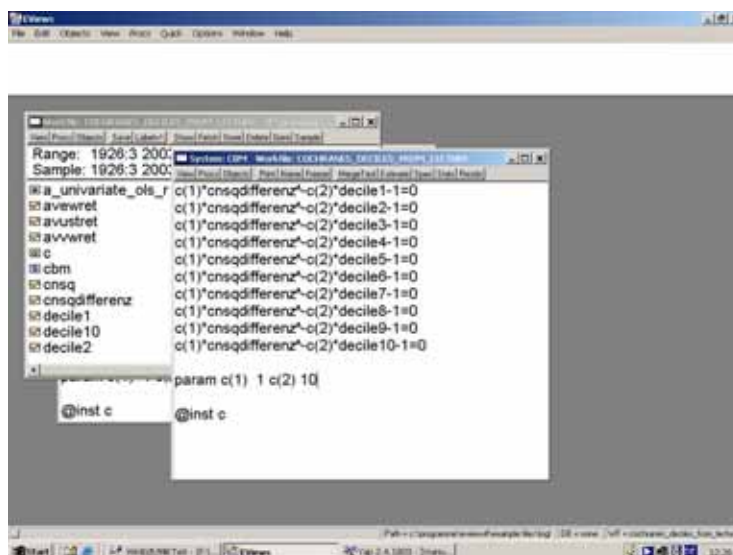
You may note that instead of entering β and γ , you have to type **c(1)** and **c(2)**

respectively. This is due to the fact that EViews gives out estimation results in the parameter vector c ².

As we are using GMM as estimation method, we also have to specify the instruments EViews shall use. This is done by adding `@inst c` to our equation system. `@inst` is the operator which allows you to specify instruments which shall be used for every equation. As we only use the "trivial" instrument, the constant c , you even could omit the `@inst c` operator as EViews automatically will use the constant for GMM estimations. (However, `@inst` will become handy when we estimate models which explicitly use other instruments than c . Then, just add the series name of the instrument after `@inst` - without any comma or semicolon, just leave space between two series names.)

Another helpful operator is `param`: It allows you to control the starting values which EViews will use when it starts the estimation. Sometimes, EViews will not converge unless you specify starting values! If you want EViews to start with e.g. $\beta = 1$ and $\gamma = 10$, type `param c(1) 1 c(2) 10`. In our example, starting values will not be necessary, so you can easily omit this line or comment it out by putting `'` in front of the `param` expression.

When you have entered all equations correctly, your screen should look like this:



Estimation

Now we are ready to estimate our model. Click on the **Estimate** button on the upper side of the **System** window. The estimation window will appear. Here you can choose options which EViews will use for the estimation.

Choose **GMM - Time series (HAC)** as we are in a time series context. The appearance of the window will change.

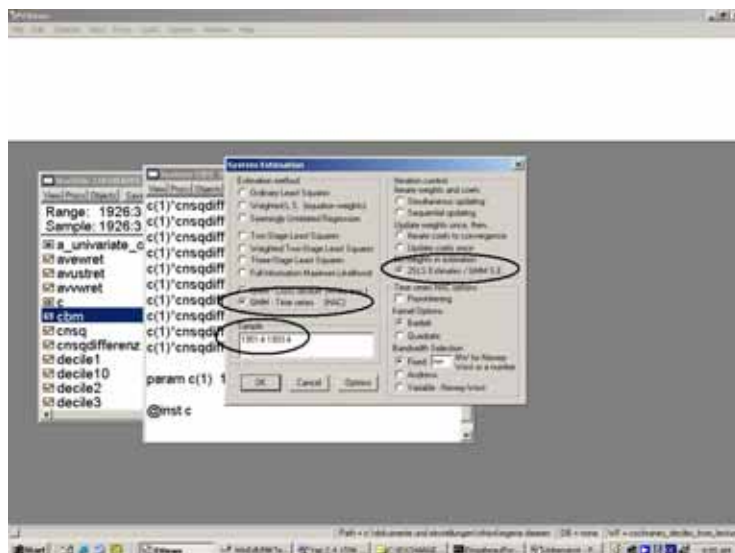
First of all, we have to specify the sample which we would like to use. As Cochrane uses only data from the fourth quarter of 1951 to the fourth quarter

²You may also define other parameter vectors with **Objects, New Object...**. Then, choose **Matrix-Vector-Coeff** and then **coefficient vector**. Thus, you can name coefficients "properly". However, this is just cosmetics.

of 1993, we will also reduce our sample. To do this, replace the entry in the Sample box by

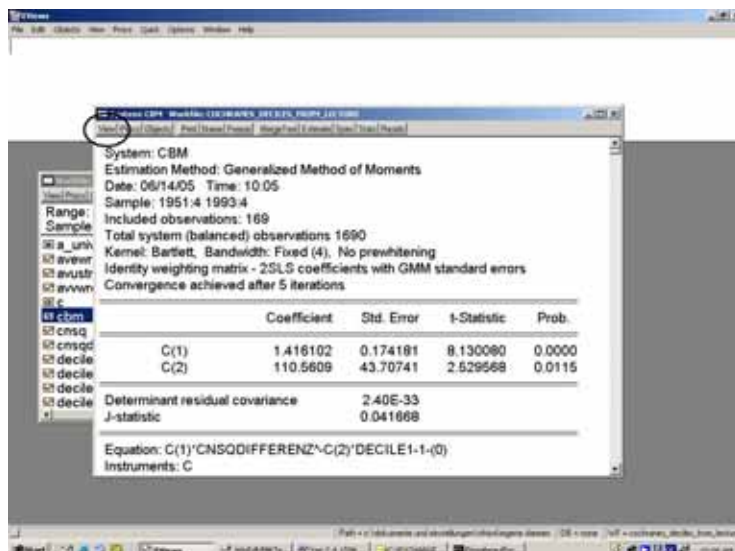
1951:4 1993:4.

Then, choose 2SLS Estimates/GMM S.E.. Your screen should now look like this:



Proceed by clicking Ok.

EViews will return the estimation results in the same window. If you have entered everything correctly, the estimation output should read as follows:



Congratulations! You succeeded in reproducing Cochrane's results! If you want to alter the moment conditions you entered in order to execute a different estimation, simply click on the View button as indicated above, then choose System

Specification. But be aware that you will lose your previous estimation results unless you save them by clicking on the **Freeze** button. This becomes handy for comparing different estimation outputs!

Computing the J -Statistic

The J -statistic reported at the bottom of the estimation output is the minimized value of the objective function. By taking this value times the number of observations included in the estimation, you will get the test statistic which can be used for testing the validity of our model. Technically, it is computed by this formula:

$$TJ_T = T \min_b [g_T(b)' S^{-1} g_T(b)] \sim \chi^2(\text{no. of moments} - \text{no. of parameters}) \quad (3)$$

It states that - under the null hypothesis that the overidentifying restrictions are satisfied - T (i.e. the number of observations) times the minimized value of the objective function is distributed χ^2 with degrees of freedom equal to the number of moments less the number of estimated parameters. This can be used to carry out hypothesis tests from GMM estimation.

In our example, we have ten instruments to estimate two parameters. In EViews you can easily compute the test statistic as a named scalar (e.g. `j`) by entering the following commands in the command window at the top of the EViews window:

```
scalar j=CBM.@regobs*CBM.@jstat
```

```
scalar j_p=1-@cchisq(j,8)
```

where `CBM` is the name of our equation system which contains the GMM estimates. The second command computes the p-value of the test statistic as a named scalar (e.g. `j_p`). To view the value of `j_p`, double click on its name in the workfile; the value will be displayed in the status line at the left hand side of the bottom of the EViews window.