Quantitative Techniques – Term 2

Laboratory 6

23 February 2006

Overview

The objective of this lab is to carry out a simplified merger simulation exercise and more specifically:

- Specification of a demand model;
- Specification of a supply model;
- Running counterfactuals.

Start Stata 9 from the Windows Start menu (Programs, F. Departmental Software, E. Social Science, Stata). Do not update the version that is installed on your machine.

Before starting your tasks, make sure that the following windows are visible on your screen and choose their size so that they do not overlap: Review, Variables, Results, Command.

Go to www.staff.city.ac.uk/a.banal-estanol/teaching.htm, download Lab6.csv and System.do to your directory, then import the data file into Stata.[1]

The file contains cross-section data on:

- p1: price of product 1;
- p2: price of product 2;
- s1: share of product 1;
- s2: share of product 2;
- sO: share of other product.

We now follow the steps outlined in Lecture 5: Merger Simulation.

Task 1 – Demand model

In this example, following the setting of Lecture 5, our focus of analysis is the merger between two firms. Product 1 and product 2 are substitutes, while O is the outside good. Our objective is to compare the market outcome before and after the merger between the two brands.

On the basis of the assumptions in Lecture 5, we obtain the following relationships:

$\ln s_1 = \ln s_o + b_1 - a*p_1$

$\ln s_2 = \ln s_o + b_2 - a*p_2$

We estimate them using cross-section data on sales in different stores.

[1] Reminder: type insheet using "*your directory*\Lab6.csv" or use the Menu bar: File…Import…ASCII data created by a spreadsheet.

Note that ln s_o is not a parameter to be estimated, but it is known. The equations above can therefore be re-written as:
$y_1 = \ln s_1 - \ln s_o = b_1 - a^*p_1$
$y_2 = \ln s_2 - \ln s_o = b_2 - a^*p_2$

- Our new dependent variables are y_1 and y_2 and we have to create them in Stata using 'generate'. For instance:

```
gen y1 = ln(s1) - ln(so)
```

Remember that the parameter 'a' is the same in both equations and therefore we should use a system estimation procedure to impose the cross-equation constraint.
At this stage of the course, we have not learnt about systems yet. In order to keep things simple, we will not go through the commands used to impose constraints and estimate the system. The necessary commands are already in the do-file System.do.

- Run this file as follows:

```
do "your directory\System.do"
```

The output you obtain is divided into two panels. Firstly, you can see the equality constraint which is imposed on the slope coefficients from the two equations. Then, you have some summary statistics on the two equations.
From the second panel, you can see that the coefficients on p1 and p2 are equal. All estimates are very significant, which is not surprising given that the sample is simulated.

```
Constraints:
 ( 1)  [y1]p1 - [y2]p2 = 0
----------------------------------------------------------------------
Equation          Obs  Parms        RMSE    "R-sq"     F-Stat        P
----------------------------------------------------------------------
y1                100      1    .2566245    0.5791     729.17   0.0000
y2                100      1    .2548161    0.4975     729.17   0.0000
----------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
y1           |
          p1 |  -.2483744    .009198   -27.00   0.000    -.2665142   -.2302347
       _cons |    1.13333   .0861667    13.15   0.000     .9633969    1.303263
-------------+----------------------------------------------------------------
y2           |
          p2 |  -.2483744    .009198   -27.00   0.000    -.2665142   -.2302347
       _cons |   .6809621   .0607457    11.21   0.000     .5611629    .8007612
-------------------------------------------------------------------------------
```

We have obtained the estimated equations:
$\ln s_1 - \ln s_o = 1.13 - 0.25^*p_1$
$\ln s_2 - \ln s_o = 0.68 - 0.25^*p_2$

We can use a = 0.25 to compute the own-price elasticity. For product 1, it is
$e_{1,1} = -a^*p_1^*(1-s_1)$
Note that the elasticity is not constant, but changes depending on price and market share.

We can then use Excel to easily calculate the own-price elasticity for each observation.

- Open the file Lab6.csv and save it in Excel format;
- Using a = 0.25 and the formula above, calculate the own-price elasticity for product 1 and product 2.

The results for the first observations should look as follows:

e11	e22
-2.285	-1.289
-1.509	-1.264
-1.172	-0.950
-2.300	-1.502
-1.184	-1.206
-1.507	-1.332
-1.732	-0.777
-1.491	-1.048
-1.231	-0.640
-2.392	-0.863

Task 2 – Supply model

For this task, we assume that firms compete on prices (Bertrand competition).

From Lecture 5,

$(P_1 - C_1)/\ C_1 = -\ 1/e_{1,1}$

where C_1 is marginal cost for product 1.

The margin for product 1 is:

$m_1 = P_1 - C_1 = 1/a*(1\text{-}s_1)$

- From the first equation, using prices and elasticities, calculate marginal prices;
- Use the parameter a = 0.24 obtained in Task 1 and the market shares in order to calculate margins for product 1 (m_1) and product 2 (m_2).

Note that we are simply assuming that firms compete on prices, we are not testing this hypothesis (this was Step 3 in Lecture 5).

You should obtain something like this:

m1	m2	c1	c2
4.735	5.274	6.085	5.546
5.342	5.144	2.718	2.916
5.787	5.482	0.993	1.298
4.960	5.411	6.450	5.999
5.869	5.208	1.081	1.742
5.342	5.081	2.708	2.969
5.081	6.219	3.719	2.581
5.144	5.208	2.526	2.462
5.631	6.313	1.299	0.617
4.682	6.313	6.518	4.887

Task 3 – Counterfactuals

We can now compare the competitive outcome with a situation of collusion after the merger. We assume that the true parameters were obtained via estimation, so we use the estimates from Task 1 for the collusion equation.

Under the assumption of <u>collusion</u>, the margin on product 1 is given by:

$M^C_1 = P^C_1 – C_1 = 1/(a^* s_0)$
where M^C_1 and P^C_1 represent the margin and the price under collusion, respectively. Note that the marginal cost is the same regardless the assumed behaviour of the firms.

From the formula above we can:

- Calculate the margin, on the basis of 'a' and the share of the other product (So);
- For each product (and each observation), obtain the price under collusion (PColl1 and PColl2) and compare it with the price before the merger to check if prices have increased.

Both margins and prices appear higher compared to the pre-merger situation.

Mcoll	PColl1	PColl2
6.219	12.304	11.765
7.062	9.780	9.978
8.681	9.674	9.978
6.831	13.280	12.829
8.170	9.251	9.912
6.944	9.653	9.913
8.681	12.399	11.262
6.831	9.357	9.292
10.684	11.983	11.301
7.576	14.094	12.463

Summary:

- In this example, two firms plan to merge;
- By estimating a demand system, we have obtained price elasticities;
- On the basis of the estimated elasticities, and of the prices observed in the market, we have calculated the implied marginal costs and margins;
- Using marginal costs and pre-merger parameters, we calculate the prices and margins that would be observed after the merger;
- Both margins and prices appear higher than before the merger.