Quantitative analysis of market power and conduct

Assignment 1: Estimation of Demand and Supply Model of a Homogeneous Good

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1

Specify the final demand and supply model as derived in class[1] (using the linear approximation). Follow the first approach, i.e. where conduct shifts from cartel to price war are known based on the price war dummy variable.

Demand: $$lnQ_t = \alpha_0 + \alpha_1 * lnP_t + \alpha_2 * L_t + \epsilon_t$$

Supply:

$$lnP_t = \beta_0 + \beta_1 * D1_t + \beta_2 * D2_t + \beta_3 * D3_t + \beta_4 * D4_t + \delta * ln\frac{Q}{N} - \phi_0 * \frac{1}{\alpha_1} - \phi_1 * I_t * \frac{1}{\alpha_1} + \omega_t$$

Where Q_t is the total quantity of grain shipped, P_t is grain rate, L_t is a demand shifter: Great Lakes Open, cost shifters: new entrant dummies $D1_t, D2_t, D3_t, D4_t$ and I_t is a conduct shifer: collusion dummy.

2

Discuss identification of the conduct parameter.

We took (as Porter) the conduct parameter as a time varying variable. In order to estimate the conduct parameter during collusive periods we also have to assume that when there is a price war, firms compete á la Bertrand, so there is perfect competition. Technically:

$$\phi_t = \phi_0 + \phi_1 * I_t$$

Where I_t is the collusion dummy, that takes value 1, if there is collusion and 0 in price war periods. In order to estimate the conduct parameter (ϕ_t) during collusive periods we have to assume that $\phi_0 = 0$ during price wars. If we would not have done this simplificative assumption ($\phi_0 = 0$), than the conduct parameter would not be recoverable from the intercept of the supply curve in price war periods i.e. from $\beta_0 - \phi_0 * \frac{1}{\alpha_1}$. One can check that[2] the conduct paramter is: $\phi_t = -\lambda_1 * \alpha_1$, where λ_1 is the estimated coefficient of the collusion dummy and α_1 is the own price elasticity of the demand.

3

Specify your instruments and variables to be included, as in Porter. Explain why the instruments are valid.

We need to use instrumental variable(s) in order to get a consistent and unbiased estimate of the own price elasticity of the demand, otherwise there would be endogenity caused by omitted variable(s). Our instrumental variable for demand is the new entrant dummy variable (D_t), that takes value 1, if there is a new firm entering into the market and 0 otherwise. This variable is a valid IV because it is uncorrelated with consumers' willingness to pay, i.e. the error term of the demand

[1]Please note that we did use the 12 seasonal or monthly dummies both in demand and supply as it is used in Porter's paper, but for spacing reasons we did not include them in regression outputs.

[2]Please find the details in the appendix.

equation, however it is correlated with the price, because it affects firms' pricing decision.

The instrument for the supply function is the Lakes dummy, that takes value 1 if the Great Lakes were opened for shipping and 0 if not. The IV is valid because it is negatively correlated with the quantity transported by trains and it is unrelated to unobserved pricing factors like economics of scale.

4

Present summary statistics of your variables.

	Mean	Standard Deviation	Min value	Max value
PRICE	.2464939	.0665263	.125	.4
QUANTITY	25384.4	11632.77	4810	76407
LAKES	.5731707	.4953728	0	1
COLLUSION	.6189024	.4863985	0	1

5

Estimate the model by OLS.

Demand estimation:

VARIABLES	LOGQUANTITY
LOGPRICE	-0.639***
	(0.0819)
LAKES	-0.452***
	(0.114)
Constant	9.512***
	(0.191)
Observations	328
R-squared	0.316

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

It turns out from the output of the demand estimation that all the coefficients are segnificant in 99% confidence interval. All the parameters have the sign that we have expected before we were running the regression. That is to say the own price elasticity of the demand is negative, the lakes' dummy has also a negative sign, meaning when the lakes were opened for grainshipping then the quantity demanded for grain transportation via train decreased. Taking into account the goodness of fit the R^2 is .316. However, estimating the demand by OLS gives us an inconsistent and biased parameter estimation, because there is endogeneity caused by omitted variables. So one should take into account these facts when interpreting the results.

Supply estimation:

VARIABLES	LOGPRICE
LOGQUANTITY	-0.127***
	(0.0273)
DM1	-0.193***
	(0.0435)
DM2	-0.176***
	(0.0633)
DM3	-0.245***
	(0.0456)
DM4	-0.452***
	(0.0979)
COLLUSION	0.279***
	(0.0258)
Constant	-0.190
	(0.273)
Observations	328
R-squared	0.577

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The coefficients of the new entrant dummies (DM1, DM2, DM3, DM4) are all significant in 99% confidence interval and they are all negative. This means, that whenever a new entrant enters the market the price goes down because of the higher level of competition. The coefficient of collusion is significant and positive, that is to say the price goes up when collusion takes place. The parameter of the log quantity is negative although it is significant (without the monthly dummies it is insignificant). In this estimation the R^2 is .577 that means a better goodness of fit. Here the same endogeneity problem arises since there are factors that are not included in the supply equation but affects the quantity (i.e. cov(log(quantity),error term of supply)$\neq$ 0).

6

Estimate your model using instruments. First, please do the 2SLS manually and show the results for 1st stage. Then, do the IV estimation using the Stata command. Check whether results are the same. Interpret your results. Compare your results with the ones obtained in 5.

Please find the estimation results in the appendix. In the demand estimation the first stage with the manual process has given the very similar results what the built in 2sls first stage gave. $R^2 = 0.34$, all the new entrant dummies are significant and negative, meaning the higher the number of firms the lower the price. The Lakes dummy is insignificant in both processes.

In demand estimation in the second stage the manual approach shows $R^2 = 0.22$, the price elasticity of the demand is -0.73 and it is significant. It means that when the price increases with 1%

the quantity demanded decreases with 0.73%, ceteris paribus, i.e. the demand is inelastic. The coefficient of the Lakes dummy is -0.444, that means if the Great Lakes are opened for grain shipping the trained quantity decreases with approximately 35,9% ($(e^{-0.444} - 1) * 100$).

With the built in approach the $R^2 = 0.31$, the own price elasticity of the demand is -0.729 and it is significant. It means if the price increases with 1% the quantity demanded decreases with 0.729% i.e. the demand is inelastic. The coefficient of the Lakes dummy is very similar to the one in the manual approach. One can see these results are almost the same as in the manual approach.

With the simple OLS demand estimation we obtained $R^2 = 0.32$. The own price elasticity is -0.639 and the Lakes dummy takes the value of -0.452. One can see the difference between the 2sls and the OLS estimates in especial concern the own price elasticity of the demand. The following table summarizes the above stated facts.

	Own price elasticity of the demand	LAKES	R^2
Manual 2sls	-0.73	-0.444	0.22
Built in 2sls	-0.729	-0.444	0.31
OLS	-0.639	-0.452	0.32

Estimating the first stage regression in the 2sls estimation process of the supply curve gives similar results in the manual and in the built in process. With the manual method the $R^2 = 0.338$, the Collusion dummy's coefficient is -0.224 and the Lakes dummy has a -0.473 coefficient. That is to say when there is collusion the quantity is lower, with about 22%. When the Great Lakes are able for shipping then the quantity of the train transportation demand is lower with about 38%, ceteris paribus. The following table summarizes the parameters that we obtained during estimating the supply function.

	COLLUSION	LOGQUANTITY	R^2
Manual 2sls	0.38	0.29	0.50
Built in 2sls	0.363	0.224	0.352
OLS	0.279	-0.127	0.58

The main findings are the following: if there is collusion the price is higher. The coefficient of the Collusion dummy is significant across all the three method. The log quantity has a negative and significant sign with the OLS, that is contradictory with the positive theoretical slope of the supply curve. Both 2sls approaches leads to positive signs in terms of the parameter of the log quantity, meaning the higher the quantity the higher the price. More precisly with the manual approach if the quantity increases with 1% the price increases with 0.22%, that means the supply curve is inelastic.

In terms of conduct we are able to recover the conduct parameter during collusive periods. The following table summarizes our findings, where conduct= -(demand elasticity*collusion). Since the 2sls approaches estimate a conduct around 0.3, firms compete á la Cournot with 3 firms in the market during collusive periods.

	Demand elasticity	Collusion	Conduct
OLS	-0.639	0.279	0.18
Manual 2sls	-0.73	0.381	0.28
Built in 2sls	-0.729	0.363	0.26

Appendix

The technically estimated supply model is:

$$lnP_t = \lambda_0 + \beta_1 * D1_t + \beta_2 * D2_t + \beta_3 * D3_t + \beta_4 * D4_t + \delta * ln\frac{Q}{N} + \lambda_1 * I_t + \omega_t$$

Where $\lambda_0 = \beta_0 - \frac{\phi_0}{\alpha_1}$ and $\lambda_1 = -\frac{\phi_1}{\alpha_1}$ and therefore the conduct parameter is: $\phi_t = -\lambda_1 * \alpha_1$.

First stage regression of the demand estimation of the "manual" 2sls:

VARIABLES	LOGPRICE
DM1	-0.320***
	(0.0540)
DM2	-0.186**
	(0.0789)
DM3	-0.477***
	(0.0539)
DM4	-0.343***
	(0.122)
LAKES	-0.0580
	(0.0722)
Constant	-0.987***
	(0.109)
Observations	328
R-squared	0.340

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First stage regression of the supply estimation of the "manual" 2sls:

VARIABLES	LOGQUANTITY
DM1	-0.0514
	(0.0897)
DM2	0.00400
	(0.128)
DM3	0.120
	(0.0932)
DM4	-0.758***
	(0.199)
COLLUSION	-0.224***
	(0.0508)
LAKES	-0.473***
	(0.118)
Constant	10.59***
	(0.185)
Observations	328
R-squared	0.338

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

First stage regression of the demand estimation with the built in stata 2sls command:

VARIABLES	LOGPRICE
DM1	-0.320***
	(0.0539)
DM2	-0.186***
	(0.0789)
DM3	-0.477***
	(0.0539)
DM4	-0.343***
	(0.1221)
LAKES	-0.058
	(0.0722)
Constant	-0.9599***
	(0.0727)
Observations	328
R-squared	0.34

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Second stage regression of the demand estimation with the built in stata 2sls command:

VARIABLES	LOGQUANTITY
LOGPRICE	-0.729***
	(0.168)
LAKES	-0.444***
	(0.112)
Constant	9.186***
	(0.244)
Observations	328
R-squared	0.314

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First stage regression of the supply estimation with the built in stata 2sls command:

VARIABLES	LOGQUANTITY
DM1	-0.0514
	(0.0897)
DM2	0.0040
	(0.1284)
DM3	0.1201
	(0.0932)
DM4	-0.7577***
	(0.1989)
COLLUSION	-0.2240***
	(0.05080)
LAKES	-0.4735***
	(0.1177)
Constant	10.334***
	(0.1357)
Observations	328
R-squared	0.34

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Second stage regression of the supply estimation with the built in stata 2sls command:

VARIABLES	LOGPRICE
LOGQUANTITY	0.224
	(0.147)
DM1	-0.198***
	(0.0523)
DM2	-0.171**
	(0.0761)
DM3	-0.310***
	(0.0609)
DM4	-0.237
	(0.147)
COLLUSION	0.363***
	(0.0462)
Constant	-3.681**
	(1.512)
Observations	328
R-squared	0.352

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$