Villas-Boas/Perloff are 202
4th handout

**Last Handout: Current handout topics in Bold**

**Topics**

1. Product Differentiation, Quality, Advertising, Asymmetric Information
   Problem Set 1
2. Imperfect information and Search models
3. Repeated Games
   Problem Set 2
4. Strategic Non-cooperative Behavior
5. **Vertical Relationships, Theory of the Firm**
   **Problem Set 3 (empirical part last question)**

Please see Course Outline at: http://are.berkeley.edu/~sberto/are202.html

**Empirical Analyzes:**

1. Stata and matlab code to estimate Salop and Stiglitz.
2. Strategic Interactions, Dynamic Collusion Models, Stata Code and Files
Data sources

main data page
http://research.chicagogsb.edu/marketing/databases/index.aspx

movement (store total sales by week) data files
http://research.chicagogsb.edu/marketing/databases/dominicks/download.aspx

**3. Estimation of Structural Demand Model, recovery of Margins and Empirical Analysis of Margins, Stata Code for Problem set 3**

**Main References:**


1. 1 . Carlton and Perloff (2000): Modern Industrial Organization, Dennis W. Carlton and Jeffrey Perloff, 3rd Edition, Reading, MA: Addison-Wesley. Book web-page: http://occawlonline.pearsoned.com/bookbind/pubbooks/carlton_awl/
2. Tirole (1989) : The Theory of Industrial Organization, Jean Tirole, 1989, The MIT Press.

## ARE 202. Lecture Notes on Double Marginalization

Motivate with wh manufacturers rarely supply directly to final consumers. Most empirical analyses of scanner data assume this to be the case, or added a pro[portional retail markup to wholesale pricing decisions by manufacturers of a certain product.. What if retailers given wholesale price also decide retail prices to maximize profits rather than just add a simple mark-up rule (or no mark-up)?

Suppose we have an Upstream firm,– manufacturer – selling to a Downstream firm – retailer. In situations when there is retail market power, sequential pricing decisions shall give rise to double marginalization (DM). The retail decisions affect the upstream firm profits, but the retailer does not take thgose profits into account when he is making his price or advertising or service decisions. This subsequent behavior imposes an extrenality on the upstream manufacturer. The coordinate vertical channel, maximizing joint manufacturer and retail profits takes care of this vertical extrenality. Vertical integration (VI) is one way to eliminate this extrenality inherent in double marginalizaiton. But there are other ways to try to replicate the vertically integrated outcome by the manufacturer using vertical restraints on the downstream retailer. A resale price maintenance contracts, a revenue sharing contract, a two part tariff contract are solutions to try to eliminate DM and try to replicate the VI outcome.

I start with a very simple model and then derive for the most general case the double marginalizaiton oucome below. The objective of these lecture notes is two fold. First to show you the profit loss of this DM situation, showing that profits for VI structure are larger than the sum of retail and manufacturer profits in DM case. The second objective is to show that, for this simple case first and then for the most general case, second, given a model of demand, and manufacturer and retail pricing behavior we can compute what would be the retail and manufacturer margins that should be occuring according to the model.

Simple model:

Suppose demand is given by p=a-b q, upostream marginal costs are constant and given by c, and there are no downstream retail costs. Manufacturers have market power and so do retailers. The manufacturers and retailers are deciding prices n a stackelberg fashion.

Starting wit the retailer first, he maximizes profits chosing p given wholesale price w,

$$\max_p |_w \ \pi^r = (p-w)q(p) = (p-w)\frac{(a-p)}{b}$$

thus optimal price shall be a best response to w and in this case given by p=(a+w)/2, then q=(a-w)/2b.

The manufacturer when deciding wholesale price to maximize his profits will take the retail best response to that wholesale price into account

$$\max_w |_{p=(a+w)/2} \ \pi^w = (w-c)q(p(w)) = (w-c)\frac{(a-(\frac{a+w}{2})}{b}$$

And thus optimal wholesale price shall be w=(a+c)/2, q=(a-c)/4b.

The upstream profits in this case shall be $(a-c)^2/8b$ and downstream profits shall be $(a-c)^2/16b$.

What would be the retail price if both were jointly maximizing profits as a vertically integrated sturcture?

$$\max_p \pi^r + \pi^w = (p-c)q(p) = (p-c)\frac{(a-p)}{b}$$

thus optimal price shall be a best response to w and in this case given by p=(a+c)/2 which is smaller than p in DM, then q=(a-c)/2b which is larger than q in DM. You can verify easily that joint profits also increase relative to DM.

Most general case:

Below is a derivation of manufacturers and retailers margins for the most general case of a multi product set of imperfectly competing upstream manufacturers setting wholesale prices in a bertrand nash fashion and then given those prices a set of imperfectly compatitive multi-product retauilers setting retail prices in a bertrand nash fashion. It shows that given a model of demand, and manufacturer and retail pricing behavior we can compute what would be the retail and manufacturer margins that should be occuring according to the model.

I focus on the case where relationships try to address the traditional problem of double marginalization resulting from the simple linear pricing model. In what follows, the supply model is solved as a function of demand side parameters to obtain an expression for both the retailer's and the manufacturer's implied price-cost margins.

***Simple linear pricing model.*** In this model manufacturers set their prices first and retailers follow. The margins that result from this behaviour correspond to the pure double-marginalization price-cost margins with linear pricing in oligopoly markets at the manufacturer and retail level.

Let there be $N_r$ Nash–Bertrand multi-product-oligopolist retailers competing in the retail market and suppose there are $N_w$ Nash–Bertrand multi-product-oligopolist manufacturers competing in the wholesale market. To solve this vertical model, one starts by looking at the retailer's problem. Each retailer $r$'s profit function in week $t$ is given by

$$\pi_{rt} = \sum_{j \in S_{rt}} [p_{jt} - p_{jt}^{w} - c_{jt}^{r}] s_{jt}(p), \qquad (1)$$

where $S_{rt}$ is the set of products sold by retailer $r$ during week $t$, $p_{jt}^{w}$ is the wholesale price he pays for product $j$, $c_j^r$ is the retailer's marginal cost of product $j$, and $s_{jt}(p)$ is the share of product $j$. The first-order conditions, assuming a pure-strategy Nash equilibrium in prices, are

$$s_{jt} + \sum_{m \epsilon S_{rt}} [p_{mt} - p^{w}_{mt} - c^{r}_{mt}] \frac{\partial s_{mt}}{\partial p_{jt}} = 0 \quad \forall j \epsilon S_{rt}, \quad \text{for } r = 1, \ldots, N_r, \qquad (2)$$

where $N_t$ is the number of products in the market.

Define $T_r$ as the retailer's ownership matrix with the general element $T_r(i,j)$ equal to 1 when both products $i$ and $j$ are sold by the same retailer and 0 otherwise. Let $\Delta_{rt}$ be the retailer's response matrix, containing the first derivatives of all the shares with respect to all retail prices, with element $(i, j) = \frac{\partial s_{jt}}{\partial p_{it}}$. Stacking up the first-order conditions given by (2) and rearranging terms, we obtain the following vector expression for the retailers' implied price-cost margins, as a function of only the demand side for each week $t$,

$$p_t - p^{w}_t - c^{r}_t = -(T_r * \Delta_{rt})^{-1} s_t(p), \qquad (3)$$

where $T_r * \Delta_{rt}$ is the element by element multiplication of the two matrices. If the equilibrium is unique, equation (3) implicitly defines the retail prices as a function of all the wholesale prices.

Each manufacturer maximizes profit by choosing the wholesale prices $p^w$, knowing that the retailers behave according to (3). Note that this model allows for different wholesale prices to be chosen for the same "physical product" sold to different retailers. The manufacturer's profit function is given by

$$\pi_{wt} = \sum_{j \epsilon S_{wt}} [p^{w}_{jt} - c^{w}_{jt}]\, s_{jt}(p(p^{w})), \qquad (4)$$

where $S_{wt}$ is the set of products sold by manufacturer $w$ during week $t$, and $c_{jt}^{w}$ is the marginal cost of the manufacturer that produces product $j$. The first-order conditions are, assuming again a pure-strategy Nash equilibrium in the wholesale prices,

$$s_{jt} + \sum_{m \epsilon S_{wt}} [p^{w}_{mt} - c^{w}_{mt}] \frac{\partial s_{mt}}{\partial p^{w}_{jt}} = 0 \quad \forall j \epsilon S_{wt}, \quad \text{for } w = 1, \ldots, N_w. \qquad (5)$$

Let $T_w$ be a matrix of ownership for the manufacturers, analogously defined as the matrix $T_r$ above. In particular, element $(j,m)$ of $T_w$ is equal to 1 if the manufacturer sells both products $j$ and $m$, and is otherwise equal to 0. Let $\Delta_{wt}$ be the manufacturer's response matrix, with element $(j,m) = \frac{\partial s_{mt}}{\partial p_{it}^{w}}$ containing the derivatives of the market shares of all products with respect to all wholesale prices. In other words, this matrix contains the cross-price elasticities of derived demand and the effects of cost pass-through. This matrix becomes very complicated with multiple products and multiple retailers and manufacturers. To obtain $\Delta_{wt}$, first note that $\Delta_{wt} = \Delta_{pt}'\Delta_{rt}$, where $\Delta_{pt}$ is a matrix of derivatives of all the retail prices with respect to all the wholesale prices. So all that is needed is to find expressions for, and compute, $\Delta_{pt}$. Dropping time subscripts to simplify notation, to get the expression for $\Delta_p$, let us start by totally differentiating for a given $j$ equation (2) with respect to all prices ($dp_k, k = 1,\ldots,N$) and a wholesale price $p_f^w$, with variation $dp_f^w$:

$$\sum_{k=1}^{N}\underbrace{\left[\frac{\partial s_j}{\partial p_k}+\sum_{i=1}^{N}\left(T_r(i,j)\frac{\partial^2 s_i}{\partial p_j \partial p_k}(p_i-p_i^w-c_i^r)\right)+T_r(k,j)\frac{\partial s_k}{\partial p_j}\right]}_{g(j,k)} dp_k - \underbrace{T_r(f,j)\frac{\partial s_f}{\partial p_j}}_{h(j,f)} dp_f^w = 0.$$

(6)

Putting all $j = 1,\ldots, N$ products together, let $G$ be the matrix with general element $g(j,k)$ and let $H_f$ be the $N$-dimensional vector with general element $h(j,f)$. Then $Gdp - H_f\, dp_f^w = 0$. Solving for the derivatives of all prices with respect to the wholesale price $f$, the $f$-th column of $\Delta_p$ is obtained:

$$\frac{dp}{dp_f^w} = G^{-1}H_f. \qquad (7)$$

Stacking all $N$ columns together, $\Delta_p = G^{-1}H$, which has the derivatives of all prices with respect to all wholesale prices. The general element of $\Delta_p$ is $(i,j) = \frac{\partial p_j}{\partial p_i^w}$.

Collecting terms and solving for the manufacturers' implied price-cost margins yields

$$p_t^w - c_t^w = -(T_w * \Delta_{wt})^{-1} s_t(p). \qquad (8)$$

Finally, the sum of the implied price-cost margins for the retailers and the manufacturers is obtained by adding up (3) and (8).

**Vertical Restraints/contracts – try to replicate the outcome of vertical integration**

Non-linear pricing, p and fixed fee
Exclusive dealing or exclusive territories
Franchising
Profit sharing or revenue sharing
Quantity forcing or quantity rationing
Legal issues on vertical restraints:
Take away – not ok when foreclosure an issue, otherwise a per case, for example exclusive territories allowed if that is the only way the retailers provide services, if compete very aggressively in all territories no mark-up to provide services

| **Benefits of making** | **benefits of buying** |
|---|---|
| Assure supply | efficiency |
| Avoid regulation | less managerial burden |
| Increase profits (DM) | |
| Agency theory, incentive alignments | |
| Price Discrimination | |
| Reduce transaction costs (Williamson) | |

When transaction costs are high there is the opportunity for opportunistic behavior. One case opportunistic behavior may arise is when there is a need for specific assets. And the fact that contracts are incomplete.[1]

For example, upstream firm may invest in assets that are valuable only in relationship with a certain downstream firm. These assets are otherwise useless. The upstream firm is at mercy of downstream firm if she invests in those assets, so she may not want to invest…
So maybe if upstream firm engages in downstream production herself, those useful investments will then be made.

[1] NOTE: To be fair, the other main stream of lit to explain make versus buy decisions has to do with Agency theory, (the existence of moral hazard), hence leading to certain vertical relationships existing to provide better marginal incentives (Laffont and Martimor, for survey etc) we'll focus here on TC.

Firms engage in vertical integration (longer term contracts) when purchasing in the spot market makes them vulnerable to opportunistic behavior … Joskow takes this literally to data, next class.

Are relation specific investments determinants of the contract length (duration) between coal suppliers (mines) and electric utilities (downstream buyers of upstream mines)?

Assumption: Risk aversion is not an important determinant of the structure of vertical relationships in this industry

Williamson (1983)'s variables of interest in coal-utility vertical relationships:

- Site specificity
- Physical asset specificity
- Dedicated assets
- Human asset specificity

Left hand side:

Contract duration= time agreed ex-ante to abide btw parties

->Variables defined as RHS
determinants of contract length
fro the empirical analysis

- Mine mouth
- Regional dummy
- Annual quantity

Villas-Boas/Perloff are 202
4th handout

**Are 202 - Lecture Notes on Identification of Market Power**

How much market power do firms exercise in the market? What are the determinants of market power?

- Conduct Structure Performance Paradigm type studies, used cross-sectional regression analyses of measures of performance (accounting margins) on right hand side variables such as concentration indexes, number of firms, and all other variables that were used as measures for structure.

- Main problems, assume easy to measure performance. And another problem is that right hand side variables are endogenous.

- Current studies, given tat hard to get direct measures of costs, to then get a measure of p-costs (mark-ups) attempt to estimate mark-ups indirectly.

How much market power do firms exercise in the market?
Indirect Approach looks at the evolution of (p,q) over time, and see if variation in (q,p) is consistent with a certain model of supply side behavior, given demand.

Demand
$q= a0 + a1\ p + a2\ Y + e$

Marginal cost

$c= b0 + b1\ q + b2\ w + v$

Firms maximize profits choosing p, max $p\ q(p) – c(q)$, where the first order conditions are given by $q(p)+ (p – c)\ dq/dp = 0$ which is equivalent to $p = q / (dq/dp) + c$

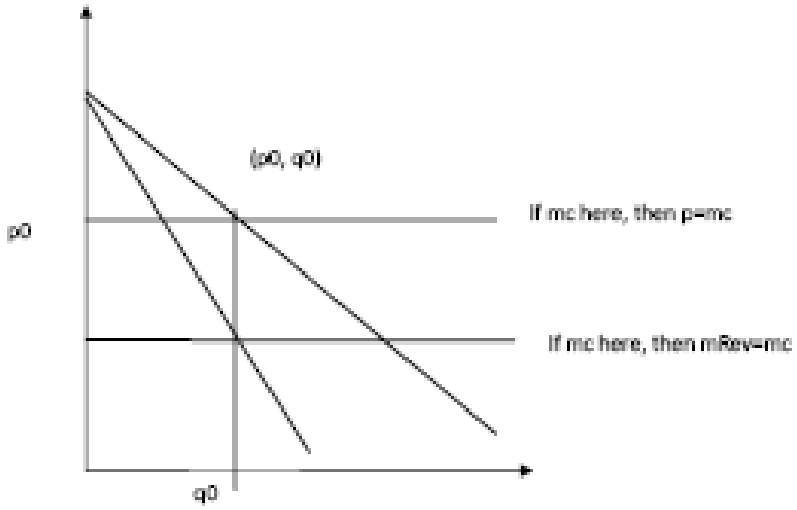
Let theta measure how close to competition the firm is, theta=0 means p=c, theta=1 means monopoly supply case, etc etc. Then we can write up the firms order conditions of firms nesting several supply models as
$p = \text{theta}\ [q / (dq/dp)] + c$ , where $c=b0+ b1\ q + b2\ w + v$.
So we can estimate the above equation to estimate theta, how far from competition the supply is, rejecting the null that theta equals zero. Note also that if theta=1 we are specifying monopoly margins and for instance is theta=1/N, where N are the number of rims in the market, we specify Cournot competitive model with N firms. Theta is a parameter that nests several conducts. Theta is called in literature conduct parameter. I refer you to Corts (1999) that cautions us to interpret the estimate as the marginal conduct in the market, where we would like to infer overall conduct. There are also other issues with conduct parameter approach, but the overall goal is to in the remainder of the notes to discuss when theta is identified. Then we can always test whether theta equals to one or zero, to try to assess benchmark margins being consistent with the market data.

Villas-Boas/Perloff are 202
4th handout

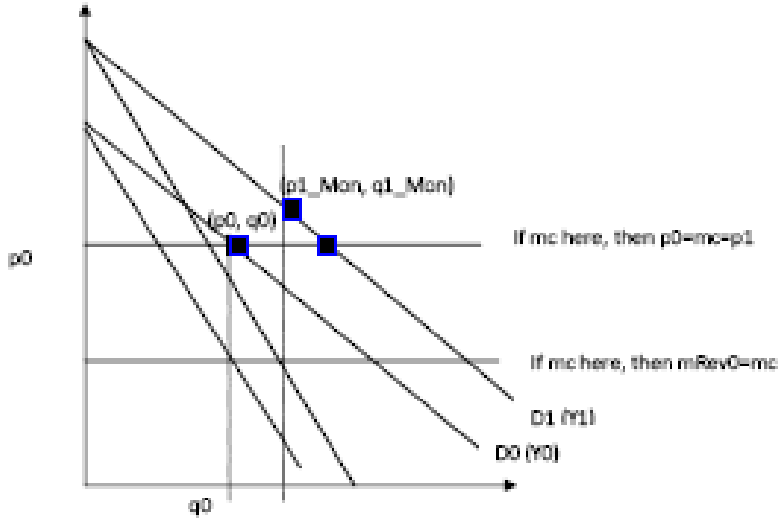
The main question now is how can we identify theta? What is the variation in the data that allows us to do this?
Starting with price quantity pairs over time {pt, qt}, we wish to estimate demand and then to infer market power ability of firms. We have a basic simultaneous equations problem.
Demand: q= a0 + a1 p +a2 Y + e
And Supply : p = theta [q / (dq/dp)] +b0+ b1 q +b2 w + v.

Villas-Boas/Perloff are 202
4th handout

Suppose market researchers found that marginal costs are constant with quantity, that is b1=0. Given demand, point (p0,q0) is consistent with competition for high marginal costs, and consistent with monopoly for low marginal costs, see below…

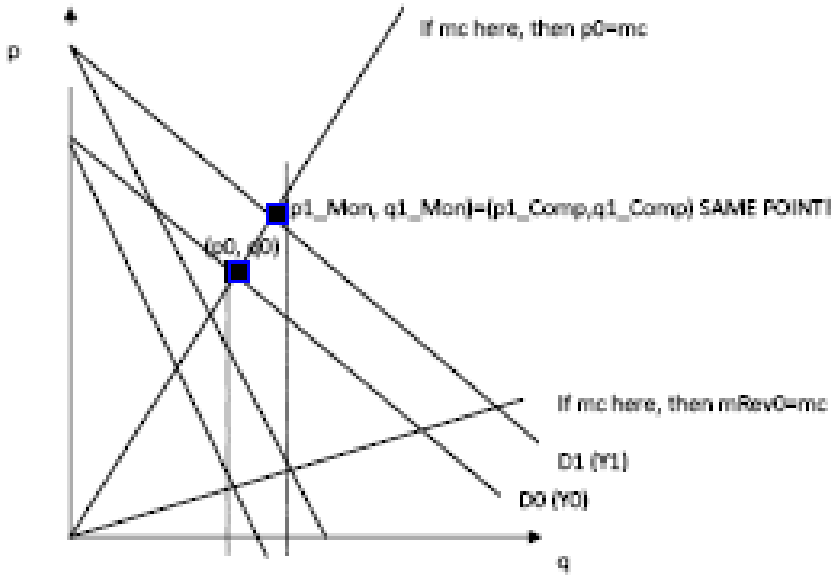



Now, if demand shifts due to a Y increase Y0 to Y1, then we could tell the two models apart




Given demand, if we do not know where marginal costs are, even though they are constant with quantity, point (p0 ,q0) is consistent with competition if mc are high, and monopoly for a certain low marginal cost. If we have exogenous variation in the data in particular an increase in Y, this leads to a shift of the demand curve. If we were to collect data the next period, where demand had a right shift, we could tell monopoly from competition apart. If there is competition in this market, then the next period's price given Y0 to Y1, should have remained the same and quantity should have increased. If instead we have a monopoly, price does not remain the same and quantity does likely

increase, but less (see bottom graph in the last page). So in this case we would be able to identify whether theta=0 or theta=1 given the shift in demand from D0(Y0) to D1(Y1). Note, if marginal costs are not constant with quantity, we need a rotation of demand, not just a shift. Please see bottom graph that for a shift in demand the two models are again not separable given data on price and quantity.




So, given that demand is given or consistently estimated, to identify supply we can either measure costs directly or use exogenous shifts in demand to find evidence against or consistent with underlying supply models (parameter theta measure departures from those models).
If interested, see Porter (1983) cartel paper.
Porter observes movements of (q,p) over time, and the research question is whether these movements are due to exogenous shifts in demand or costs or whether these are price wars.

## ARE 202. Lecture Notes on Deriving margins of Firms given demand and supply side model

The objective of these lecture notes is to show that, for a simple case first and then for the most general case, that given a model of demand, and firm pricing behavior we can compute what would be the margins that should be occuring according to the model.

Lets go back to the simple model of a monopolist with constant marginal cost c facing demand p=a-bq, or q=(a-p)/b. He maximizes profits

$$\max_p \pi = (p-c)q(p) = (p-c)\frac{(a-p)}{b}$$

from the first order conditions

q+ (p-c) (-1/b)=0 solving for the margin

p-c=1/b q  (1).

So given a demand function already specified or estimated (parameters a and b), given the monopoly model we can compute p-c that should be occuring in the market, it should be equal to 1/b times q. In problem set 3 you will be asked to estimate a demand function and then assuming a model of supply behavior (monopoly), to estimate the average margins in the market given the demand estimates.

If you divide (1) by price you get a familiar expression that the percent margins in an industry are inversely related to demand elasticity.

(p-c)/p = 1/b q/p, since b=-dp/dq, (p-c)/p=1/el.

Imagine we had data on margins from other cost sources. Then we could compare the implied margins in (1) with the data margins to test for the structural model we were using.

Most general case, retailers, manufacturers, but same idea:

Below is a derivation of manufacturers and retailers margins for the most general case of a multi product set of imperfectly competing upstream manufacturers setting wholesale prices in a bertrand nash fashion and then given those prices a set of imperfectly compatitive multi-product retauilers setting retail prices in a bertrand nash fashion. It shows that given a model of demand, and manufacturer and retail pricing behavior we can compute what would be the retail and manufacturer margins that should be occuring according to the model. Define $T_r$ as the retailer's ownership matrix with the general element $T_r(i,j)$ equal to 1 when both products $i$ and $j$ are sold by the same retailer and 0 otherwise. Let $\Delta_{rt}$ be the retailer's response matrix, containing the first derivatives of all the shares with respect to all retail prices, with element $(i, j) = \frac{\partial s_{jt}}{\partial p_{it}}$. Stacking up the first-order conditions given by (2) and rearranging terms, we obtain the following vector expression for the retailers' implied price-cost margins, as a function of only the demand side for each week $t$,

$$p_t - p_t^w - c_t^r = -(T_r * \Delta_{rt})^{-1} s_t(p), \qquad (3)$$

where $T_r * \Delta_{rt}$ is the element by element multiplication of the two matrices. If the equilibrium is unique, equation (3) implicitly defines the retail prices as a function of all the wholesale prices.Doing the same exercise for the manufacturers and solving for the manufacturers' implied price-cost margins yields

$$p_t^w - c_t^w = -(T_w * \Delta_{wt})^{-1} s_t(p). \qquad (8)$$

where delta w is defined as delta r but is the manuf response matrix. See vertical lecture notes for total derivations.

Files from IdentifMarketPowerEmp Analysis Folder:

datapset3.dta Pset3.do

**Question 3.** Empirical question

Use datapset3.dta and pset3.do to read in that data into stata.
In the do file, please write in the necessary commands to answer the questions below, perform the necessary analysis, report estimates (you may want to compare to tables in last pages of problem set – this is what you should be getting. If you are not able to arrive at the results in the table please use the tables I provide to interpret the numbers rather than your numbers. Solution stata commands shall be provided to you in class discussion later.)
We will start with estimating a homogenous demand model for beer.

<u>Part 3.1. Please answer the following questions - Demand.</u>

a) Report summary statistics of quantity sold, and break up those summary statistics for quantity sold for summer and not summer months. Report summary statistics of prices, and of prices charged during summer and not summer months. Describe what you find. Compare differences in average quantity sold for summer and not summer months. Same for prices.

b) Run an OLS regression of quantity sold each week on price without any other controls. Explain the estimated coefficient and test for its significance.

c) Run an OLS regression of quantity on price, where you may want to control for the fact that the observations originate from different brands (id variable). Compare what happened to the price point estimate in this specification relative to the simple OLS without controls in b).

d) Same as c) but now also control for the fact that your observations pertain to different seasons (so you can control for summer temperature maybe) and for different years. What happened now to the price point estimate relative to b).

e) what is the residual in d), for example, what would be all economic factors you can think of that would be in that residual? Would any be

correlated with price (that is do consumers see and firms see and therefore price according to that residual?). How is that residual different from c and from b)?

f) what if I told you I have a variable that affects the way firms set prices but is uncorrelated with the residual in d). Would wholesale prices be one such good variable if you want to estimate how quantity responds to changes in price, but you are worried that prices when set take into account things that also affect quantity, and are therefore endogenous in d)? Run an IV regression using the same specification in d) by instrumenting for prices with wholesale prices. Report the price point estimate of f) and compare to the one in d), also what happened to the standard errors. Explain.

snap of tables you should be getting:

| | | estimate | std |
|---|---|---|---|
| b) | price \| | -70.95912 | 3.313297 |
| c) | price \| | -164.0561 | 5.231639 |
| d) | price \| | -163.5117 | 5.300701 |
| f) | price \| | -148.6568 | 11.79938 |

Here, we are interested in investigating determinants of margins at the retail level, in the beer category. In particular, we are interested in finding out whether we find empirical evidence consistent with repeated interactions and collusive agreements covered in class.

Part 3.2. Empirical Analysis of Margins for beer

g) Please comment the following output (table next page) with respect to the following.

- What is the research question you are trying to answer in this table.
- What is the estimated equation, what is the left hand what is the right hand side variable and what is an observation?
- What is the difference between those three specifications in (1), (2), and (3)?
- What can you take away from the empirical results presented in this table?

h) If you are interested in estimating retail margins for beer, but you do not have data for wholesale prices, but someone told you the retailers basically are setting monopoly retail prices, and therefore monopoly margins, how would you obtain an estimate of average retail margins given the demand estimates in f). Please derive exactly using a demand and supply model how you would derive the implied retail margin.

i) Please compute the "inferred retail margins" at the mean values of prices and quantities, given the demand point estimates in f).

j) How do the margins estimated in i) compare to the average difference between the observed data on price and wholesale price. What do you conclude?

## Table for question 3.2. g)

Dependent variable Price - Wholesale Price of a beer product sold each week, for one store

| | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| Variable | Estimate | Std | Estimate | Std | Estimate | Std |
| Expected Demand | -0.0001 | 0.0003 | 0.0007 | 0.0003 | 0.0006 | 0.0003 |
| Current Demand | | | -0.0015 | 0.0002 | -0.0014 | 0.0002 |
| Current Costs | | | | | 0.7883 | 0.2907 |
| Constant | 0.8664 | 0.0204 | 1.1564 | 0.0474 | -2.3256 | 1.2851 |
| Product Fixed Effects | yes | | yes | | yes | |
| Year Fixed Effects | yes | | yes | | yes | |
| R squared | 0.01 | | 0.0163 | | 0.018 | |
| Number Observations | 3030 | | 3030 | | 3030 | |

## Do file:

```
**problem set 3
**first year students and villas-boas
**first version april 23 2008, problem set due may 1 2008
*****************************************************
*******************************************************

**change into your work directory
cd
"C:\ARE\ClassNotesEtc\For_are202\After2008\EmpiricalAnalyses\Identifica
tionMarketPowerForARE202\createData"

**load data sent from Rebecca Hellerstein (NY Fed) April 10 2008
**homogenous product demand estimation for beer, use IV for price
wholesale prices**
**************************************

clear
use datapset3

**** summer dummies
gen         summer=0
replace     summer=1 if (week>=1991 & week<=203) | (week>=241 &
week<=256) | (week>=294 & week<=308) | (week>=346 & week<=360) |
(week>=398 & week<=400)
**** year dummies
gen         year=1991 if week>=191 & week<=220
replace     year=1992 if week>=221  & week<=272
```

```
replace     year=1993 if week>=273  & week<=324
replace     year=1994 if week>=325  & week<=376
replace     year=1995 if week>=377  & week<=400
tab         year, g(year_)

*Generate interaction between summerdummy and avgtemp and year effects
gen summer_temp=summer* averageTemp

**defining fixed effects
xtset id

*****************************************************
**OLS and IV Regressions - Demand:
*****************************************************
**ols use xtreg y x1 x2, fe and no fe options
**  iv use ivxtreg y x2 (x1=instrum x2),fe
**where x1 is endogenous variable, x2 are exogenous variables,
** instrum is the instrument for x1.

**b- run an OLS regression of demand q=a +b p with brand dummies, no iv
price with wholesale price
**no demand shifters, no fe
**c with fixed effects for id
**d demand shifter averagesummerTemp year dummies, OLS
**f iv regression

*****************************************************
**the other part of the problem set is for you to interpret
*****************************************************
gen margin=price-wholesalePrice

xtreg margin summer_temp year_2-year_5, fe
xtreg margin averageQ summer_temp year_2-year_5, fe
xtreg margin averageQ averageWp summer_temp year_2-year_5, fe

**end of do file
```