

Operating Instructions for The Competitive Strategy Game Version 3.50

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I have tried to make the operation of the game user friendly, but it is still a long way from the polish of a professionally written and distributed program. If you stick with the instructions, however, it should operate without a hitch.

Before contacting me with problems, **PLEASE** check the FAQ that I have set up at <http://faculty.haas.berkeley.edu/borenste/CSGsupport.html> . There is no support for the software other than me and I don't have time to respond to questions very promptly.

1. REQUIREMENTS: The CSG runs in all versions of Windows up through Windows 7. There is no version of the software for the Mac OS. The game is written to run inside a DOS window (yes, it is from an earlier era). It can be run from Windows (*e.g.*, by clicking on the executable file in Explorer), but that has the disadvantage of closing the window immediately after the program runs. If there is an error in the execution, the window closes before you can see what the error is. This can be avoided by opening a DOS window (from the start button, “All Programs” – > “Accessories” – > “Command Prompt”), navigating to the relevant directory (*e.g.*, “cd c:\CSGfiles”) and typing “csg350” at the command prompt.

For organizational purposes, it is best to give the game its own directory.

The biggest problem you are likely to face is the risk that you will accidentally lose or overwrite files. Since you have the only records of the game, that could be a disaster. For that reason, I make a lot of use of the DOS attrib command which can change files to “read only” so you cannot overwrite or erase them. The command “attrib +r <filename>” changes the file to read only and “attrib -r <filename>” changes it back. Each time the game is run, it concludes by asking you if you would like to change the files associated with the game to read only. I also recommend immediately copying all new files to a memory stick or another computer each time you run the game.

2. HOW THE GAME WORKS: The game is a simulation of the strategic interaction between eight companies that compete with one another in any or all of four different markets. Each market differs in the size and growth rate of demand, the capital intensity of production, the relative importance of entry, capacity and marginal production costs, the cost of and ability to inventory the product, and the demand substitutability of brands in the market. The markets also differ in the potential for competition or collusion, due to cost and product differentiation among firms, and the size of the market relative to the efficient scale of production. Within any one market, firms differ in their entry, capacity, and marginal costs.

Table 1: Operating Costs for Company X

Market	A	B	C	D
Entry Cost	10,000	20,000	100,000	3,000
Capacity Cost Per Unit	200	600	10	30
Marginal Cost	5	15	8	31

Each team of students controls one firm in the game. In doing so, they decide which market or markets to enter and when, how much investment to make in production facilities for each market and when to make that investment, when to exit a market, what quantities to produce and what prices to charge.

The game is divided into periods. Firm strategies for each period must be submitted before the game is run for each period. The game operator then enters the strategy and runs the game. The output from the period is then distributed to the players. The interaction with students – collecting strategies and distributing results – is most easily done through the CSG website, <http://csg.haas.berkeley.edu>. Running the game itself *cannot* be done on the website. That is done on your personal computer, which is where the software resides and all of the game output files are created.

An important aspect of the competitive strategy game is the role of information. Some data are public information, such as all firms' prices and production capacities, the degree of substitutability across brands within each market, and some basic information about demand. Other variables are not publicly known, but noisy signals are available. For instance, each firm knows its own sales in each market, but the total sales in each market is known publicly only with a degree of error. Similarly, no firm knows the production costs of its competitors with certainty, but it does have an idea of the range of possible costs of other firms.

(2.1) PRODUCTION AND COSTS: In order to produce goods and sell them in a market, a company must (1) enter the market, (2) build production capacity for that market, and (3) produce goods. Each step in the process is costly. Costs for each step in each market differ across firms. Each firm's company profile, which contains private information, includes a table, similar to table 1 that indicates each cost the company would have in each market. These costs do not change over the course of the game.

Market Entry Costs: In order to enter each market a firm must pay a one-time entry fee or setup cost. This cost is sunk once paid; it cannot be refunded or salvaged. It is assessed automatically when the firm builds its first unit of capacity in the market. (The entry fee is assessed again if a firm reenters a market in which it has retained no production capacity.) A firm can enter no more than one market each period. The operator can change this to

allow entry in to multiple markets simultaneously.

From the market profiles (see Attachment A for an example), which are public information, the teams learn the range of possible entry costs that firms might have for each market. For instance, the market profile for market A might indicate that the entry costs for this market are drawn from a distribution with a mean of \$8,000 and a standard deviation of \$2,000. (All random variables in the game are normally distributed.)

Costs Of Capacity: A firm's production cost in each market is determined in part by its capacity in that market. (Each of the four markets involve completely different goods, so there is no way to use capacity in one market for production in another market.) Before a company can produce from capacity, it must take one period to build the capacity. If, for instance, a firm decided after period 2 that it wanted more production capacity in market D, it would announce a capacity increase as part of its strategy for period 3. It could not actually produce from that capacity, however, until period 4. Capacity changes become public information during the period in which they are announced, before they can be used for production. The decision to enter a market and the announcement of building capacity in that market occur simultaneously.

In the company profile, each team learns its firm-specific cost of building capacity in each market. There are no scale economies in building capacity; building 10 units of capacity costs exactly 10 times as much as building one unit of capacity. As with entry costs, the market profiles indicate the distribution of capacity costs for each market from which each firm's individual capacity cost is drawn. Capacity can be increased at any time in the game.

A unit of capacity lasts until one of three things occurs: (1) the capacity exhausts its useful life (shown in the market profile), (2) the firm decides to eliminate units of capacity before they have exhausted their useful lives, or (3) the game ends. Unlike the entry costs, capacity costs are partially recoverable. In the period after a unit of capacity is installed, it declines in value by a certain percentage of its building costs, which is shown in the market profile. After that, the value drops by a (generally smaller) constant percentage each period. This percentage (of the contemporaneous value not of the original building cost) is also shown in the market profile. Shutting down capacity for its depreciated value can be done in increments as small as one unit, so for instance a team could reduce its capacity in an industry from 50 to 49 and receive the depreciated value of the unit. (Consistent with the timing of building and using capacity, a company that is liquidating capacity can produce from that capacity during the same period that it is liquidated. The liquidation occurs after production in that period.)

If a unit of capacity is used until it exhausts its useful life, then the capacity is automatically removed from the firm and the firm receives the scrap value of exhausted capacity (shown in the market profile). If a firm requests a reduction in capacity, the game will default to eliminating the youngest capacity (with the highest depreciated value) first, but this can

be overridden, as discussed below in the section on strategy submission. Note that expired capacity is eliminated before requests for capacity reduction are followed, so a team should not request a capacity reduction greater than the amount of capacity it holds in a market that is *not* expiring that period. If you do not want the complication of capacity expiring during the game, just set the capacity lives to be any two-digit number greater than the number of periods that will be played. If you do set the parameters so that capacity will expire during the game, then it is important for students to know the age profile of their capacity. This is included in the company updates unless you change a switch discussed below.

At the time that the game ends (see section 6, “Ending the Game”), all remaining capacity is automatically cashed in for its depreciated value.

Marginal Costs: Once a team has installed capacity for a market, it can produce and sell units at some marginal cost. If production is less than or equal to available capacity, then marginal cost of each unit is the marginal cost given in the company profile. The market profiles show the distribution of marginal production costs for each market from which each firm’s individual marginal cost is drawn.

Production can also exceed available capacity, but the marginal cost of producing units beyond capacity increases as production increases beyond capacity. The increase in marginal cost depends on the slope parameter s which determine the increase for a given ratio of output to capacity. So, the firm’s marginal cost function if it has available capacity k and marginal cost up to capacity of m is

$$MC(q) = \begin{cases} m, & \text{if } q \leq k; \\ m \cdot (1 + s(\frac{q}{k} - 1)), & \text{if } q > k. \end{cases}$$

The increase of marginal cost for production beyond capacity is common for all firms in a market and is shown in the market profile.

For instance, assume in a given market that a firm has 100 units of available capacity in market A and its company profile indicates a marginal cost of 20. Assume also that the market profile for A indicates that the slope parameter for MC is 0.5 for quantity beyond capacity. Every unit up to 100 would then cost the company 20 to produce. Unit 101 would be 1% above capacity and would therefore cost 0.5% more than the basic MC or 20.10. Unit 102 would be 2% above capacity and would therefore cost 1.0% more than the basic MC: \$20.20. Producing 102 units would thus involve variable costs of $100 \cdot 20 + 1 \cdot 20.10 + 1 \cdot 20.20 = 2040.30$ f. (Only available capacity is considered in determining costs. As explained above, capacity is not available until the period after it is produced. Note that producing in a market without capacity would involve exceeding capacity by an infinite amount and would therefore be infinitely costly.)

(2.2) PRODUCTION, SALES, AND INVENTORY: In the standard configuration of the game, a firm’s strategy each period will include its decision on quantity to produce and

price to charge. If there is sufficient demand, a firm may sell all of its production in that period plus any stock it has inventoried going in to the period. If the firm sells less than it produces, due to insufficient demand or a strategic choice, then the excess may be stored for future periods. The cost of storing one unit for one period is common to all firms in a market and is shown in the market profile. This standard configuration can be changed in two ways prior to the beginning of the game. One switch allows the game operator to make the good in any market perishable, so that it cannot be stored from one period to the next. In that case, a firm still produces in advance, but any product it does not sell in that market at its announced price goes to waste. Another switch makes the market produce-to-order. In this case, the firm does not set production in advance; it sets only its price and the maximum amount that it is willing to sell at that price.

Besides price, production quantity, and any adjustments to capacity, a firm's strategy in each period may include a maximum allowed units to be sold. If no maximum is included in the standard-configuration market, then the maximum is the quantity produced plus the inventory quantity going in to the period. That is, the default is to sell all production and inventory if there is sufficient demand at the announced price. For instance, assume that in the first period a firm is in a given market chooses to produce 100 units. When demand is revealed, assume that it sells only 96 units at the price it has announced. It then carries 4 units into the following period, paying a cost of 4 times the per-unit storage cost. Assume that in the following period, the firm decides to produce 90 units. It may then sell up to 94 units, because it has four units in inventory. (Units do not deteriorate in inventory.) If it sells less than 94 units, then it will carry the difference into the following period as inventory. The firm may choose to restrict sales to less than 94 units, by setting a maximum sales of, say, 87 units. In that case, if demand is greater than or equal to 87, it will still sell 87 units and carry the 7 excess units into the following period. If demand is less than 87, the firm will carry 94 minus actual quantity demanded into the following period.

If the good is perishable, then the default maximum is to sell up to all production at the announced price. If the market is configured as produce-to-order, then the default maximum sales is the capacity of the firm, which is almost never optimal if the slope parameter for MC at outputs above capacity is less than infinite.

(2.3) COST OF FINANCING: Each firm begins the game with some amount of money in a bank account, currently set to \$1,000,000, but this can be changed by the operator. All financing of the business comes from this account, but the balance can be negative or positive. The firm earns 2% interest per period on positive balances and pays 5% interest per period on negative balances. Both figures can be adjusted by the game operator. In addition, the interest rate on debt can escalate with the quantity borrowed, with as many as five steps in the function. See (4.4) below. Since there is no inflation in the game, these are real as well as nominal interest rates. Money spent is withdrawn from the account and revenues earned are deposited to the account at the end of each period.

(2.4) MARKET DEMANDS: As in the real world, firms do not know the demand function in any market. At the beginning of the game, they are given a bit of information in the market profiles: the quantities that would have been sold in period 1 at different prices and with different numbers of firms. At any point in time, the quantity sold will depend on the prices charged by each firm and – because consumers have heterogeneous tastes – the number of brands in the market. (Each firm may have at most one brand in each market.)

The sensitivity of total quantity sold to the number of brands in the market – holding price constant – will depend on the degree of heterogeneity among brands, i.e., the extent to which consumers consider different brands good substitutes. If consumers think that different brands are nearly identical, then adding brands to a market will have almost no direct effect on total quantity. If consumers think that different brands have very different attributes, then adding brands to a market will expand the size of the market to a greater extent. As the number of brands increases, the additional market-expanding effect of an additional brand in a market will decline. These effects are demonstrated in the first table of the market profile (attachment A).

Qualitative evaluations of the degree of brand substitutability in each market are given in the market profiles. This factor is independent of which firms introduce brands and cannot be affected by a firm’s strategic choices. Some quantitative information on brand substitution is given in the second table of the market profile.

The brands in a market are symmetrically differentiated. No brand has a perceived or actual overall quality advantage over others. If all brands in a market were to charge the same price, then all brands would be expected to get approximately equal market shares (provided each had sufficient production plus inventory to meet that demand). This would be true regardless of market shares in previous periods.

The actual structure of the differentiation is a variation of the logit demand model (described, for instance, by Besanko, Perry, and Spady, “The Logit Model of Monopolistic Competition – Brand Diversity,” *Journal of Industrial Economics*, June, 1990). The population of consumers in a market is determined by some starting population number multiplied by the market growth rate each period. Each consumer is assigned a base reservation price for the good, drawn from a normal distribution with mean zero (so about half of the population has negative reservation prices and no possibility of purchase. This is just a normalization factor.) This distribution implies that the density of consumers with a given (positive) reservation price declines monotonically in reservation price.

Every consumer (with positive base reservation price) is then assigned a brand-specific “offset” for every brand in the market, which is added to her base reservation price to determine the consumer’s reservation price for that brand. The offset is drawn from a normal distribution with mean zero and standard deviation equal to some proportion x of the specific consumer’s base reservation price for the good. This parameter x determines

the degree of product differentiation in the market. If, for instance, x is small, then a consumer's reservation price is likely to be nearly equal for all brands — low product differentiation.

The consumer then purchases the one unit of the brand that gives her the highest positive net consumer surplus, which is equal to her base reservation price plus her brand-specific offset for the brand minus the price of the brand. If no brand gives her positive net consumer surplus, then she buys none.

This procedure is carried out for every consumer in every market. Note that since the reservation prices and brand-specific offsets are drawn from a random distribution, there is randomness in the sales made at a given price (and number of firms). Thus, in a particular instance a lower price (holding number of firms constant) could be associated with lower sales or a higher number of firms (holding price constant) could be associated with lower sales, though such outcomes will not occur on average. Also note that there is no customer loyalty or tendency to retain market share. Each period, reservation prices of every consumer for every brand in every market are redrawn. I may change this in future versions.

Total demand in a market changes over time. Each period the number of possible consumers in a market changes by some proportion, called the market growth rate. The market growth rate follows a random walk. The market profiles give the growth rate observed in period 1. In each market, the growth rate changes from the previous period by a random amount, but the average change in the growth rate is zero. Thus, if the growth rate was 7% last period, it will be 7% this period plus or minus the random change. Besides the period 1 growth rate, the market profiles also gives information on the amount by which the growth rate could change each period. Once the market growth rate changes from its original level, there is no tendency for it to return to that level.

After the initial market profiles, the only additional information firms receive about the size of each market is from observing prices and quantities sold in the market. The market update (see Attachment B for an example) distributed each period will give the production capacity of each firm in each market and the price charged by each firm in each market. It will also give an approximate market quantity sold during the previous period. All information in the market update is public.

(2.5) STRATEGIES AND MARKET OUTCOMES: Each period, every firm submits a strategy, which consists of (1) the price it will charge in each market in which it has production capacity, (2) the quantity it will produce in each market (if the market is not produce-to-order), (3) a maximum allowed level of sales in each market (less than or equal to production in the period plus inventory from the previous period in markets that are not produce-to-order), and (4) any changes in production capacity it will make. In addition, a strategy may include a public statement, which will be reported in the market update.

Once all strategies are received, the markets operate for that period. In each market, every firm sells to any consumer that wishes to buy its brand, up to the point that the firm's sales are equal to its maximum allowed. If demand for a brand exceeds the maximum allowed sales for that brand, then the maximum allowed is sold and the output is distributed randomly among consumer trying to purchase from that firm. Consumers who do not obtain the brand they want due to this rationing may purchase another brand, if another brand offers them positive consumer surplus, or may not buy in the market.

After the market operates in a period, the program produces two sets of information. The first is the market update sheet. It contains the prices charged by each company in each market, the changes to capacity of each company in each market, approximate total sales in each market. It also contains any public statements made by each company. The second sheet is the company update (see Attachment C for an example), which contains private information on the quantity that the firm sold in each market that period as well as summary information on the costs, revenues, and financial status.

(2.6) GAME ENDING: To deal with the end game problem, I usually tell the class that the game will end randomly on one of the last three possible periods in the term. Each of these three periods is equally likely to be the last one of the game. This is obviously an imperfect solution, and you might think of the “end game problem” as an educational experience, rather than a problem.

3. GETTING THE GAME SET UP:

(3.1) You should choose a two-letter file extension for all files associated with your game. I will use ZZ in this document, but all references to ZZ below should be replaced with your two-letter file extension. The distinct extension is necessary to avoid confusion between files if you are running more than one game at once, and to avoid confusion between the original files that come with the game and those that you create.

Before you begin setting up the files for the game, you must decide whether you want output of the game to be produced as ascii files for printing on an HP-compatible printer, as T_EX files (Plain T_EX, not L_AT_EX), as ascii files for distribution by email, or as files for distribution through the CSG web page (see section (3.3)). Using the CSG web page is by far the most common choice and is strongly recommended. I don't really support the other options, but have left them in for those who are used to using them. (The T_EX output is more attractive than HP-compatible ascii files, but you must have T_EX to use it. The email output looks like the HP-compatible ascii output, but it has no HP printer commands, and it outputs a separate file for each company that includes the company's (private information) update and the (public information) market update.)

You also have to edit the header file to include the information that will go at the top of all output documents. If you want to use the CSG web page, then use an ascii editor to make changes to HEADERW.EXP. If you want output for an HP-compatible printer, then

use an ascii editor to make changes to HEADERH.EXP. If you will want T_EX output, then use an ascii editor to make changes to HEADERT.EXP. If you will want output for email distribution, then use an ascii editor to make changes to HEADERE.EXP. (In any case, the second line of the file allows you to turn off the printing of the age profile of capacity in the company updates if, for instance, you think this is more information than the students can handle or need for you implementation of the CSG.) You should edit the next few lines after the first two lines of the file to set up the header information on the output files. Finally, you must then save the header file you have been editing as HEADER.ZZ (where ZZ is replaced by the two-letter name of your game, and note that the "W" just before the extension is dropped) and I recommend changing the file attribute to read only: "attrib +r HEADER.ZZ" at the DOS prompt.¹

(3.2) Before you can run the program, you also have to copy the file COMPNAME.EXP to COMPNAME.ZZ. Then you have to edit the file, using an ascii editor, replacing each line with the three-character name of a firm in your game (if you are using the web page, all names must contain only letters and numbers). These are the company names that will be used in all of the handouts and their order determines the number of each firm. If you are running a game with fewer than eight teams, you should just name the additional teams something that indicates they are not functioning (NUL, 000, etc. Each team **MUST** have a different name, *e.g.*, you cannot call two non-functioning teams "NUL"). Then, each period the null teams should just submit a strategy of no capacity change, no production, and zero prices. Finally, you should change COMPNAME.ZZ file attribute to read-only so you don't accidentally overwrite it: "attrib +r COMPNAME.ZZ" at the DOS prompt.

(3.3) The CSG Web Page. One of the options for administering the CSG is to use the CSG web page. The web page is <http://csg.haas.berkeley.edu> . You cannot run the CSG on the web page. The web page is used only for strategy submissions and output distribution. If you use it, you still need to obtain the CSG software and run the CSG on your own computer. The web page greatly reduces the administrative hassles with strategy submissions and with distributing output from the CSG. Instructions for using the web page can be found by going to it and clicking on "Instructors interested in creating a new game."

(3.4) The CSG now ships with two sets of default parameters, which are described in the next section. For either version, there are sample instructions to students, STRAGAME-Advanced.doc and STRAGAME-Basic.doc (also .tex files). You will have to edit one of these files to match your course plan (or make up your own handout). The attachment tables for these handouts have been constructed in T_EX so I distribute PDF versions STRAGAME-Advanced-tables.pdf and STRAGAME-Basic-tables.pdf.

¹ NOTE: Many ascii editors add ".txt" to the end of the filename as the default. The program won't recognize the file if this happens. It must be saved as only HEADER.ZZ (replace ZZ with your game id).

4. CHANGES YOU CAN MAKE TO THE GAME: The CSG now ships with two default parameter sets, Basic and Advanced, which are in MKTINFO-Advanced.EXP and MKTINFO-Basic.EXP. The Advanced parameter set is the version that has been shipped with earlier versions of the CSG from 1998-2010. The Basic parameter set is a simplified version that eliminates many of the decision variables for students. In particular, in the Basic version, firms produce to order matching production to quantity sold up to their production capacity. Firms cannot produce beyond their capacity. There are also no inventories in the Basic version. Finally, there is no change in market size in the Basic version, the growth rate is fixed at 0%.

If you do not want to use either of the default parameter sets, you can alter the parameters directly in either MKTINFO file. Think carefully before changing these parameters as it can affect the attractiveness of the market and the ability of firms to make a profit. Changes to the first few parameters will obsolete the tables in the market profiles. If you change these, you must run the demand data generator (described below) to produce new data for these tables. The handout file STRAGAME.DOC (or STRAGAME.TEX for the \TeX version), which describes the game for students, is written for the parameters that are in the MKTINFO.EXP that I am shipping. If you change parameters in MKTINFO.EXP, you will need to make associated changes in STRAGAME and in the market profiles that you hand out to the students (which are in MKTPRFL.TEX and MKTPRFL.TXT).

(4.1) If you look at the parameters for each market in the file MKTINFO.EXP you will see that there are 20 lines for each market. Changing any of the first three lines makes the demand data in the market profiles obsolete. If the parameters on the first three lines are changed, the demand data generator (see section 8) must be used to generate new demand data for the market profiles. The next 16 parameters can be changed more easily, but you must also make the appropriate change in the associated market profile. With the exception of “Initial POP,” that simply involves changing the same number in the market profile. In changing any parameters in MKTINFO.EXP, make sure not to alter the location of the decimal point and the alignment of the number, since the program reads this file in fixed format. Any changes should be made with an ascii editor.

(4.2) Explanation Of Parameters –

Lines 1-3 (Mean of Consumer Reservation Price for the Good, Standard Deviation of Cons Res Price for the Good, Std Dev of Brand-Specific Adj as % of Res Price) – Explained in section 3. The “Std Dev of Brand-Specific Adj as % of Res Price” is the offset “x” discussed in section 3. Changing these parameters obsoletes the demand data in the market profiles and requires using the demand data generator (see section 8) to produce new data for the market profiles.

Line 4 (Initial POP (about half have res price < 0)) – Determines the size of the potential market. Since the mean of consumer reservation prices is zero, about half of these people will have positive reservation price for the good. If this number is changed, then every

number in the first table of the associated market profile (Information on Market Demand and the Effect of Brand Proliferation), which gives points on a market demand function, must be altered by the same proportion as Initial POP is changed. So, if this number is doubled, every entry in the market demand table must be doubled. No change to the second table in the market profile (Information on Brand Substitution) is necessary. Initial POP is the size of the population in period 1.

Line 5 (Initial Growth Rate) – The growth rate follows a random walk (note that it is the growth rate of population, not the population size itself, that follows a random walk). This parameter is the initial value of the population multiplier.

Line 6 (Standard Dev of Change in Growth Rate) – Each period the growth rate changes by the addition of a random variable that is normally distributed with mean zero and standard deviation equal to this parameter.

Lines 7-12 (Mean of EC, Std Dev of EC, Mean of K, Std Dev of K, Mean of MC, Std Dev of MC) – These are the means and standard deviations for the normal distributions from which each firm’s entry cost (EC), cost of acquiring capacity (K), and marginal cost (MC), respectively are drawn.

Line 13 (Inventory Cost Per Unit Per Period) – The cost of storing one unit of the good for one period. This parameter is moot if the product cannot be stored, as determined in line 20.

Line 14 (Slope parameter for MC for output $> K$) – When production exceeds capacity, the marginal cost of production increases as production increase. This parameter determines the slope of that change in MC.

Line 15 (Capital Depreciation in its first period) – A unit of capacity declines in value each period it is used. This parameter determines the proportional loss of value of the unit of capacity during the first period in which it is used.

Line 16 (Capital Depreciation per period after its first period) – This parameter determines the proportional loss of value of the unit of capacity during each period after the first period in which it is used.

Line 17 (Maximum Number of Periods that a Unit of Capacity Can Be Used) – The parameter determines how many periods a unit of capacity can be used before it evaporates. Note that the productivity of a unit of capacity does not decline. It has the same productivity during every period in which it is useful and then disappears. By setting this parameter to be greater than the possible number of periods that the game will be played, you can effectively make capacity infinitely lived (which was the case in previous versions of the game).

Line 18 (Scrap Value At End of Capacity Life (proportion of orig value)) – This parameter determines the proportion of the original purchase price that the firm recovers when the

capacity is used to the end of its useful life and then (automatically) scrapped. It should probably be set so that the absolute loss in value during the last period in which the unit of capacity is used is smaller than absolute loss in value during any previous period. That is, then Line18 should be set so that:

$$(1 - \text{Line15}) \cdot (1 - \text{Line16})^{(\text{Line17}-2)} - (1 - \text{Line15}) \cdot (1 - \text{Line16})^{(\text{Line17}-1)} \\ > (1 - \text{Line15}) \cdot (1 - \text{Line16})^{(\text{Line17}-1)} - \text{Line18}.$$

Thus, the opportunity cost of using a unit of capacity will decline monotonically as the capacity ages, until it becomes useless. This parameter is moot if the life of capacity is set to be greater than the length of the game.

Line 19 (Match Output to Demand Each Period?(0=NO 1=YES)) – Setting this option to 1 eliminates the ability or need to inventory. You can think of this as made-to-order production: the price determines quantity demanded and then the firm produces that amount, or less. The maximum amount the firm will produce is determined by the QMAX that is part of the firm’s strategy. If QMAX is set to zero in a market where production is being matched to demand, the program defaults to allowing the firm to produce up to its capacity. Setting Line19=1 and requiring QMAX to equal capacity, causes the firm to produce the minimum of quantity demanded at the price it sets or capacity. (This was the operation of markets in Version 1.0 of the game, which I distributed and used in Winter 1994.) This is a much simpler market organization (and makes Line14 irrelevant). A slightly more complex setup is to set Line19=1, but allow students to choose QMAX. If output is to be matched to demand in all four markets (Line19=1 in all four markets), the program drops all reference to inventories in the output it produces. Obviously, changing Line19 from 0 (NO, the default) to 1 (YES) requires that you make some significant changes in STRAGAME.DOC.

Line 20 (Can the Product Be Stored? (0=NO 1=YES)) – This parameter allows you to make the product unstorable, but still maintain separate production and sales outcomes. Changing this from 1 (YES, the default) to 0 (NO) means that the firm still chooses production, and may sell up to the amount it produces each period, but any excess of production over sales goes to waste (there are no additional costs of disposing of the waste). This question is moot if you answer YES to the previous question and cause the program to match output to demand. If you answer YES to the previous question or NO to this question, then the cost of inventory is not relevant.

(4.3) The market parameters have been set to assure that at least a monopolist can make positive profits over the life of a 12 period game for the Advanced parameters and a 9-period game for the Basic parameters. If you plan to run the game for fewer periods, the mean of EC (and possibly K also if capacity life is long relative to the game) distributions should probably be lowered proportionally, e.g., a 6-period game should have mean EC

(and K) that are half those in the MKTINFO.EXP (and you should probably change the standard deviations to assure that you won't get negative values).

(4.4) At the bottom of the MKTINFO.EXP file are more parameters that can be changed: the borrowing and savings interest rates, the initial cash positions, and a switch to allow multiple market entry by a firm in a single period. The interest rate on borrowing can step up at certain levels of debt. Both the debt levels at which the interest rate changes and the interest rates themselves can be adjusted by the operator.

(4.5) Once you have decided what, if any, changes to make to MKTINFO-Advanced.EXP or MKTINFO-Basid.EXP, you should make the changes with an ascii editor and then rename the file MKTINFO.ZZ. The descriptions of the markets are in MKTPRFL.TXT which you can also print using the DOS print command (T_EX version MKTPRFL.TEX). If you change parameters in MKTINFO.ZZ from those in MKTINFO.EXP, then you must make the associated changes in MKTPRFL.TXT (or MKTPRFL.TEX). The market profiles should be distributed to the students when the game begins.

5. RUNNING THE GAME:

(5.1) Prior to running the first period of the game, you have to create the attributes of the eight firms. To do this, you start the game program by typing “CSG350” at the DOS prompt. The program will ask you for the two-letter identification of the game you want to run and the period that you want to run. To create the firm attributes, type zero (“0”) for the period you want to run. The program will recognize that the file COMPINFO.ZZ is not present in the directory and will announce that it is going to create COMPINFO.ZZ, which is its own company information file. COMPINFO.ZZ is a table of numbers with no text. It contains the cost structure of each firm in each market. The same information is also presented in more readable form in COMPPRFL.ZZ, a handout file that will be in HP ascii, T_EX, email, or web format depending on which HEADER?.EXP you edited before (if email format, it will produce 8 files of the form COMPPRFL.*** where *** is the name of the firm). It will then change the file attribute on COMPINFO.ZZ to read only. At this point it is wise to copy all files you have created to a memory stick or another computer. If you lose COMPINFO.ZZ, you cannot recreate it because the cost values have been generated by a random number generator. You should print the COMPPRFL.ZZ file to hand out to students when the game begins (or send the COMPPRFL.*** by email). If you are using the CSG web site, you need only to have COMPPRFL.ZZ available when you register the game at the web site. The registration process includes uploading this file so that the cost information is placed on each team's web page. (Team web pages are password protected.) Once you have registered a game, you will receive an email with the passwords for each team, which you will need to distribute to the teams.

(5.2) Now you are ready to run the first period of the game. To run each period, you have to create the file STRAIN??.ZZ, where ?? is replaced by the two-digit number of

the period. So, for the first period, you have to create STRAIN01.ZZ. If you are using the CSG web page, you need only follow the web page directions for creating the strategy input file. The structure of the STRAIN??.ZZ files is shown in STRAINFO.EXP. (Leaving the QMAX input set to zero when output is *not* being set to demand implies that the firm wants to sell everything, inventory (if the good is storable) plus all production. This is almost always the preferred option. When a market is produce-to-order, QMAX will generally be set above capacity by an optimizing firm.) The program reads this file in fixed format, so it is important that you do not change the alignment of the numbers and that you enter only integers. If a market has been set to be produce-to-order, then the production number has no meaning, but some number must still appear as the production figure (zero is fine in that case).

Note that there is one blank line between each strategy. The number above the name of each firm is the period to which the strategy applies. The program checks to make sure that this matches the period it is running, so that it catches cases in which you have inadvertently forgotten to change a team's strategy from the previous period. The teams' strategies need not be in the same order as the companies in COMPNAME.ZZ, but each name in STRAIN??.ZZ must match exactly (same case for letters) with a name in COMPNAME.ZZ. Remember, in the first period, firms can only invest in capacity (entering no more than one market per firm per period, unless you change that switch). They cannot sell output until the period after the capacity is built, so no sales take place in the first period.

The second strategy in STRAINFO.EXP (for MOO) illustrates how the normal response to a request for capacity reduction – removing the youngest capacity first – can be overridden. Rather than just ordering a certain reduction, the strategy can specify the age of capacity to be sold off. The MOO strategy shown indicates that the firm wants to sell off 2 units of capacity that are listed in the most recent company update as being 2-periods old (note that this is one period younger than these units will be when they are actually sold off) and 7 units of capacity that are listed in the most recent company update as being 3-periods old. Up to 10 units/age pairs can be included in the strategy of a given firm in a given market (all on one line, with each entry taking a total of 6 spaces including leading blank spaces). That said, this is unlikely to come up and I have avoided this complication in STRAGAME.TXT by telling the students to see me if they want to override the default. I expect that only very rarely will strategies deviate from the standard format illustrated by the other seven firms in STRAINFO.EXP. The CSG web page does not allow for overriding the standard capacity reduction, but it can still be done by hand by editing the strategy input file that the web page creates.

Earlier versions of the CSG website accommodated public statements by the firms, but in these days of social networking that has become outdated. The CSG webpage no longer accepts public statements.

(5.3) To run the game each period, within the DOS window in the directory where you are keeping the software and game files, you type “CSG350”. The program will then ask for the two-letter identification of the game and the period you want to run. If the program runs into trouble, it will tell you why – for instance a certain file is corrupted or a strategy charges a zero price in a market in which the company has positive capacity or tries to reduce capacity in a market below zero – and will then terminate. You can also run the game by clicking on the `csg.exe` file in Explorer, but the window then closes immediately after the game runs and will not let you see any error messages.

(5.4) The last step of running the game is to distribute the information it creates. Assuming that are using the CSG web page, refer to the instructions on the web page (section 9) for details of how to do this.²

(5.5) Finally, again copy all the files that you have created to a backup location, such as a memory stick or another computer. Because the market growth rates and consumer choices are generated by random processes, they cannot be recreated if you lose the data specific to your game.

(5.6) You can alter the history of play in the game. To do so, you must edit the most recent `PLAYIN??ZZ` file. For instance, if you decided to fine a firm for violating antitrust laws, you would do so by using an ascii editor to change the relevant figure in the CASH AT END OF PERIOD area of the `PLAYIN??ZZ` file. Be very careful making such changes and make sure that the placement of the numbers doesn’t change since the program reads the file in fixed format. To make a change, you need only to alter the most recent `PLAYIN??ZZ` file (that is, if five periods had taken place at the time you wish to make a change, you would need only change `PLAYIN05ZZ`). The program uses only the most recent `PLAYIN??ZZ` file to get all game history when it runs.

6. ENDING THE GAME: On the last period of the game, you should inform the program that this is the last period. To do so, change the period number above each company name in the `STRAIN??ZZ` file to 99. The program will accept 99 even though it will not match the period being played, and will prepare the game for completion. This means it will set all of the capacity change variables to liquidate all capacity at the end of the period. (The program does not make any allowance for residual inventory at the end of the period. Residual inventory receives zero value in the final cash calculation.)

7. PRODUCING A SUMMARY OF THE GAME: A supplementary program

² If you have set the game for email distribution, then each period it will produce eight files called `UP-DATE??.***` where the `??` is the two-digit number of the period and `***` is the three letter name of the firm. Each file contains the market update and the firm’s own company update. If you have set the game for HP-compatible or `TeX` output, then it will produce two files. The `CMPUPD??ZZ` file contains eight pages, a separate company update for each firm (`??` is the two-digit number of the period). The `MKTUPD??ZZ` file contains just one page, the market update.

(summ350.exe) is included with the game that allows you to produce a summary sheet of all activity in the game, including information unknown to the players, such as market growth rates, and every team's costs and sales. This may be useful to you during the game for you to analyze what is going on, and can be used in class at the end of the game as part of a retrospective analysis. To produce the game summary sheet, type "summ350". The program will then ask for the name of the game you want summarized and the last period to include in the summary. The program produces a flat text file that is formatted to be easily read into a spreadsheet program. Once you load the output of summ350 into a spreadsheet program, you can produce graphs of data analysis.

8. THE DEMAND DATA GENERATOR: The demand data generator can be used to generate data for the period 1 demand in the market (before any growth). This is necessary if any changes are made to the fundamental structure of demand in a market, as represented by lines 1-3 of the market information (see section 4.2). Even if no such changes are made, the demand data generator can be used to give students enough additional "data" to estimate demand functions using regression. The demand data generator takes as input (1) the market for which data are to be generated, (2) the two-letter name of the game (e.g., ZZ), and (3) sets of prices for 1-8 firms in the market. Then, after reading MKTINFO.ZZ, the demand data generator reads each set of prices and produces quantities for each firm for which a price is given. As in the market profiles, the demand data generated assumes that each firm has sufficient capacity or production to meet its demand. The input file DMDGN350.IN gives the exact structure of the inputs. You need to open DMDGN350.IN with an ASCII editor and change the game id to your game id. Then you can edit the market letter, and the lines of data of number of firms and their prices. See the top of the file DMDGN350.IN for more information. Example input files for each of four markets are given in DMDGN350.INA through .IND. If you use these files, you must change the name of each to DMDGN350.IN before running the program.

9. USING THE CSG WEBSITE: The CSG website is an interface for students to submit their strategies and for the instructor to distribute results. The CSG itself runs on your PC completely independently of the website. But the CSG website makes it much easier to collect strategies and distribute results than any of the other alternatives, so using it is strongly recommended.

To use the CSG website, you must first set up the CSG on your PC. After unpacking the files, you should set up your first game before going to the website. That means editing the HEADERW.ZZ file (and saving it as HEADER.ZZ), the COMPNAME.ZZ file and the MKTINFO.ZZ file as discussed above. Then run period 0 of the CSG in order to create COMPPRFL.ZZ. You have to change "ZZ" to some other two-letter game id and it cannot be the same as any games currently running on the CSG website. So go to the website, <http://csg.haas.berkeley.edu> , to see what is already in use.

Setting Up a CSG Game on the Website: Now it's time to set up the game on the website. Go to the CSG website, <http://csg.haas.berkeley.edu>, click on "Log In" and then click on "Register" if you have not previously registered as a user of the new CSG website. Fill out the form making sure to enter an email address that you monitor regularly. The address will receive your game setup confirmation. It is also where I will contact you when we need to delete your game from the website after the term is over. Once you have registered once, you don't have to do this again.

Next log in to the website with your new user id and password and then click on "Create" just below the top banner. Enter the full game name, number of students and type of students. Then upload the company cost file that you created when you ran period 0 of the game COMPPRFL.ZZ. Then click the "create" button.

Once game is has been successfully created, go to your email account and make sure you received the confirming email, which will include the passwords for the game.

Then go back to the webpage and increment the period from 0 to 1. After doing that, click to unlock the page so students can start inputting their strategies for period 1.

Instructions to Students for Entering Strategies and Viewing Results: Students use the website to view their company cost parameters and the results of each round, and to enter their strategies. To do so, they need to get to their company webpages. First, the student should go to the CSG webpage and click the game in which their team is playing. Then click on their team name, which will take them to the team log in page. The username is the two-letter game id followed by a hyphen and the three-character team name, *e.g.*, ZZ-XXX. Passwords are preset in the game creation process and have been sent to the instructor. You need to distribute the passwords to the appropriate students.

Entering the username and password takes the students to their team webpage, which has the public market updates, the private company updates. If the game is unlocked, then there is also a link at the top that says "Edit Team Strategy for Current Period (??)" where ?? is the current period number. Clicking on that links takes the student to a page that has fields for Price, Production Quantity, Max Quantity to Sell and Capacity Change. After filling out the fields that they don't want to be zero, they can hit the submit button. If at any time later (before you download the strategies) they want to change their strategy, they can do so by returning to the page, making changes, and hitting submit again.

After submitting, the students should be sure to log out of the website so another user of the computer cannot get to their team webpage.

Downloading Strategies and Uploading Results: At the end of each round, the instructor has to download the submitted strategies, run the CSG on your own PC and upload the results. To do so, go to the CSG website and click the "Log In" button, then log in with

your user id and password. Then click on the game for which you want to download strategy submissions.³

Once you are at the game page, click near the top to lock the game so students cannot enter strategies while you are processing the results.⁴ Then, under “Master Input Files for Each Period” click and download the file for the current period. That is the STRAIN???.ZZ file for the CSG software to use.

Run the CSG on your PC, then return to the CSG webpage, log in and upload the results using the “Upload Results” link at the bottom of the page. After uploading the results, click the “Increment” button, so the webpage moves to the next period. Then click “Click here to Unlock” so students can start entering strategies for the next period.

10. TEACHING NOTES: The game can be used to illustrate many different economic and strategic teaching points. In almost all cases, the game’s educational value is enhanced by use of a spreadsheet. They can then use it to figure out costs, approximate demand curves, and run various scenarios of possible competitors.

When I start the game, I give a short lecture on a few of the major points about costs and product differentiation. I demonstrate how the fixed costs per period and the sunk costs of entering a market should be treated differently than marginal costs. I then circulate a spreadsheet that does the optimal capacity and price calculation for a monopolist (ignoring the uncertainty about market growth).

I also talk about residual demand curves, first in the context of homogeneous goods and then with product differentiation. This is a good time to remind them of the goal of profit maximization and the role of setting marginal revenue equal to marginal cost, since some students get it in their heads that they should set $P = AC$ or $P = MC$. The demand function and cross-elasticity information in the market profiles can be used within a spreadsheet to create interpolated residual demand functions. I have also generated additional demand data points (using the demand data generator described below) to give the students enough to estimate the demand function with a regression (ignoring the fact that real data of this sort would present endogeneity problems).

The students catch on quickly to the fact that they must pursue their comparative advantage, and I often have a discussion about how one might figure out which markets are most likely to be hospitable. They realize that no one number determines comparative advantage in a market and they eventually figure out that they can construct a hypothetical cost function for a competitor who is, for instance, one standard deviation below the mean on all costs. A basic understanding of statistics is helpful. I explain that all cost variables are

³ You will only have access to the games that you have created.

⁴ The webpage will not let you download the strategy submissions unless the game is locked.

drawn independently, so the joint probability of being more than one standard deviation below the mean on all costs is actually quite low.

Since the residual demand and cost analysis leads to straightforward calculation of a best response function, one can even ask more advanced students to derive the (approximate) two-firm Nash equilibrium for given demand, cross-elasticity, and cost information. More generally, I ask the students to think about whether they can make money in a given market if their own costs are, say, 5% above a competitor's. I want them to get the idea that this matters much more in market D, where the good is very homogenous, than in market C, which is highly differentiated.

I originally used the game in a course called "Competitive Strategy" at Stanford GSB and in a senior seminar at U.C. Davis. The early part of these courses was designed to cover topics that are relevant to the game: entry deterrence, residual demand curves, predation, exit, cooperative and non-cooperative oligopoly, collusion in repeated games, and multimarket contact. With all of these topics, examples and applications can easily be taken from the game. I have also used it in a Ph.D. course at Davis and have written problem sets that walk them through the demand, reaction function, and equilibrium estimation. At the end of that course, I had them estimate behavioral parameters (as Bresnahan called them in his I.O. handbook chapter) using the data from the game.

For many years, the game was used in the second half of the MBA core micro course at Berkeley-Haas. We used a basic version of the game (no growth, matching production to output, no ability to produce beyond capacity), but it seems to be quite successful. Many students have commented that it makes the oligopoly section of the course much more intuitive. Note that with fairly minor changes, markets can be turned into virtual Cournot (make the depreciation on capital zero in market D where goods are already nearly homogeneous, so firms set capacity first and then set prices) and differentiated Bertrand (make the capital cost zero in a market). The game is now used in a core strategy course at Haas that is taught in the last 7 weeks of the first-year curriculum. Since its creation in 1994, the CSG has been used at more than 75 universities and colleges in about 20 different countries.

11. TECHNICAL SUPPORT, QUESTIONS, AND USE RESTRICTIONS: I can be contacted most easily by email at borenste@haas.berkeley.edu. My address and telephone number are Haas School of Business, University of California, Berkeley, CA 94720-1900, 510-642-3689. Before contacting me with a problem, please check the FAQ at <http://faculty.haas.berkeley.edu/borenste/csgfac.html>.

This software may be copied and distributed freely so long as it is distributed in its original form. Please do not distribute files that you have altered. Also, please let me know if you are using the game as I like to keep track of the experience people have had with it. Please send me your comments and suggestions as I will be producing revised versions.

Attachment A: Example of a market profile

MARKET DESCRIPTION: Market X is a large market, but shows very little growth prospect. Consumers consider different brands to be usable substitutes if prices are sufficiently different, but they do have favorite brands, which they will buy if prices are close to one another. Entry costs for market X are moderate, and vary substantially across firms. Production is very capital intensive and there is significant variation across firms in the efficiency of production.

PRODUCTION COST INFORMATION:

Mean Entry Cost: \$50000 Standard Deviation: \$3000
 Mean Cost of one unit of Capacity: \$2000 Standard Deviation: \$400
 Mean Marginal Cost: \$40 Standard Deviation: \$5

Percentage Depreciation of Capital in Period After Construction: 30%

Percentage Depreciation of Capital in Following Periods: 10%

Maximum Useful Life of Capacity: 8 periods

Scrap Value As a Percentage of Original Capacity Cost: 35%

Inventory Cost: 10 per unit per period.

Slope parameter for MC for output > available capacity: 10

DEMAND INFORMATION: The following demand information is for period 1. Growth or decline of the market in subsequent periods would affect aggregate quantities. For the figures below, it is assumed that each firm has sufficient production plus inventory to supply the demand for its product at the indicated prices:

Information on Market Demand and the Effect of Brand Proliferation: If there had been the indicated number of firms each charging the same indicated price, the cell shows the approximate market output that would have resulted:

Number of Firms in Market	1	2	3	4
Price 200	3059	3660	3831	4176
300	1439	1681	1915	2169
400	512	711	861	1059

Information on Brand Substitution: With two firms in the market, if firm 1 charges the price shown in the lefthand column and firm 2's price differs by the amount shown in the top row, then the cell indicates the approximate market share of firm 1.

Price Differential of Firm 2	-20%	-15%	-10%	-5%
Firm 1 Price 200	22%	28%	36%	43%
300	16%	22%	31%	40%
400	13%	21%	28%	39%

OTHER MARKET INFORMATION:

Market Growth Rate in Period 1: 1%

Standard Deviation of Change in Growth Rate: 0.5 percentage points

Attachment B: Example of a Market Update
UC MARKET UPDATE AFTER PERIOD 5

PRICES CHARGED: (***** indicates no capacity for production this period)

COMP	XYZ	MOO	YES	SFI	DOA	TFT	BAM	XXX
MKT								
A	250.	300.	200.	*****	200.	220.	100.	*****
B	*****	*****	*****	270.	*****	*****	*****	*****
C	*****	300.	*****	*****	*****	300.	*****	300.
D	*****	*****	*****	500.	800.	*****	*****	600.

CAPACITY AT END OF PERIOD:

COMP	XYZ	MOO	YES	SFI	DOA	TFT	BAM	XXX
MKT								
A	50.	200.	400.	0.	0.	480.	0.	0.
B	0.	0.	0.	550.	0.	0.	500.	0.
C	0.	37.	0.	0.	0.	60.	0.	150.
D	0.	0.	0.	40.	100.	0.	0.	700.

APPROXIMATE MARKET SALES: ($\pm 10\%$)

MARKET	A	B	C	D
APPX. SALES	3408.	535.	280.	2546.

Attachment C: Example of a Company Update
Company MOO(#UC2) Update After Period 5

	A	B	C	D
Beginning Inventory	0.	0.	0.	0.
Production	100.	0.	55.	0.
Quantity Sold	100.	0.	55.	0.
Ending Inventory	0.	0.	0.	0.
Price	300.	0.	300.	0.
Capacity at Start of Period	100.	0.	45.	0.
Capacity At End of Period	200.	0.	37.	0.
Inventory Costs	0.	0.	0.	0.
Variable Costs	5100.	0.	2438.	0.
Capacity Costs	86600.	0.	-9782.	0.
Entry Costs	0.	0.	0.	0.
Revenue	30000.	0.	16500.	0.
Net Revenue	-61700.	0.	23844.	0.
Cash At the End of Period 4:				813446.
Interest Earned (Expense) :				16269.
Total Net Revenues :				-37856.
Cash At the End of Period 5:				791859.

Age Structure of Capacity at End of Period 5

(***** = maximum capacity life)

	A	B	C	D
Maximum Capacity Life	4	10	8	6
New Capacity	100	0	0	0
1-Period Old Capacity	100	0	0	0
2-Period Old Capacity	0	0	0	0
3-Period Old Capacity	0	0	19	0
4-Period Old Capacity	*****	0	18	0
5-Period Old Capacity	*****	0	0	0
6-Period Old Capacity	*****	0	0	*****
7-Period Old Capacity	*****	0	0	*****
8-Period Old Capacity	*****	0	*****	*****
9-Period Old Capacity	*****	0	*****	*****
10-Period Old Capacity	*****	*****	*****	*****