B09.A BASIC ECONOMIC CONCEPTS: MICROECONOMICS.

Learning Curves and Some Revision April 25th 2006.

A) Following on from the discussion on long run costs and the economies of scale, we now consider the very long run. Whence we now move onto some analysis of learning curves. The explanation may be couched under the following headings.

(i) The firm learns over time so there are dynamic changes in costs. As management and labour gain experience with production, the firm's marginal and average cost of producing a given level of output falls. Thus, whereas economies of scale result in movements to the right along the long run average cost curve, the effect of learning is to shift the entire cost curve downwards. We can investigate these effects econometrically, seeing how far the fall in average costs are due to cumulative industry output (learning) and the average scale of the production facility.

(ii) This is sometime modelled by the learning curve where we show the degree to which hours of labour per unit of output decline as cumulative output rises. We explain all this by putting numbers into the following relationship: $L = A + BN^{-\beta}$ where N is the cumulative units of output produced, L is labour input per unit of output and A, B and β are constants. See the illustrative table in Pindyck and Rubinfeld where they use the equation $\log(L) = -0.322\log(N/10)$ to derive the numbers. We shall do this in the lecture, but you would be well advised to do this on your own, making use of a scientific calculator.

(iii) Now think of some application of these ideas and the learning curve in practice. The learning curve for Airbus Industrie is a classic example but we also take examples from the semiconductor industry. Studies of generations of dynamic random access memory (DRAM) semiconductors suggest a learning rate of about 20%. This means that a 10% increase in production would lead to a 2% decrease in cost.

(iv) Both the market for commercial aircraft and DRAMs are highly competitive. There is an entry fee to be paid to enter the market. This is a massive exogeneous sunk cost. In the case of DRAMs this is currently $2 billion dollars for a new chip factory. When the facility is established, more R & D needs to be done to ramp up production and reduce unit costs. This R & D is a hefty endogeneous sunk cost. Learning curves help here to plan the volume of cumulative production and relate it all to costs, hopefully to generate a positive cash flow in the end.

(v) The entry fee to be paid is evidently a massive barrier to entry. Sutton calls the increase in entry fees over time as the accelerationist mechanism. For example in 1968, it was reckoned that the development cost of some $750 million dollars for the Boeing 747 (first jumbo jet) amounted to 98% of the net worth of that company. Boeing had first mover advantage over the Douglas DC – 10 and the Lockheed Tristar in this battle between these United States companies. Of course, the European Union gave considerable launch aid to enable Airbus Industrie to get off the ground with the Airbus A300 series. The current struggle between Boeing and Airbus involves the payment of accelerating entry fees for the development of the giant Airbus A380 which Boeing have chosen not to match. The development cost of the A380 is about $15 billion and Boeing claims that Airbus has benefited from launch aid of some $17 billion in loans since 1970. However, the development of the Boeing 787 – the smaller dreamliner- may be matched by the heavily subsidised A350. The European Community counter charges that Boeing cross subsidises its commercial aircraft from profits from military contracts and arguments rage at the World Trade Organisation (WTO) in Geneva. Boeing point out that Airbus have developed 5 planes in the last 5 years to 1 of Boeing. These are extremely costly legal battles. Perhaps the booming market for aircraft, with the heavy demand for planes both from low cost and other airlines and the buoyant orders from China, may mean that there is sufficient room for both these global players. This is all without considering Stackelberger first mover advantage and game theory competition in the duopolistic Boeing Airbus situation.

(vi) In the case of DRAMs, we have the present dominance of Samsung (Korean), leading Micron (US), Hynix (Korean), Infineon (German) and Nanya (Taiwan). In 2001, these top five firms accounted for 88% of the world market and are all chasing each other down the learning curve. Another way of putting it was suggested by Gordon. E. Moore in 1965, who was later to found Intel. Moore's law states that the number of transistors that can fit on a computer chip- thus the capacity to crunch numbers- doubles every eighteen months. This allows computers to double in speed, or to fall in price by half.

B) Now we move on to a summary of the main topics covered in this course this year.

(i) The price system and the resource allocation problem. Consideration of a two good economy. General equilibrium theory, interdependence, substitutability and complementarity. Walras Law. Case studies of the English cotton famine and Gazprom's exercise of economic muscle in the market for gas. Economic systems gather information about exchange opportunities.

(ii) The fundamentals of supply and demand and associated elasticity measures. The approach was numerical, using case study material from agriculture. Particular emphasis was placed on using elasticity information to derive numerical supply and demand curves. We used the case of agriculture to flesh out the determinants of supply and demand, both in the short run and the long run.

(iii) The concepts of consumer surplus and produced surplus were analysed, using both the United States wheat market and the Sugar Quota to show how one can carry out welfare analysis. What are the gains to producers, the losses to consumers, the deadweight loss, the revenue to governments and the value of quota rents? How do both the United States and the European Union protect sugar producers and what are the proposals for reform, after EU and WTO meetings in December 2005?

(iv) Optimal pricing strategy, the optimal pricing formula, optimal mark up on cost and optimal mark up on price. We draw upon elasticity concepts which apply to price discrimination as well. Again we used numbers to illustrate principles, including the two part tariff pricing strategies used by amusement parks, and private clubs.

(v) We also studied the role of advertising, derived the Dorfman-Steiner equation and asked how far this helped determine the optimal amount of advertising.

(vi) Theoretical and empirical approaches to demand. We studied the utility approach in detail, going back to the origins with W.S.Jevons. Then we went through indifference curves in a conventional way, analysing the substitution effect, the income effect, Giffen goods, bliss points etc. We used Dwyer and Lindsay's case study of the Irish potato famine. They argued that the Giffen paradox could not have happened in the situation of the 1840s.

(vii) Continuing consumer demand theory, we used the Leibenstein article to explain what he calls non functional demand. In an affluent society one recognises the interdependence of consumption activities with the concept of network externalities. We carried out a formal analysis of bandwagon, snob and Veblen effects.

(viii) Classification of market structures and the structure-conduct- performance model. Measures of industrial concentration, from the simple five firm concentration ratio to the Herfindhal-Hirschman index. Should the SCP direction of causation be reversed? Does Tesco's dominate because it is very efficient?

(ix) The textbook explanation of the necessary and sufficient conditions for profit maximisation in perfect competition contrasted with contrived monopoly. Assuming that costs are identical, how did Harberger calculate welfare loss due to monopoly? How can one refine and criticise his approach?

(x) Removing the assumption of constant costs means we have to consider the sources of economies of scale, both technical and managerial. This can be measured by using cost functions and production functions. We used the specific forms of $TC = aQ^{b}$ and $Q = AK^{\alpha} L^{\beta}$ in our analysis. We explained the nature of costs in economics, both short run and long run. We outlined how statistical cost analysis, both short run and long run are carried out in practice. Regression equations are used and Joel Dean's classic case study of the hosiery knitting mill analysed..

(xi) Finally, we covered the dynamic changes in costs with the work on learning curves, discussed in part A) of this document. Grafted onto the conventional analysis are the concepts of exogeneous and endogeneous sunk costs and the accelerationist hypothesis. In fact the inverse of a learning curve is the forgetting curve, which may be the concluding joke.

C) Other Comments.

The examination lasts 2 hours and you are required to answer 3 questions out of a possible 10 questions, so you do have quite a bit of choice. Do look back at my weekly summaries of what we covered. They usually do have further guides to reading. Everything, including the four exercise sheets and selected solutions and a former examination, is on the link. Good luck if you need it!

John Mark April 2006.