ECONOMICS WEB INSTITUTE

YOU ARE A MONOPOLIST

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Overview

"You are a monopolist" is an ambivalent model that keeps together two natures:

1. it is a computer **game everybody can play**, even without any theoretical knowledge and just for fun;

2. it is an interactive model that sheds new light on the traditional context of **monopoly theory**.

The more the player already knows about the neoclassical model of monopoly, the more she (or he) will appreciate the differences with this new dynamic setting of the same problem. **Students** will better understand the theory and find a positive answer to the many doubts they usually have when facing textbook explanations.

But even if the player never heard of monopoly models, she (or he) can quickly grasp what's going on in this game and intelligently play it.

In other words, this model presents the outline of **a new theory about monopoly**, with demonstration preceding explicit statements. While playing and taking decisions, **the player develops his own point of view on the subject** and the discussion that is contained in the present essay will be much more convincing (or purposefully rejected!).

The reader is invited to **play the game before reading** the chapter 2.

By contrast, the description in chapter 1 may turn out to be useful for playing, since it slightly extends the instructions given within the software, distributed by the Economics Web Institute at http://www.economicswebinstitute.org, where you can **download** **it for free**.

In chapter 2, we shall try to describe **how people play**. It is an ambitious blind experiment, since it is highly possible that there exist a lot of different approaches.

In chapter 3, a **comparison** with a **standard model** is proposed so to highlight differences in assumptions and crucial features. Which of the models is more realistic is left to the sovereign judgement of the reader.

With concluding remarks, we shall present some perspectives on **future developments** of the software and the relative analysis, which gives scope to an **active role** of the reader.

1. Description of the business game

1.1. The context: production, inventories, supply and demand

In this game, there exists just one firm producing only **one good**. No explicit competitors appear but surely the demand is reactive to the price of the good, with some consumers implicitly renouncing to buy that good if the price is too high for them. The good is not differentiated along features, as instead it is the case in this other model.

The game lasts 20 periods of time; at least it is so with default basic options.

You are the monopolist, thus **you takes the main decisions** of the producer. You are free to choose:

i) the current-period **price**

ii) the current-period **production quantity**.

But consumers are not obliged to buy all your supply at the price you decide. Thus, it is well possible that at the end of a period you are left with **unsold supply**. Luckily for you, the good is a **durable**; thus it can be sold over periods with no physical deterioration or any other quantity loss.

In other words, unsold supply piles up in inventories: each period, in addition to the current production, your supply comprehends those inventories. **Supply is not equal to production**, unless inventories inherited from the previous period are zero.

A "shorter-side" rule holds: if demand is lower than supply, then the exchanged quantity is determined by demand. If, by contrast, the demand is higher, the limiting factor is supply (and inventories fall to zero).

Demand is "demand for buying", not an obligation to consume: what consumers do with the good is their business, not yours. Demand is not necessarily equal to consumption. The fact that the good is a durable may also mean that consumers keep it for many periods, enjoying its services for long. **Consumption psychological rules are not decisive in buying decisions**.

1.2. Key decisions: price and quantity

Each period you decide the price of the good and the current production level. In order to take informed decisions you need to know at least your **costs**: they **proportionally rise with production**. Each unit of the good costs you 10 monetary units (dollars if you want). If you produce 5 units of the good, your costs will be 50.

If you produce zero units, your costs will be zero (at the level 1 of the game).

Since **you do not know the quantity demanded** in each period before choosing, you'll have to face **a fundamental uncertainty** about demand and its reactions to different prices.

Your aim is officially to **cumulate profits** over time. Each period, profits are computed as the difference between total revenue and total costs.

If you produced 10, starting from zero inventories, and you sold 8 units at a price of 15, then your total revenue was 8 times 15 (equal to 120), while your total costs were 10 times 10 (equal to 100). Your current cash profits are 20, while you keep 2 units of the good as inventories [1].

2. Strategies

In this chapter, we shall refer to common behaviours and attitudes of real players. The best situation would be that you played before reading further, since, by having **a personal experience**, you will in very good position to judge what follows, comparing our arguments with what you thought and with how you took decisions [2].

In fact, we risk a lot by trying to imagine your behaviours in advance!

Decision-making process may depend by personal attitudes, thus theu can turn out to be constructed with a wide range of possible features. Accordingly, it is hardly possible to forecast what you actually did.

Yet, we have observed a good number of people playing, thus we shall anyway put forth an outline of framework for rationalising and interpreting their behaviours [3].

2.1. Incomplete information and pro-active behaviour

The first feature of the decision-taking process seems to be a feeling of **freedom**. You feel free to choose both price and quantity. Your consciousness is, however, mixed with a **perplexity**: how high will be demand in the next period? The system is clearly autonomously moving, so that even if you keep price at the same level you can be sure that **the future will not simply be a copy of the past**. At the same time, demand is responding to your price changes, although not always in a predictable way. The possibility of taming demand and reach accurate forecast can

be an aim in itself in certain strategies, but it is not an automatic result of your experience with the game. Even after many periods, **you still can make mistakes of forecast**.

Thus, from "freedom" and "ignorance" rises "**responsibility**", a positive attitude toward the external world aimed at forming an idea of how it works. First periods are often periods of mere experimentation where profits are not the crucial point and your attention is rather concentrated on understanding the environment.

2.2. Period-by-period tactics and general strategies

People we saw playing reveal a distinguishable approach. They usually take **reasonable decisions period after period** in a dialectics with **broad self-imposed guidelines**.

First, they form an **idea of what should be done** (or tried), partly basing on the same **description** of the game given through the instructions and partly on what they **observed** in past periods. Then they take their tactical **decisions** on price and production and look at market response. Further, they express a **judgement** of the obtained results.

This judgement can be based, in a mixed measure, on six elements:

1. the **profits obtained**, compared to the **previous** periods;

2. the **profits obtained**, compared with a **target** of 200 (computed by dividing the general target of 4 000 and the 20 periods of standard story duration);

3. the **demand gap** (the difference between demand and supply), which can be negative, positive or near zero;

4. the **demand dynamics**;

5. the level of **inventories**;

6. the **forecast gap** between what they expected and what happened.

Other elements could well play a role in players' judgements, but for this introductory analysis these can be said as fundamental.

Judgements turn out to be mainly of the following shapes:

1. "**satisfaction**" for the good results (higher profits than the previous period and/or than 200, a small demand gap with demand stable or not falling too much, inventories under control and good forecast performance);

2. "**disappointment**" for lost opportunities (as with **demand largely unfulfilled**);

3. "**alarm**" for **bad signals** in a general situation that can be considered as satisfactory or neutral;

4. "**dissatisfaction**" for bad results;

5. "**unease**" for a risky/threatening situation of **progressive worsening** of the situation across periods.

Other judgements can well emerge, as this is a first short list.

If you played the game, you may compare this list with your owns.

Judgements heavily influence new reflections on what to do. In general, "satisfaction" brings forth **continuity** in tactics with small changes in the same direction as the previous period, in the attempt of incrementally improve performance. Still, a long positive time series may give rise to such a confidence climate to provoke a bold leading move (as a significant increase of price or production). If this move doesn't bring to the expected result, an abrupt return to previous levels is often a consequence.

In general, "**dissatisfaction**" brings forth a need for re-evaluate past tactics and rethink one's approach, leading to **radical changes**.

In short, when a new decision is taken, it is subject to previous judgements and reflections. Furthermore, throughout this process, a new insight on the functioning of the system takes place.

We shall see in the following some basic examples of specific tactics. But now we rather pass to examine **general strategies** of players.

Indeed, all players we saw developped **their own mental and explicit guidelines for behaviour**. A framework for **interpreting** what happens, these guidelines help deciding **a stream** of relatively coherent decisions. Strategies cover usually the entire story, if not even all stories played by the same person. **The player uses the strategy and stick to it**, especially if it gives good results.

In fact, the feasibility of the strategy, its profitability, the level of satisfaction for results are all tests for the strategy. In case of very negative results, the same strategy could in theory be put under question. Yet, from what we observed, this rather does not happen. Even very poor results are interpreted within the mental framework and they are not used for overwhelming it. They are attributed to bad implementation and the intractable autonomy of the environment rather than to the strategy itself.

2.3. Ex-post emerging strategies

Ex-post emerging strategies are **gathered by the analyst from completed stories**. Without observing, talking or interacting with decision-makers, one can observe the moves and try to ascertain an automatic strategy that would have brought to the same choices.

Ex-post emerging strategies can be much simpler than conscious strategies. More in general, they needn't to be equal to them, just to mimic their outcomes.

When you shall analyse stories stored in a spreadsheet file, you will try to single out which is the emerging strategy of the player.

2.4. Some basic examples of general tactics and strategies

Earlier, we introduced the idea that players usually take **reasonable decisions period after period** in a dialectics with **broad self-imposed guidelines**.

Reasonable period-by-period tactics depend on subjective judgements about past situations, system functioning and future conditional developments.

We do not have enough empirical observations to evaluate in which situations certain decisions are normally taken or which is the variability field around this "normal" behaviour.

Still, we did observe specific patterns of behaviour when the situation is particularly clear-cut.

When demand significantly outperformed supply, with a large positive demand gap, the systematic move of the player in the next period is an **increase of price or quantity** or both. More in general, when the situation looks good, an increase of price (or quantity or both) is very likely to happen. The increases are larger when one "leverage" only is used, while being smaller if both are changed.

Conversely, if **demand was neatly lower** than supply, the decision is always in the direction of a **reduction of price (or quantity or both)** [4].

Whether to move price or quantity or both depends largely on the general strategy one adopts.

Arguably, there exists a good number of common and reasonable strategies that can be used for "You are a monopolist".

We shall now outline three of them, just to give an example of what we mean by "strategy".

A **first** strategy is characterised by the reflection that, in order to maximise the quantity sold at any level of price, **no consumer demand should be left unfulfilled**. Since the good is durable, the fact that inventories piled up is just a temporary / irrelevant phenomenon. Accordingly, this insight leads to a large production in the very first periods, letting inventories grow. Afterwards, as new pieces of information about demand levels and variability are available, one tries to forecast next period demand and decide to supply more than that (or equivalently **to be generous in forecasting**). Only in the last two-three periods, the player tries to sell out inventories, reducing production at very low levels.

Price is kept **higher enough** than average cost (10) in order to be sure of **a relevant margin**. Usual tactics are used for adapting to different phase of the business cycle and to possible different situations.

A **second** strategy we saw is **to "tame" demand** through the **price**, while keeping quantity around a certain "satisfactory" level. Systematically increased when demand is higher, price is then decreased when it's lower.

Inventories are targeted at a constant buffering level, with production targeted at expected demand. This generates **countervailing reactions to past shocks**: if inventories piled up, production is reduced accordingly and vice-versa.

A **third** strategy is aimed at **reducing the importance of demand shocks** by **producing much less** than the demanded quantity and by fixing extremely **high prices**.

In this way, **whatever demand does**, a high **rate** of **profits** is assured and the monopolist can ignore demand intemperances. Price and production are fairly constant, with zero level of inventories.

This strategy is clearly **at odds with consumers' desires** and is arguably negative from the

point of view of society as a whole, implying a large welfare loss as it does. This shows an important argument against monopoly, which goes beyond those arising from standard neoclassical theory.

3. The comparison with a standard neoclassical model of monopoly

3.1. Information assumptions

Largely the dominating paradigm in economics, the neoclassical tradition has always emphasised the **rationality of behaviour** in a context of **perfect information**. Thus, a monopolist is assumed a) to know demand, b) to be able to compute the profit obtained in every combination of price and quantity and c) to choose the unique combination that maximise profits.

As the standard intermediate-level textbook by J. Tirole ("The theory of Industrial Organization" – MIT Press - 1988) puts it: "In all this chapter – and in most of this book – we make the hypothesis that the **monopolist perfectly knows its demand curve**" [5].

Certain developments connected with games theory and the analysis of imperfect/incomplete information have proposed new analytical devices [6].

They work out a framework which, although definitely modified in many important respects as with the introduction of stochasticity, is still largely based on **sophisticated maximisation-led behaviour**: there exist **a well-defined set of possible choices**, whose profit outcomes can be given an **objective probability** of occurrency. Demand levels have specified probabilities, with known distribution of probability for the quantity demanded at each price.

Thus, **expected value of profits** for **each** price can be computed and the choice of price and quantity can be established "optimally".

The monopolist's expectations about demand are not subjective, they simply reflect the mathematical process governing demand.

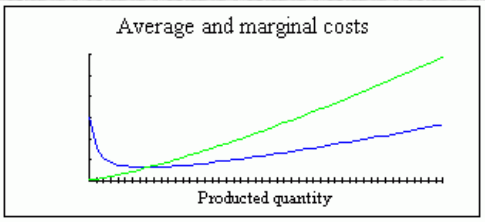
No personal preference or strategy can play any role: all "rational" players play exactly at the same way.

All this sharply differs from our model. Demand is here unknown and you could try to guess the future but nobody could assure you that your expectations are exact, not even on average across periods.

3.2. Cost assumptions

The relationship between costs and the level of production is described in the typical cost structure of a neoclassical model as a U-shaped **average cost curve**, where per-unit cost is decreasing for low levels of production, reaches a minimum, then begins to rise.

In the following Graph 1, average costs are in blue colour, whereas marginal costs are in green:



Graph 1

The firm is assumed always to work at production levels in the right part of the curve, when average cost is rising. This is the same that saying that the marginal cost, i.e. the cost of one further unit, is higher than the average.

In "You are a monopolist", we have adopted an **easier framework** where **unit cost is constant**. Thus, increasing production of one unit adds a constant to total costs. As "advanced" option, the model offers the introduction of a fixed cost of 50 for each period, independently from production levels.

Our hypotheses are in line with managerial models of "break-even point" analysis, currently employed in simplified (but real!) business plans.

3.3. Behavioural split: price and quantity

Exactly as in the standard one-good neoclassical model of monopoly, in our model the firm has to decide the values of two variables: the price and the quantity of production [7].

A fundamental difference, however, is due to the fact that in the neoclassical model the known demand curve relates one quantity to each price, thus the monopolist, by choosing price, automatically fixes production at the demanded level. **Price and quantities are decided**

together as a couple, whereas **in our model the two decisions** are neatly separated.

The formal symmetry for which, in the neoclassical model, choosing one price means producing a definite quantity and that there exist only one price at which a certain quantity is sold gave rise to models where the monopolist chooses quantity and "let the market" selecting the market-clearing price.

This is basically nonsense. Which shop-keeper says to the consumers: "Hey, I have to sell 42 chairs, tell me at which price you would like to buy all of them, no less, no more"? Consumers would cheat, or simply, individually would not know which is that price. They can just say, when over time and separately they come to the shop, that, at pre-specified price, they accept to buy a chair or not. In which supermarket have you been allowed to fix the price at which you buy?

In fact, the co-ordination device between the producer and the consumer is, in our model as well as in shops, the inventory stock. The shopkeeper decides both how much to keep in his shop and the selling price. If demand over time is lower than the offered quantity, the inventories will not fall as expected and, usually, the shopkeeper would delay re-ordering.

3.4. Maximisation

In standard neoclassical model, the monopolist is assumed to maximise profits, i.e. **to choose the production-price couple** at which the difference between turnover and total cost is at its maximum level. The idea behind is that monopolist's choice can be seen as **mere choice among known outcomes**.

In imperfect information neoclassical models, what is maximised is usually the expected profits, objectively computed as **the sum of the different profits that can arise at a given price**, each **weighted** with the **probability** it occurs.

As a simplified instance, let the following probabilities be objectively given and subjectively known to the monopolist, with proportional cost of production equal to 10, as in the game:

	Demanded Q = 10	Demanded Q = 20	Expected profits
price = 20	prob. = 0.3	prob. = 0.7	(20-10)x(10x0.3) + (20-10)x(20x0.7) = 30 + 140 = 170
price = 30	prob. = 0.8	prob. = 0.2	(30-10)x(10x0.8) + (30-10)x(20x0.2) = 160 + 80 = 240

In this situation, since 240 is more than 170, the monopolist will choose a price of 30, facing the relatively probability of demand .

By contrast, in "You are a monopolist" usually players do not compute expected profits in this way. Have you assigned probabilities to demanded quantities for each price? Have you computed expected profits?

Even if you did, how can you be sure that those probabilities are objective, i.e. derived from the mathematical structure of the model without any personal contribution, so that everybody would have expressed the same probabilities?

In other words, we think that, for our model, profit maximisation is not a **substantive procedure** for determining choices unambiguously.

Is the normal player involved with "some sort" of profit maximisation? Well, two answers here can be given. On the one hand, the stated aim of the game is to hit 4.000 over 20 periods. What is pursued is a "satisfactory" result, which in literature would be classified as a target for **bounded-rational players** (see Herbert Simon for this fundamental concept) [8], not for rational neoclassical monopolists [9].

On the other hand, it is true that in each period the player makes **its best** to reach a good performance (not only in terms of current profits but also **relatively to the objectives** that its strategies underlines as **important**).

In other terms, maximisation may well be a **broad goal** but it does not imply any specific choice: it is not operational - in the sense of Herbert Simon. Between the broad goal of profit maximisation and the specific task of choosing price and quantity, intermediate elements are required: strategies and tactics.

3.5. Fundamental freedom about targets

Usually the player accepts the stated target for profits to be 4.000. In a good number of cases, however, we saw players deliberately choose **different goals**. For instance, a player said that he was concerned with consumers' well-being and that he was conscious to be a monopolist, i.e. that if a consumer can't buy from him, he will not consume that good altogether. Thus, that player tried to keep the price low for allowing as many people as possible to buy.

Others tried, at least for some periods, to "develop" the market, as they said, by keeping prices low. It is noteworthy that real firms do the same in order the consumer to have an experience with the good and repurchase it in the future (often at higher prices) − in marketing terms, those firms use a "price penetration" strategy.

More in general, player feel free to set their own goals. Profits are not always included in the targets, or may turn out to be just "constrains" to the actions: "I do this and this, provided profits are not expected to fall 'too much'".

4. Future developments

In this brief essay, we have tried to outline possible emerging behaviours of the players in the business game "You are a monopolist". We have distributed the software, in order you to form your own opinion on that.

We shall further develop models with **many firms** (such as this) and entire economies, with emerging properties for general price level and employment, also based on your e-mails about your stories and relevant reflections. Simply keep in touch with the Economics Web Institute at http://www.economicswebinstitute.org.

NOTES

[1] In fact, according to certain accountancy rules, you should take into account inventories in order to compute revenues and profits. In certain systems, your profits would be considered as high as 40, with inventories summed up to cash profits and evaluated at cost value.
But in the present game, the rule is to look at cash profits only, while fully accounting the production cost of the inventories in the present period.
With zero inventories at the end of the 20^{th} period, and ignoring interest discounting over periods, the two conventions give the same outcome.

[2] If, by contrast, you feel of not being a good judge of your own acts and you distrust introspection as a means of knowledge, you could try to look at others playing, relying rather on repeated empirical observations.

[3] Our attempt will be greatly improved by your own reflections, if you shall be so kind to summarise them in an e-mail to the Economics Web Institute (info@economicswebinstitute.org).

[4] What did you do in these situations? Did you behave differently? If you agree that these are reasonable decisions, far-reaching consequences arise from even such "weak" considerations.

[5] See this book for a structured approach to modern neoclassical theory.

[6] For a good introduction to game theory with a strong emphasis on imperfect information see E. Rasmusen "Games and information" − Basil Blackwell − 1989.

[7] In our model, supply is not only production as in the standard neoclassical model, but it sums up production and inventories.

[8] See for instance: Simon, H.A.: 1948/1976, Administrative Behavior. (New York: Free Press);
Simon, H.A.: 1978, "Rationality as Process and a Product of Thought", American Economic Review 68: 1-14.;
Simon, H.A.: 1979, "Rational Decision Making in Business Organizations", American Economic Review 69: 493-513.;
Simon, H.A.: 1991, "Organizations and Markets", Journal of Economic Perspectives 5:25-44.)

[9] The target can be rationalised as being fixed by the true owner of the firm and given to the management: "If you do not want to be fired, you must earn 4.000 over 20 periods".

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