The Application of Sutton's Theory to the Pharmaceutical Industry

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Sutton's Theory separates manufacturing industries into those with horizontally and vertically differentiated products. The escalation parameter, α, further divides the latter, based on the effects of a firm's spending on its market share. Cliodhna Barlow analyses the pharmaceutical industry within this framework, using figures for R&D, advertising and concentration. She concludes that the industry is a Type 2 low-alpha industry.

Introduction

The roots of the modern pharmaceutical industry can be traced back to the development of orthodox methods of drug research shortly after the Second World War. Since then, many changes have occurred within the industry. Government regulations, opening up of markets (e.g. The Single European Market), increases in the costs of drug research, new methods of drug development, and expansion of 'me-too' products, among others, have taken their toll on the industry's market structure.

In this essay, I will apply Sutton's theory to the pharmaceutical industry and attempt to determine whether there is a relationship between market size and market structure as he suggests. The pharmaceutical industry is a research and development (R&D) intensive industry and I will explore the effect of this characteristic on competition and concentration levels. Finally, I will examine the impact of globalisation and the increasing cost of innovation, which have been brought to light with the evolution of the industry.

Sutton's Theory

According to Sutton (1991) manufacturing industries can be divided into two types, which Schmalensee (1992) later labelled as Type 1 and Type 2. A Type 1 industry is characterised by homogenous and horizontally differentiated products. On the other hand, a Type 2 industry is characterised by vertically differentiated products. In Type 1 industries, given free entry, the basic intuition is that as market size increases, profits increase and there will be an incentive for more firms to enter the market until the profits of the last entrant just cover the exogenous overhead costs paid on entry. This would indicate a rise in the number of firms and reduced concentration.

Firms in Type 2 industries compete not only in price and horizontal product differentiation, but also in their advertising and/or R&D expenditure. Generally, advertising and R&D expenditure are a choice variable decided by the individual firm, and it is this choice that underlines the fundamental difference between Type 1 and Type 2 industries (Matraves, 1999). An increase in market size within a Type 2 industry may encourage firms to increase their expenditure in advertising and/or R&D in order to differentiate their products and typically increase the consumers' willingness to pay, thus increasing their market share. Therefore, as market size expands there is an incentive for firms to gain market share via advertising and/or R&D expenditure, which ultimately raises overhead costs. Sutton refers to this as the 'escalation mechanism', whereby fixed costs per firm are raised, which can possibly have a consolidating impact upon market structure. Undoubtedly, market structure will be less fragmented than in Type 1 industries.

Sutton (1998) further investigates the relationship between R&D intensity and market structure in Type 2 industries in order to derive why some R&D intensive industries remain unconcentrated e.g. the pharmaceutical industry. He attempts to determine the extent to which a fragmented industry, in which all firms have a small market share (and so can only finance relatively low R&D investment), can be destabilised by a firm that outspends its many small rivals. He introduces a ratio a/K, where K is the amount outspent by the firm and a is the direct change in market share caused by K. This ratio, which Sutton refers to as the 'escalation parameter' is denoted by α ("alpha"), and plays a fundamental role in Sutton's theory. It indicates the extent to which a fragmented industry can be destabilised by an outspending firm (entrant or otherwise).

It is difficult to measure the value of alpha directly, so information is extracted from observable industry characteristics. In an industry, a firm decides to follow a number of "technological trajectories", that is develop progressive technological paths that lead to the development of different groups of products. A firm can choose to follow one particular trajectory, and focus all its spending on it, or to spread its spending across several. Focusing on a single trajectory is associated with the standard 'escalation mechanism', as previously mentioned, and such an industry is labelled 'Type 2 high-α'. It is termed a high-α industry, because if all firms within that industry are concentrating on a single trajectory, a deviant firm that outspends its rivals in R&D can destabilise the market. Where firms developing many trajectories are associated with the 'proliferation' of various distinct technologies, such an industry is labelled 'Type 2 low-α'. This industry is termed

low-α because a deviant firm that outspends its rivals in one area will not destabilise the market, as the rival firms are following many different trajectories which they can fall back on (assuming linkages between product groups are weak i.e. minimum transfer of knowledge from one product group to another).

If a deviant firm increases its market share as a direct result of its R&D spending decisions, it can disrupt the industry structure. In a Type 2 high-α industry, the deviant firm can capture some market share, regardless of how many other firms are in the industry. As a result, this type of industry will be associated with high R&D spending and high concentration. On the other hand, in a Type 2 low-α industry, the deviant firm may be able to capture some sales along a particular trajectory, however, it may not be able to capture a significant market share. This industry will be characterised by high R&D spending and lower concentration. Matraves (1999) adds that in Type 2 low-α industries, the escalation of R&D causing a shakeout of technologies over time will not be observed, but rather a proliferation of technologies, where new ones enter and exist alongside the old. In this way, concentration levels may remain low indefinitely.

The Pharmaceutical Industry: Applying the Theory

Sutton (1998) argues that R&D technology in pharmaceuticals is that of a low-alpha industry. Is there evidence to support this? I will now examine whether the industry is characterised by high R&D and advertising expenditure, and lower concentration levels as the theory suggests.

R&D Expenditure

When R&D is expressed as a share of total revenue, the pharmaceutical industry has emerged as one of the largest spenders in the manufacturing sector, ranking alongside electrical equipment and electronics, aerospace, and chemicals (Ballance, 1992). Furthermore, this expenditure has been rising steadily. American companies, for example, were devoting roughly a fifth of all their revenues to research in 1989, up 15% per cent since 1975. This pattern can be similarly seen in the United Kingdom, where research expenditures were 5.7 per cent of gross output in 1970, but had risen to 13.3 per cent by 1988, and estimates for other European countries are even higher (Scrip 1433). Sums such as these are large in comparison to the industry's turnover, but because public funding is not considered, they understate the total amount spent on research.

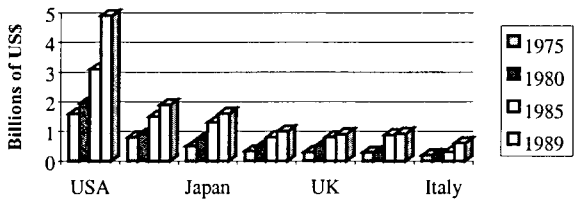
THE APPLICATION OF SUTTON'S THEORY TO THE PHARMACEUTICAL INDUSTRY

The radical change in the methodology of drug discovery has had an impact on the costs of research. In the past, technologies by which most drugs were discovered can be traced to random screening of thousands of compounds for efficacy against a given disease, accidental discoveries, or incremental improvements to existing drugs (Schwartzman, 1976). Over the past two decades, this 'random drug design' has been replaced by new technologies, using a more 'rational drug design' approach. Although this new drug discovery process is more efficient, the 'cost of innovation' has increased. The average cost of developing a new drug, or the cost of innovation, was estimated to be $359 million in 1992 (taking into account compounds that failed), compared with $231 million in 1987, only five years earlier, and $54 million in 1976 (Di Masi, J et al, 1991).

Government regulation is another factor restricting drug discovery, and may render large R&D investments useless, thus increasing costs. Following the thalidomide disaster in the 1960's, it became obvious that the public were potentially vulnerable. New regulations and policies were brought in, for example the Kefauver-Harris Amendments of 1962 introduced the need for an Investigational New Drug (IND) requirement, and proof of efficacy was added to the requirements of the New Drug Application (NDA) before approval for marketing. These regulations caused a substantial fall in the numbers of new chemical entities (NCE) introduced on to the US market by almost half (in the 1960's only 236 were introduced on to the market) (Redwood, 1998). Despite the fact that the number of products being produced has slowed down, the industry's financial commitment to research has steadily increased. Figure 1.1 illustrates the pattern of research spending (in 1980 US dollars) of the main countries in the industry during 1975-1989.

Figure1.1

R&D expenditures by the pharmaceutical industry in selected countries, 1975-1989 (constant 1980 US dollars)



Source: Estimates derived from data supplied by national pharmaceutical producers' associations and the Office of Health Economics, London (Balance, 1992).

Advertising

In the past, pharmaceutical manufacturers sold their products directly to the consumer rather than to doctors. Some firms spent large amounts of money on advertising to promote their branded products. However, with the introduction of government regulations to protect the public from potentially harmful substances, the channel of distribution changed. The market for drug products can now be divided into two main areas: the over-the-counter sector, and the prescription sector. The latter comprises the most important sector of the market, and can be sub-divided into the intra-mural market (hospital) and the extra-mural market (consumption at home). The extra-mural market is significantly larger in volume and value (De Wolf, 1988).

As a direct result of the change in distribution, companies have adapted their marketing strategies. The bulk of promotional expenditure is now being spent on company sales-teams, who visit individual physicians promoting the various drug products, and explaining the benefits and advantages to be gained. This process is known as 'detailing', and by the early 1970s all major companies started investing heavily in it, to the extent that the average US physician had 1.7 visits per week (Sutton, 1998). Furthermore, during the period 1983-1988, the sales staff of the world's top pharmaceutical firms grew by 50 per cent (Balance, 1992). This activity is extremely labour intensive, and as a result raises a company's costs considerably. However, some firms have invested heavily in detailing, in order to reap the benefits

of simultaneously launching their products across emerging global markets, and to remain competitive. Undoubtedly, Table 1.1 shows a widespread increase in the amount of money firms invest in promotional and distribution activity:

Table 1.1 *The Average Cost Structure in Selected Developed Market Economies, 1987 and 1988 (per cent of operating revenues).*

Cost component	*United States 1988*	*Switzerland 1987*	*Fed. Rep. of Germany 1988*
Manufacture	35	40	39
Marketing	22	24	27
R&D	10	15	14
Administration	6	6	7
Other Costs	6	5	6
Operating Profit	21	10	7

Source: For the United States, company reports for eleven leading firms with calculations by UNIDO; for Switzerland, SSCI (1988); for the Federal Republic of Germany, UNIDO calculations based on PMAG, Pharma Daten 90 (1990) (in Ballance, 1992).

The magnitude of the marketing investment is highlighted in Table 1.1. Moreover, when this figure is compared to R&D expenditure, it clearly outweighs it, and in some cases it is more than twice that of R&D. Although the data in Table 1.1 may appear a little outdated, Table 1.2 portrays the marketing and R&D expenditures during the period 1993-1995 of three of the leading pharmaceutical companies. Taking into account administration costs, marketing expenditure still prevails over R&D expenditure.

Table 1.2 Pharmaceutical Marketing and R&D Expenditure 1993-1995

Year	Merck & Co.		Eli Lilly		Bristol-Myers Squibb*	
	Marketing & admin. as % Sales	R&D as % Sales	Marketing & admin. as % Sales	R&D as % Sales	Marketing & admin. as % Sales	R&D as % Sales
1995	19.8	8.0	27.4	15.4	11.9	8.8
1994	21.2	8.2	25.0	14.7	11.4	9.2
1993	27.8	11.2	25.6	14.5	11.0	9.9

* = Advertising and Promotional Expenditure.

Source: Company Annual Reports 1995 (in McIntyre, 1999).

The rise in the over-the-counter drug sector has encouraged firms to invest heavily in advertising, as this can directly influence the consumer, and thus the sales level. An interesting point to note, however, is that investments in detailing may be limited. When all prescribing physicians have been contacted and informed of the products, further promotion may be ineffective. In this way, detailing efforts may reach a saturation level. The effect of marketing on the value of alpha, as a result, may remain quite small. For example, if detailing efforts of firms reach a saturation point, an outspending firm will not capture significant market share. In terms of the over-the-counter sector, an outspending firm may capture some market share: however, this sector is currently only a small part of the overall market, thus the effects would be minimal. If this sector increases substantially in the future, the structure of the market may be altered via the impact of advertising.

Customer loyalty can be created through promotional activity, and it is hoped to be strong enough to withstand the forces of competition. If a firm is promoting a product (especially in the case of a generic drug) before any other company, it can attain a first-mover advantage. The benefits of this can be great, as people will trust the original brand, because they know and are familiar with it. On the other hand, some people argue that the first-mover advantage may be limited in the case of pharmaceuticals, whereby some people may experience side effects. In this case, a competing brand may be more suitable for a certain subset of patients, and this company may effectively capture this share of the market.

The change in marketing activity has been of benefit to consumers in terms of getting the latest drugs to the market in the shortest amount of time. A worldwide launch can now be accomplished in only three years, where it once took eight to ten (Balance, 1992). Despite claims of biased influence, it is accepted that the promotional activity of the pharmaceutical industry is an important source of information for doctors. This translates to better advice for the consumer.

However, marketing expenditure has escalated, so much so that critics fear that it represents a misuse of market power. Interest groups, such as various government bodies and insurance companies, have also expressed concern about marketing costs rising disproportionately. Furthermore, appropriate action may be necessary should a pharmaceutical company try to pass its high costs onto consumers in the form of charging a premium price.

Concentration

It has been confirmed that the pharmaceutical industry is distinguished by high R&D and advertising/ marketing expenditure. I will now investigate if it is characterised by low concentration levels.

Whether concentration is high in the pharmaceutical industry essentially depends on the substitutability of products associated with different technologies. In spite of the effectiveness of R&D, if substitutability is low, concentration may also be low (Matraves, 1999). Much economics literature classifies pharmaceutical products as "therapeutic categories". Sutton uses "chemically related groups", as it better prepares the market for the purpose of applying the theory. Whatever the classification, what is eminent is that there are a wide variety of technologies to develop such products. As previously mentioned, there has been a change in research methodology. Temin argues that the industry was transformed after the Second World War, and that there is no one central product: 'the revolution in drug research allowed many different drugs to be discovered and promoted' (Temin, 1979). A firm's product range tends to be horizontally differentiated, making different versions of the successful drug rather than successive improvements. Therefore, differences across firms tend to be in the number of therapeutic categories covered. A further point is the issue of side effects. The varying biological make-up of consumers ensures that no 'one drug suits all'. In this light, firms cannot capture all of the market as their products may not suit all consumers. They may however, adapt their products, or extend their range in order to capture a share of the various sub-markets.

A firm may also extend their product range, or adapt their products via a merger or acquisition, where important technical know-how may be acquired. This has a direct effect on concentration. From the early 1960s until the end of the 1980s, the composition of the world's largest pharmaceutical companies was remarkably stable. At the end of the 1980s, the tranquillity of the industry was disrupted by an all-time high number of acquisitions and mergers. During the period 1988-1990 the estimated total value of mergers and acquisition was around $45 billion (Ballance, 1992). The pace has now slowed, but the industry has entered a new era, where the presence of acquisitions and mergers will be more commonplace.

What is also interesting about the recent merger/acquisition activity is that a lot of the firms involved have been large corporations. The 1989 merger of two large American and British companies- SmithKline Beckman (SKB) and Beecham-

attracted much attention and marked a turning point for the world's larger drug producers. Other recent merger/acquisition activity includes: BASF acquiring Boots (1995), Ciby-Geigy and Sandoz forming Novartis (1996), and Roche acquiring Boehringer Mannheim for $11 billion (1997).

Looking at concentration levels tells a different story. From a national perspective, concentration levels have been very stable. Using Cr4 data during the period 1987-1991, it is observed that concentration levels remained the same with slight fluctuations in some countries e.g. Italy decreased from 17 to 15, and the UK increased from 34 to 35. At the EU level, concentration decreased by three percentage points, which is a relatively large change over the seven year period (Matraves, 1999).

On the other hand, from a global point of view, concentration levels are changing. Up until 1988, the market shares of the leading twenty pharmaceutical firms remained quite stable, although their ranking changed. Between 1988 and 1995, however, the global market shares of the top ten firms increased from 25.4% to 31%, an increase of 5.6 percentage points in concentration. Furthermore, the firms ranking 11-20 increased their market share from 16.2% to 18.6%, an increase of 2.4% (Matraves, 1999).

Globalisation and the Cost of Innovation

The globalisation process has opened up markets for many companies, effectively increasing the market size. This is consistent with Sutton's (1991) theory, that as market size increases, this raises the incentive to escalate the level of advertising and/or R&D expenditure. Therefore, the observed escalation in R&D and advertising/marketing expenditure within the industry may be attributable to the increase in market size.

However, the relationship between market size and expenditure is limited in some areas, especially with regard to firm size. The increases in R&D and advertising/marketing have put major financial constraints on small companies. Henderson and Cockburn (1996) find that smaller firms are disadvantaged for two main reasons. Firstly, *ceteris paribus*, research programmes located within larger organisations are significantly more productive than rival programmes located in smaller firms. Secondly, this superior performance flows as much from economies of scope as it does from economies of scale per se. The increase in the cost of innovation also puts pressure on the smaller sized firm, and this pressure is further

reinforced because i) the return to new drugs is highly distorted, a few 'blockbusters' dominate the product ranges of the major firms and ii) only the top 30 drugs world-wide cover average R&D costs (Matraves, 1999).

The recent merger/acquisition activity also suggests that smaller firms are finding it difficult to survive in the changing industry environment. This certainly has implications for the market structure and raises the question whether it is necessary for a small company to merge in order to remain in the industry.

Conclusion

Many structural changes have occurred in the pharmaceutical industry, for example government regulation, changes in drug methodology and globalisation. These changes have had an impact on the levels of R&D and advertising/marketing, and we have witnessed a steady escalation of spending by companies in both.

Concentration has remained stable on a national level, but has increased on a global level. The increase in the cost of innovation, and also the effectiveness of advertising, as the over-the-counter market expands, have been two contributing factors to the increase in global concentration. An interesting point to note, however, is that the top four worldwide firms' combined market share is only 14.6% of the total market (from 1995 data). Compared to other industries this does not convey a highly consolidated market.

Admittedly, the disadvantages to smaller firms limit the fragmentation of the industry. Nonetheless, the industry still remains relatively fragmented, given that it is both R&D and advertising intensive. This is possibly due to the fact that the proliferation mechanism dominates over the escalation mechanism. From the available evidence, one can only conclude that the pharmaceutical industry, consistent with Sutton's theory, is that of a Type 2 low-alpha industry.

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