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Semester V – Industrial Economics

Unit 5

TECHNICAL PROGRESS AND PERFORMANCE

Part 2

Topics covered: Market structure and innovation, Technical progress and innovation, Theories of Schumpeter, Arrow and Demsetz regarding market structure and innovation

Introduction

The growth of economies depends on the growth and survival of industries and firms. It is important to know how industries develop and change. A crucial part of this change, in many industries and for overall economic growth, is continual development of new or improved production methods and products.

Economists define technology as ideas, or knowledge, that help us produce output from inputs. Having better technology means being able

to produce more output with a given amount of inputs or less inputs required to produce the same level of output.

It is taken as axiomatic that innovative activity has been the single, most important component of long-term economic growth. Prof. Abramovitz, in the mid-1950s argued that in the most fundamental sense, there are only two ways of increasing the output of the economy: (1) you can increase the number of inputs that go into the productive process, or (2) if you are clever, you can think of new ways in which you can get more output from the same number of inputs.

Because of technological progress. We have learned to produce more with less of the scarce inputs, thus reducing the dangers posed by the finiteness of available resources.

The most persistent debate over innovation intensity has been that involving the role of market structure.

The most popular Schumpeterian approach hypothesizes that monopoly is a fertile ground for the germination of new product or new process than is competition. For a particular industry demand function, the monopolist has more control over price and therefore, has a lower price elasticity then the more competitive firm. Arrow on the other hand postulates that a competing firm would rather try hard to grab the market share by continuous innovation. Scherer analyzed that an oligopolistic behavior is pro innovation. A comparison of innovation in monopolies and competitive oligopolies would yield more meaningful results. The market structure may consist of monopoly or competition which may affect the speed and quality of technical progress. This directly leads to economic welfare. Other factors affecting the same may be firm size, conglomerate diversification along with market power effects.

In the Theory of Economic Development (published in 1911) Schumpeter viewed small entrepreneurial ventures as seedbeds of technological discovery, yet three decades later in Capitalism Socialism and Democracy (published in 1942) he advanced the now familiar hypothesis that large firms with market power accelerate the rate of innovation. Because market power is endogenous to Schumpeterian growth-new firms enter and may come to dominate an industry through creative destruction-his 1911 and 1942 arguments are not entirely separable. For the most part, however, the literature has focused on Schumpeter's 1942 position to understand whether, -a market structure involving large firms with a considerable degree of market power is the price that society must pay for rapid technological progress. between what How balance society gains to create a from Schumpeterian innovation and what it loses through high pricing and restrictions of output is a recurrent issue in the economics of antitrust enforcement.

Theory shows that market power can stimulate technological progress because firms innovate on the expectation of receiving monopoly rents. Thus, Philipe Aghion and his co-authors build on F. M. Scherer's

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inverted-U relationship where competition has a positive effect on innovation up to an inflexion point after which its effect decreases.

The Inverted-U Relationship

Mentioned and hinted to in Scherer (1965) is the possible idea of an inverted U shape relationship between market concentration and innovation. This theory was developed significantly further and justified through two contrasting effects. The theory from that paper is shown graphically below.



The reasoning behind the inverted-U theory is proposed in two distinct effects. Firstly, at low levels of product market competition (PMC), the escape competition effect dominates, as the motive is strong – similar to the replacement effect in Arrow (1962). Followers also have a low

incentive to innovate in such industries because it depends on the amount of "neck and neck" firms – how many are escaping competition (trying to catch up). For these reasons, industries will move into a position with leaders and followers, where the followers are stuck, and this leads to a situation/with low innovation. For high levels of PMC, the Schumpeterian effect dominates, with firms led by the incentive to make supernormal profits, and again become stuck in a state of low innovation. Only in a situation where PMC is at a medium level do firms not become stuck in a low innovation state.

Market structure and incentive to invent

There is significant contribution by economists Schumpeter, Kenneth Arrow and Demsetz in the area of technical progress.

Arrow states that invention is propelled more in competitive structure rather than monopolies. Demsetz and Schumpeter proposed that innovation was the key characteristic of monopoly. They attributed the same to the entrepreneurial flair of the monopolist which prompted innovation.

Joseph Schumpeter

He formulated the concept of *creative destruction* (1939) after observing the great merger waves of early 20th century America. He defines it as a process whereby old ideas and industrial structures (products, processes and organizations) are continually replaced by new industrial activity, this is thought to be the source of continuous progress and improved living standards.

Schumpeterian belief

Schumpeter believed that there are stronger incentives for monopolists to innovate compared to competitive firms because firms can capture gains without being imitated by rivals. In reality, many innovations are made by firms with dominant market share, Microsoft Corporation in computer software market being just one example. the The contemporary economic literature makes reference to the Schumpeterian hypothesis referring to the existing correlation between being able of market and innovative ability to the enterprise. The Schumpeterian hypothesis tells us that there is a close relationship between innovation and market structure. Only companies that have market power, at the best the monopolist, can support the costs related to innovation, indeed, is the innovation itself determines that a monopoly position, the defense of which brings further innovation a virtuous circle. In fact, once a company, through innovation, achieves a monopoly position, tends to reinforce this position, controlling and extending the period of benefit due to agreements with innovation and patents. Therefore, only the large firms are induced to seek innovation to increase and strengthen its market power, which is why the monopoly is more rewarding for the purpose of economic growth compared to the competitive market.

Schumpeterian thought on technical progress

In standard growth model of creative destruction growth is stimulated by technical progress, which consists of product innovations and process. Any innovations, in fact, introduces a qualitative improvement and/or a decrease in cost of production, and this is the necessary condition for the next innovation. At every stage of the innovation process, the innovative entrepreneur, exploits the competitive advantage and monopolize the market. In other words, Schumpeter contradicts the position of the classical economists according to which competition stimulates performance, arguing that the prospect of achieving a monopoly rent induces firms to invest in R & D and promotes, as well, dynamic efficiency, i.e. ability of the economic system to generate innovation. By extending the interpretation of the initial positions of Schumpeter it can get to support that innovation is the only factor that allows the firm to exit the competitive balance of long period, where the profit is zero, obtaining temporary monopoly positions. In addition, through the internalization of the research activity, generate further innovation that excludes others from access to technology. In other words, the monopoly encourages innovation and provides the ability to implement dynamic efficiency.

Innovation And Profit

The risk inherent in the introduction of a new production process, it proceeds in the idea that the entrepreneur can rely, at least for a short period of time, on obtaining an extra profit before the imitators 'reach '.In other words, boost innovation derives from the existence of rigidities which slow down the spread of new technologies. If such rigidity is removed, it equivalent to destroying every incentive to innovate. It is precisely the competitive dynamics of the process of 'creative destruction 'that is lost when the innovation is reduced to a routine process. In this regard, Schumpeter argues that the profit is attributable to the normal return of a factor of production, but it is a premium paid to transitional entrepreneur innovator.

Innovation and problem of financing

It is not disputed the fact that research is a source of economic growth. Empirical studies also show a high correlation between the extent of expenditure on research and development and productivity growth. The Schumpeterian position is that research, necessitating large amounts of capital can best be conducted by companies that have, or may enjoy market power. Innovation produces profits and surplus remain unchanged until the contractor maintains a monopoly position, in other words, the temporary monopoly of the firm exists and is a cause and effect of innovation. If a new method of production is designed, for example, the aim is to reduce the unit cost of production by maximizing output. A cumulative process of concentration of market power at enterprises continually at the forefront in technological change can be an element which promotes the financing innovations arising from internal sources, as enterprises large and solid. Moreover, if there is a possibility of financing innovations with internal resources, and if the financial market is not perfectly competitive, than market power can be a decisive element for the realization of innovation and, therefore, to consolidate in position of competitive advantage.

Arguments in favour of monopoly

Concentrated firms can better finance R & D activities.

Better economies of scale especially in concentrated large firms.

Better position to protect the patents

Rigorous attitude for countering potential competition

Can attract better research personnel

Limitations

Several arguments against monopoly power being conducive to innovation also exist. They are;

- 1. Monopoly firms will become lax and inefficient.
- 2. The firms in concentrated markets will have less inclination to invent.

- 3. Innovation limits monopolist's profits.
- 4. Cost of re-equipment will exceed the benefits of the same.

Monopoly v/s competition

Initially, it appears logical to think that firms in competition would have more incentive to innovate because of the need to outperform rivals with new and improved products or services. Monopolists would not have to continually innovate because they have the cushion of total or almost total market share. This simplified view makes a number of assumptions, however. Monopolists certainly have the capabilities to innovate efficiently. They have large economies of scale due to diminishing unit costs.

Along with the fact that they can charge prices well in excess of marginal cost, the potential profits are enormous. These profits can be re-invested into new technologies and processes to stimulate innovation. Research shows that monopolies do utilize these capabilities to innovate. Monopolists also have an in-depth understanding and experience of the economy in which they operate in, leading to precise innovative decisions being made. Often this involves incumbents enforcing their monopoly power by erecting barriers to entry to protect themselves.

Indeed, the ease of entry of potential entrants into the market is a crucial determining factor of monopolist behavior. When barriers to entry are low or non-existent, monopolists usually try to innovate rapidly to retain their market share and high profits. This is because their need to

maintain market power is greater than competitive firms'need to outperform its rivals. This firm will produce a higher output, set lower prices and invest more in research and development. Smaller firms may not even enter the monopolist market as it is seen, paradoxically, as being too competitive.

If the barriers to entry are high, the incumbent will have no immediate need to invest in new technologies as its existing monopoly is less likely to be challenged. This assumes that strategic investment by leaders will make potential entrants less aggressive. Despite large firms being proportionally more innovative than small firms, these small potential entrants are capable of —leapfrogging the incumbents to gain a larger proportion of the market. This assumes that the technology required for innovation is available to all firms. Because of this, theory suggests that monopolists always have incentives to innovate whether barriers to entry are high or low.

Kenneth Arrow

The first economist to identify flaws in the Schumpeterian analysis of innovation was Kenneth J. Arrow who, in a seminal paper, questioned the common view that monopoly stimulates innovation (Arrow 1962). His point was that a pre-innovation monopolist has a weaker incentive to innovate than a firm operating in a competitive market. For a monopolist, innovation simply replaces one profitable investment with another, something that Arrow called the —replacement effect.

Incumbents may thus be resistant to change or unable to respond to radical innovation due to organizational inertia. The monopolist may actually receive a lower net return from introducing a new innovation that displaces activities of the old one. This is because the opportunity cost of innovation adds to the actual cost arising when the incumbent's capital stock is locked into a particular technology, slowing response to a new more profitable innovation.

Endogenous growth theory

Arrow was one of the precursors of endogenous growth theory, which seeks to explain the source of technical change, which is a key driver of economic growth. Until this theory came to prominence, technical change was assumed to occur exogenously – that is, it was assumed to occur outside economic activities, and was outside (exogenous) to common economic models. At the same time there was no economic explanation for *why* it occurred. Endogenous-growth theory provided standard economic reasons for why firms innovate, leading economists to think of innovation and technical change as determined by economic factors that is endogenously to economic activities and thus belong inside the model.

Arrow's Belief on market structure and innovation

Arrow stated that when there is competition to innovate, monopolists innovate at a slower rate than competitive firms, who in turn innovate below the socially optimizing level. This has been confirmed empirically in a study of innovation in transition economies which concluded that new firms drive innovation and that for these firms competitive pressures raise innovation. Policies to encourage product market competition were found to assist both old firms before transition and new firms who would be spurred to innovate because of the potential increased profits derived from outdoing competitors.

Arrow's model

Arrow (1962) considered that in case of a process innovation in an industry with constant costs, where even problems of uncertainty and inappropriateness were ignored, a competitive firm shall be able to charge all firms an arbitrary royalty for the use of innovation. Whereas a monopolist shall himself invent and set marginal revenue equal to marginal cost before and after innovation. These potential profits determine the inventiveness in the market.

In these regard, two cases can be considered.

Case 1: Invention would produce a drastic cost reduction.

For e.g. if D is a linear market demand curve and c is the pre invention unit cost curve, then a competitive industry will set price equal to c, while a monopolist will set a price equal to marginal revenue (MR) equal to c, giving a price w and profits P=wxyc.



Now, if a drastic cost reducing innovation is introduced, unit cost falls to *c*'.

In case of competition, the inventor charges firms a per unit royalty r, to maximize his profits. This involves restricting competitive output ot where MR = c'. giving maximum profits P'=puvc' from a per unit royalty, pc'. Thus the competitive industry would set a price p and pay a total royalty P' to the inventor. The inventor in turn may invest in invention if the cost borne by him was less than P'.

In case of monopoly, the monopolist sets a price P where MR=c'. his profits are P' but the incentive to invent = P'-P as he'll get extra profits

from the invention. Now this P'-P < P', which deters the monopolist from inventing.

Thus Arrow compares the additional profit to be gained from undergoing some process innovation (that is, reducing marginal and average of production) in perfect competition and monopoly markets. He shows mathematically the profit increase for a monopolist when reducing marginal cost should be less than for a perfectly competitive producer – where we assume that marginal cost is equal to average cost in such markets. This is because the perfectly competitive firm can capture the whole market, given homogeneous goods in the industry, if we assume either perfect intellectual property rights or the possibility of secrecy. A monopolist already earns some (pre-innovation) supernormal profit and just 'replaces' this profit with a small improvement. The monopolist however only sees a slight improvement in profits through the fall in costs, but already had the entire demand so sees no increase in that respect For this reason a monopolist may have less incentive to innovate and increase its profits, than a perfectly competitive firm who can move to achieve positive profits from an original position of zero profit. Arrow (1962) calls this the 'replacement effect'.

Case 2: Invention creates social benefit

The potential social benefit arising by reducing costs by cc' is equal to are ctsc'. This benefit would be possible only if the invention was made freely available. This would reduce the price to c'. The monopolist may

have to settle with lesser gains which would ultimately lead to underutilization of the invention. Any invention whose research cost is less than ctsc' would only be socially viable. A further concern is that even if monopolies do allow plentiful innovation and technological advances, their existence means that consumer welfare is not maximized. Despite the fact that some of the benefits of innovation are transferred to consumers when the monopolist expands output and lowers prices, the deadweight welfare loss (*uvs*) to consumers increases. The opportunity cost of monopoly expansion is loss of consumer welfare because the progressive monopolist limits output below the competitive level proportionately more after innovating than before.

Arrow also analyzed the situation under the assumption of moderate cost reducing invention. In this case the costs fall from c to c'.



In competition, the inventor can set a maximum royalty cc' and hence to total royalty = area cabc'

The monopolist sets MR = c' and hence the profits will be equal to area puvc'. Hence he incentive to invest will be puvc'-wxyc

Hence it is again proved that;

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Area wxyc >putc
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Area cabc'>ctvc'

Thus incentive to invent under competition would be tvba+ (wxyc-putc). Thus even small cost saving inventions are worth consideration in competition than monopoly.

Other contributions in support of Arrow's belief

Geroski (1990) has defined two further reasons why monopolies could have a negative effect on innovation. Firstly, the absence of competitive forces could reveal a behavioral disadvantage of monopolies who may relax in the knowledge that they have large current market share and high profits. Secondly, in a competitive market, more firms are searching for innovations, therefore the probability of an innovation being discovered in any time period is high. Monopoly and the presence of entry barriers may then lead to inefficiencies in innovation.

Hoppe and Lee (2000), who studied entry deterrence and innovation in monopolies for durable goods, found that the durability of a good either acts as an entry barrier itself or creates opportunities for incumbents to deter entry by limit pricing. This results in underinvestment in innovation when the incumbent chooses not to innovate. It also leads to inefficient innovation whether the incumbent chooses to innovate or not.

Concern of social welfare

A further concern is that even if monopolies do allow plentiful innovation and technological advances, their existence means that consumer welfare is not maximized. The opportunity cost of monopoly expansion is loss of consumer welfare because the progressive monopolist limits output below the competitive level proportionately more after innovating than before.

Large firms v/s small firms.

A number of counterarguments to those in favor of large firms being the most efficient innovators have also been offered in the literature. Mansfield (1968) and Mansfield et al. (1971) suggested that in large firms, where there are more people involved in decisions and there is a longer chain of command, there might be a managerial coordination inefficiency and loss of flexibility. The most frequently heard argument is that firms may become bureaucratic as they grow large. Also,

researchers may be less motivated in larger firms because they do not have as much personal benefit from their efforts as do researchers in smaller firms, and unexpected research findings may be more likely to get lost in the shuffle in a large than in a small firm.

In general, the relative strengths of small firms lie in behavioral characteristics. For instance greater motivation in management and labor, due to intertwined ownership and management, and more variation and improvisation in the tasks of workers, tacit knowledge in unique skills, more efficient communication, and flexibility.

Harold Demsetz

Arrow's analysis has been criticized by Demsetz (1969)

Demsetz criticizes Arrow on two counts. First, "Arrow's inventor not only produces an invention but, in addition, he possesses the monopoly power to discriminate in the royalty charges he sets for the two industries". This criticism may be dismissed out of hand. The two industries (monopolistic and competitive) postulated by Arrow do not exist simultaneously. They are mutually exclusive hypothetical alternatives. What Arrow tries to show is that incentive to invent under competition is greater than it would be if the industry were monopolized. Moreover, under Arrow's assumptions, the monopolist himself only can innovate. Hence there is no question of a royalty charge in the case of monopoly.

Demsetz's second and more interesting criticism is that, in discussing the incentive to invent, we must isolate the normal restrictive effect of monopoly on output. Hence he defines MR in Figure 1 to be the demand curve facing the competitive industry, and the demand curve of the monopolist remains the same, i.e., D. Then, for any given constant unit cost, both the monopoly and the competitive industries will produce the same rate of output. In this case, the incentive to invent in the monopoly industry is p'c'xy - pcut, whilst that for the competitive industry is p'c'wv, which is proved to be smaller for the linear case.



Demsetz then concludes that "the incentive to invention is just the reverse of what Arrow concluded. It seems to me that Demsetz's method

of isolating the restrictive effect of monopoly on output is questionable. The pre-invention output levels of competition and monopoly are equalized, but the post-invention levels are not; the monopoly output (p'y) is twice that of the competition output (p'v). This causes a bias in favor of monopoly. In fact, Demsetz is able to show that the incentive to invent is higher under monopoly than under competition precisely because the post-invention output is greater under monopoly. If both the pre-invention and post-invention output levels are equalized, Arrow's conclusion that the incentive to invent is smaller under monopoly is valid.

Demsetz analysis seems to be more correct but Arrow's seems to be practically useful. According to Arrow, in a given industry a move form monopoly to competition, will lead only to static welfare gains in terms of increasing output, but also greater incentives of invention. This ground provides an argument in favor of competition policy.

Summary

The overall effect of market structure on innovation is complex. Theory has generally supported Schumpeter's hypotheses. The empirical evidence in favor of Schumpeterian innovation dynamics, on the other hand, is weak. The relationship most likely depends on the characteristics of the industry under consideration (particularly the number of firms in the market and the level and availability of technology). Geroski(1990) has stated that the role of rivalry in stimulating innovation is considerable but is nowhere near as important as that of technological opportunity. Monopolists are capable of doing this due to higher profits and the ability to feed off past innovations. The benefits are offset by the possible negative effects of social welfare loss to consumers and the squeezing out of competitors; problems that are avoided in a competitive market. Institutions and government policy are significant. Technological change and productivity growth has been known to occur more freely when the government sets a favorable climate for change.

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