



Effects of Firm Size and Market Structures in Technological Innovation: A Review of Literature

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Abstract

This paper reviews the literature dealing with the effects of market structure and firm size on firm technological innovation. Numerous empirical studies have been conducted to investigate whether monopolies or competitive markets influenced the firms' need to actively innovate and improve productivity and product quality. The overall evidence is best characterized as mixed as the results are regarding to the importance of competition, firm size, investment climate, and countries considered (developed and developing). The growth of economies depends on the growth and survival of industries and firms. If you analyze national or multinational economies, industry competition, or company management, 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.

Keywords: firm size, innovation, competition and industries

Introduction

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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 more technology means being able to produce more output with a given amount of inputs.

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. And, if you are an economist you are bound to be curious to know which of these two ways has been more important - and how much more important

Technology turns out to have a very important role to play in overcoming the limitations imposed by diminishing returns to labour and capital. At many points in history, some suggestions have been pronounced based on the idea that scarcities in one input or another (land, oil, people) will bring economic growth to a grinding halt. These propositions have been disproven so far mostly 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.

Theory

The relationship between market structures and innovation has motivated a voluminous empirical literature focusing on both developed and developing countries. Uncertainty exists over which market structures provide the most supportive environment for innovation and technological progress. The theoretical debate focuses on the polar opposite market structures - monopoly and perfect, or near perfect, competition. Schumpeter (1976) realised, however,

that there is little practical relevance in studying perfect competition, it being an idealised concept. A comparison of innovation in monopolies and competitive oligopolies would yield more meaningful results.

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, Commercial Bank of Zimbabwe in the Zimbabwean banking sector being just one example. There have been various arguments for and against the proposition that monopolies provide greater incentives to innovate than competitive oligopolies. A striking feature of the debate is the lack of consensus on basic issues.

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." How to create a balance between what society gains from Schumpeterian innovation and what it loses through high pricing and restrictions of output is a recurrent issue in the economics of antitrust enforcement. (Bhaskar Sastry, 2005)

Theory shows that market power can stimulate technological progress because firms innovate on the expectation of receiving monopoly rents. Thus, Philippe

Aghion and his co-authors build on F. M. Scherer's inverted-U relationship where competition has a positive effect on innovation up to an inflexion point after which its effect decreases (Bhaskar Sastry, 2005). Where rivals are close—in “neck-and-neck” industries—competition always increases innovation, but in “unlevelled industries” characterized by technology gaps competition may reduce incentives to innovate if laggards expect a reduction in their post-entry rents.

Literature survey of empirical studies

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 utilise these capabilities to innovate. For example, Blundell et al (1999) found in an analysis of British manufacturing firms that the monopolist's large size resulted in higher investment in research and development.

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 behaviour. When barriers to entry are low or non-existent, monopolists usually try to innovate rapidly to retain their market

share and high profits. Etro (2006a) has shown that in a market where entry is free but a firm has leadership, the firm will act more aggressively than any firm in a competitive market. 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. One estimate suggests that for a new firm to enter a monopoly-dominated industry, it would require assets greater than 40% of an industry's value (Parente and Prescott 1999), which could only discourage potential entrants from entering the market.

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. Etro (2006b) finds, however, that this assumes that strategic investment by leaders will make potential entrants less aggressive. They can also react more aggressively and the outcome then is unclear. In the long-run, potential entrants should be able to invest in new technologies and innovate on a smaller scale. 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 (Bhaskar Sastry, 2005).

Etro (2004) has viewed monopoly innovation favourably showing that the innovative process is naturally connected to the persistence of monopolies. Their investment in research and development would be beneficial to society as they advance new technologies. Hausman (1998) has earlier argued that the actions of monopolies with regards to price discrimination, particularly third-degree price discrimination, may not always be at the expense of consumers. Monopolies are capable of opening new markets, achieving economies of scale and higher efficiency and, importantly, increasing net social welfare.

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 organisational 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 (Bhaskar Sastry, 2005).

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 optimising 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 (Aghion et al 2002). 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.

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 behavioural 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.

A further concern is that even if monopolies do allow plentiful innovation and technological advances, their existence means that consumer welfare is not maximised. This contradicts the evidence provided by Hausman (1988) and Etro (2004), amongst others. In a recent paper, it has been shown that the social welfare benefits of innovation are illusory because these are captured by the monopolist as extra profits (Reksulak et al 2005). 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 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.

A number of counterarguments to those in favour of large firms being the most efficient innovators have also been offered in the literature. A firm already in possession of monopoly power may be less motivated to innovate because it feels less threatened by rivals (Scherer, 1980), or because sales of new products may be at the expense of the sales from existing products. 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 behavioural characteristics. For instance greater motivation in management and labour, 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 (Nooteboom, 1994; Rothwell and Dodgson, 1994).

There are also other characteristics of small and large firms, which may represent an advantage as well as a disadvantage. For instance while the presence of fewer hierarchical layers in smaller firms may on the one hand reduce bureaucracy, increase flexibility and result in less filtering of proposals, it also limits career opportunities for their employees. Less filtering of proposals can result in very original ventures, or a fatal lack of opposition to misapprehensions. Or while craftsmanship may yield unique or scarce competencies, it can also result in a lack of attention for marketing and financial planning.

Most empirical findings suggest that small and medium-sized firms, rather than large firms, conduct R&D more efficiently. Also small firms and independent inventors are disproportionately responsible for significant innovations (Audretsch, 1990; 1991). This is in close agreement with the conclusion by Vossen (1996) that smaller firms are more profit/cost efficient in innovation. There are however other, complementary explanations for the empirical finding that small firms have much more innovative output than one would expect on the basis of their innovative input. First, small firm R&D tends to be underestimated in many standard surveys, because mainly formal R&D, conducted in separate R&D departments is measured (Kleinknecht and Reijnen, 1991). Moreover, studies of the different components of innovation costs indicate that larger firms have higher shares of R&D in total innovation costs than

smaller firms (Archibugi, Evangelista and Simonetti, 1995), so that independently from the way it is measured, R&D would underestimate the innovative input of smaller firms. Second, the results of Feldman (1994) indicate that small firms more effectively take advantage of knowledge spillovers from corporate R&D laboratories and universities. And third, the economic value of innovations may differ between smaller and larger firms, as suggested by Cohen and Klepper (1992), who find theoretically that under certain stochastic conditions, larger firms will produce fewer innovations per dollar spent on R&D, but their innovations will be on average of a higher quality.

From the stylized fact that smaller firms produce more innovations than one would expect on the basis of their input, Zenger (1994) concludes that apparently organizational diseconomies of scale outweigh the technological economies of scale in R&D. The aforementioned explanations and the organizational characteristics related to size mentioned in the last paragraph suggest however, that it is not either small firms or large firms which are the better innovators per ser.

Instead, small and large firms are probably good at different types of innovation, or their roles vary over the industry cycle in a "dynamic complementary" (Nooteboom, 1994). Large firms are probably better at the kind of innovations that make use of economies of scale and scope, or require large teams of specialists, such as fundamental, science based innovations and large scale applications, which are probably also the innovations with higher average economic value (Klepper, 1992). Small firms are likely to be relatively strong in innovations where effects of scale are not (yet) important and where they can make use of their flexibility and proximity to market demand, such as new products or product market combinations, modifications to existing products for niche markets, and small-scale applications. Moreover, the small firms' efficiency in producing these kinds of innovations is enhanced by their ability to take

advantage of knowledge spillovers from large firms' corporate R&D departments (Cf. Acs, Audretsch and Feldman, 1994).

Conclusions

This paper provides an extensive survey of the literature on the effects of market structures and firm size on the ability of a firm to innovate, examining both the theory that underlies the work in this area and the results of empirical studies published since 1911. Overall, a larger number of studies appear to favour the conventional Schumpeterian findings that monopolies have positive effect on innovation. But the results on the firm size are still not conclusive.

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