

# **The Impact of Firm Size on Innovative Activity: An Analysis Based on Egyptian Firm Data**

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**Abstract**

The paper examines the relationship between the innovation activity and the firm size. This research administers a questionnaire-based survey developed from the UK Innovation Survey (CIS). The survey covers quantitative and qualitative information addressing the innovation activities in the small and medium sized firms in Egypt during the period 2010-2012. The sample covers manufacturing firms in different regions in Egypt such as north, middle and Upper Egypt as well. The paper uses a logit model to study the relationship between the innovation activity and firm size and an ordered logit model to study the relationship between the sources of innovation and performance. This paper demonstrates there is a positive relationship between size firm and innovation. The main policy implications of these results are that innovation policies should explicitly identify their major objective and target group of firms.

**Keywords:** Innovation Activity, Egyptian SMEs, Firm Size

**JEL Classification:** O31, O32

## 1. Introduction

Mansfield (1968) argues that innovation is the key stage in the process leading to the full evaluation and utilisation of an invention or the creation of a new type of industrial organization. In fact, Schumpeter identified five forms of innovation (Deakins and Freel, 2003): the introduction of a new good, the introduction of a new method of production, the opening of a new market, the conquest of a new source of supply of raw materials, as well as new forms of organisation.

In a series of important papers, Von Hippel (1974, 1976) has described the concept of “sticky knowledge” and how problem solving efforts in innovation are concentrated upon inter-firm relations where knowledge is “sticky” (i.e. costly to transfer between firms). In this type of innovative process, the locus of problem solving lies within a process of interaction with customers who become a primary source of information. Symmetrically, it might be expected that process innovations on the other hand will frequently depend upon product innovation and differentiation in the supplying industry. The role of equipment investment may be particularly important in this regard, with both knowledge generation and human capital formation an outcome of equipment investment activity.

Why should small firms differ from larger firms both in the decision to commit resources to innovation and in the process itself? There are many possible differences between small firms and large firms in their role as innovators, Storey (1994) argues that the ability of smaller firm to provide something marginally different, in terms of service or good, which distinguishes it from other goods or services provided by larger firms. If this is the case, differentiation and specialization in product characteristic space may be the source of a relative advantage for small firms, i.e. in product as opposed to process innovation (see for example Hoffman *et al*, 1998). Management texts frequently draw

attention to organisational differences, especially in the relative merits of flexibility against routine. The following table (drawn from Deakins and Freel 2003) is suggestive of the advantages and disadvantages of small firms in innovation activities.

**Table 1 Advantages and disadvantages of small firms in innovation**

Advantages	Disadvantages
Potential for growth through differentiation strategies	Difficulties accessing finance for growth
Government schemes established to facilitate small firm innovation	High transaction costs involved in accessing schemes
Some regulations are applied less rigorously to small firms	The relative unit cost of regulatory compliance is higher for small firms
Lack of bureaucracy; greater risk acceptance; rapid decision-making	Lack of formal management skills
Suffer less from routinisation	Suffer more from uncertainties and associated costs
Flat management structures and local project ownership are likely	High staff turnover, little formal training
Flexibility and rapid-decision-making may make firms attractive partners	Firms suffer from power asymmetries in collaboration with larger partners
Nearness to market ensures fast reaction to changing market requirements	Little or no market power, poor distributions and serving facilities
Efficient and informal internal communication facilities rapid internal problem solving	Lack of time and resources to forge external technological linkages

Source: Deakins and Freel 2003

Of course, in economics, Schumpeter's (1942) hypothesis regarding the relationship between size, market power and innovation has been extensively investigated since Schumpeter(1942), the idea that size may confer some advantage on firms deploying resources in order to innovate has provided a staple for over forty years in the empirical literature. Schumpeter's original ideas embraced both the impact of size per se as well as the impact of market structure, i.e. that market power- *ex ante*- was more conducive to

innovation than competition. At least the promise of *ex-post* market power is of course generally regarded as a condition for innovation.

The advantages relating to firm size are generally recognised as consisting of some or all of the following (see e.g. Simeonidis, 2001; Cohen, 1995):

- The fixed costs and economies of scale associated with the innovation process requiring large sales volume,
- Potential for economies of scope,
- Access to external finance,
- Risk diversification,
- Insofar as large size is associated with market power, large firms may be better able to appropriate returns from innovation.

Note that the first four of these amount to capital market imperfections. There are however some counter-arguments. Simeonidis in particular notes the possibility of control loss in large bureaucratic organisations, echoing the management literature cited above. Empirical evidence on the role of size per se on innovation is rather mixed, and has been dogged by both econometric and by measurement issues. The focus on R&D expenditures or employment- at best an input into the innovation process- may of course bias the results in favour of large firms that have formal R&D departments and against smaller firms who may have individuals who are performing similar roles but are not so classified. Patents on the other hand vary considerably in their use-both though time and according to the so called “appropriability conditions”- across industries. Precisely because of the continuing debate about the measurement of inputs and outputs relating to innovation, surveys such as the Community Innovation Survey (CIS) may be extremely valuable in extending our knowledge.

This paper aims to study the relationship between firm size and innovation in Egyptian Small and Medium Sized Firms.

This paper is organised as follows. The next section discusses the literature review. Section 3 presents data collection. Section 4 introduces the methodology. Section 5 concludes.

## 2. Literature Review

In his theory of *Economic Development* (1912) and in *Capitalism, Socialism and Democracy* (1942) Schumpeter proposed two major alternative patterns in innovative activities (Malerba&Orsenigo, 1995). The first one, labelled as Schumpeter Mark I or “creative destruction” (see, Breschiet *al*, 2000), is proposed in the earlier theory of *Economic Development*, 1912. In this work, Schumpeter examined the typical European industrial structure of the late nineteenth century characterised by many small firms. According to this view, the pattern of innovative activity is characterised by technological ease of entry in an industry and by a major role played by new firms in innovative activities. Breschiet *al* (2000) argues that firms introduce this kind of innovation did not innovate before: it is called “widening”.

The second one, labelled Schumpeter Mark II or “creative accumulation” (see, Malerba&Orsenigo, 1995; Breschiet *al*, 2000), is proposed in *Capitalism, Socialism and Democracy*, 1942. In this later work Schumpeter discussed the relevance of the industrial R&D for technological innovation and the key role of large firms. According to this view, the pattern of innovative activity is characterised by the prevalence of large firms who innovate on a more routine basis. Breschiet *al* (2000) call this “deepening”. Schumpeter Mark II hypothesis regarding the relationship between size and innovation has been investigated many times in the years since his death. The following table identifies some of the more influential studies:

**Table 2: The relationship between innovation and firm size (empirical studies)**

Study	sample	Country	Data	Dependent Variable	Firm size	Result
Scherer (1965)	448 large industrial firms	US	Cross section	Patents issued in 1959	3 measures of firm size for 1955	Patents increase with firm sales but at less than proportionate rate
Scherer (1984)	196 industries	US	Cross section	Patents counts	US industries	In more than half of these industries, patents increase with industry sales but at less than proportionate rate
Pavitt et al (1987)	4378 innovations 1945-1983	UK	Cross section	4378 significant innovations	UK employment	The relationship between innovative activity and firm size may well be increasingly U shaped.
Audretch and Acs(1991)	732 large firms	US	Cross section	Number of innovations	Firms with more than 500 employees	Innovations increased less than proportionately with firm size
Cohen and Klepper(1994)	196 industrial	US	Cross section	R&D expenditure	US industries	A positive and statistically significant impact of business unit size on R&D expenditure
Arvanitis (1997)	2-digit industries	Swiss	Cross section	R&D expenditure	Swiss employment	Small firms can innovate without noticeable disadvantages
Boasm and De Wit (2004)	66 industries	Netherlands	Cross section	Product innovation	Dutch employment	There is a positive relationship between product innovation and firm size

It can be seen from Table 2 that some studies have indeed found a positive relationship between firm size and technological change (Scherer, 1965, 1984). On the other hand, there are some studies have identified no relationship or even a negative one (Cohen and Klepper, 1994). Audretch and Acs(1991) argue that there are two main reasons for these inconsistent findings. The first is that different measures have been used to quantify technical change (e.g. patents, R&D). The second reason is that most studies examining the relationship between firm size and technical change has had to use a truncated distribution of firm sizes where either no or few small firms were included.

### 3. Data

The questionnaire was administered during August 2014. The data for this paper was collected using a standardized questionnaire. 100 questionnaires were distributed to small and medium sized firms in several cities in Egypt. The total response was 70 useable replies. The response rate of 70% was reasonable. The questionnaire contained 7 questions. The first three questions concerning financial data about the firms such as turnover, exports and capital. Question 4 asked about the number of employees .Firms are asked- in Question 5 to specify their market on a scale of 1-4 (1=local,2= regional, 3=national, or 4=international. Questions 6 and 7 focused on product and process innovation as question 6 asked if the firm has introduced a product which is new to the firm while question 7 asked if the firm has introduced a process which is new to the firm. According to question 6, a product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems.

- Product innovations (new or improved) must be new to your enterprise, but they do not need to be new to your market.
- Product innovations could have been originally developed by your enterprise or by other enterprises or institutions.

According to question7, a process innovation is the implementation of a new or significantly improved production process, distribution method, or supporting activity.

- Process innovations must be new to your enterprise, but they do not need to be new to your market.
- The innovation could have been originally developed by your enterprise or by other enterprises or institutions.

The answer of Questions 6 or 7 treated as a dummy variable takes 1 if the firm introduced new product or process and 0 if not.



#### 4. Methodology

In this section I present my model which builds on the model of Scherer (1965), Audretsch and Acs (1991) and Roges (2004). Scherer (1965) studied the relationship between the patenting and sales, using the following equation to identify the relationship between innovation and firm size:

$$P_i = \alpha_1 + \alpha_2 S_i + \alpha_3 S_i^2 + \alpha_4 S_i^3 + u_i \quad (1)$$

Where  $P$  is patents and  $S$  is sales.

Scherer (1965) found a positive relationship between the patents and sales. Audretsch and Acs (1991) used the same model but they used the number of innovations as a dependent variable instead of patents but they also found a positive relationship between the innovation numbers and sales.

Roges (2004), used a probit model to study the relationship between the innovation activity and the firm size. The author found a positive relationship between the innovation activity and size.

In this section the model of Scherer (1965), Audretsch and Acs (1991) and Roges (2004) are developed, using logit model to study the relationship between the innovation activity and sales.

The following equation will be estimated

$$IA_i = \alpha_1 + \alpha_2 TU_i + \alpha_3 TU_i^2 + \alpha_4 TU_i^3 + u_i \quad (2)$$

From equation (2) it can be seen that the innovation activity can be used as a dependent variable (this is a dummy variable which has value 1 if the firm has engaged in any innovation activity or 0 otherwise (King et al, 2005)). On the other hand the turnover ( $TU$ ) can be used as independent variable. Moreover, variables as control for unobserved heterogeneity such as regional dummies and market size dummies can also be used. the Scherer (1965) model which allows for non-linear impact of size on innovation is used here.

When *IA* is regressed non-linear on *TU*, the second derivative  $\frac{d^2 AI}{dTU^2}$  of the estimated function expected to be positive, *AI* is increasing at an increasing rate with *TU*, and so innovation activity must generally be increasing more than proportionately with turnover. A negative second derivative implies the opposite relationship.

**Table 3 Innovation Activity**

Depended Variable (IA)	Coeff	S.error	sig
<u>Explanatory Variables</u>			
TU*1000	0.024	0.012	***
TU*(1000) <sup>2</sup>	-0.031	0.001	***
TU*(1000) <sup>3</sup>	0.001	0.000	***
Market dummies	Yes		**
Regional dummies	Yes		**
No of observation	70		
Wald test chi <sup>2</sup>	210.3		
Pseudo R <sup>2</sup>	0.83		***
***= significant at 1%			
**= significant at 5%			
*= significant at 10%			

From Table 3 it can be seen that the relationship between the innovation activity and turnover is positive and significant at 1%. (The innovation activity is a dummy variable indicating whether enterprise undertakes innovation activity.(Questions 6 and 7 in the questioner actually answer this question). This result supports the Schumpeterian hypothesis about the positive relationship between the innovation and firm size. It can be seen that the coefficient of the squared turnover (*TU*) is negative and this means that the innovation activity increases at a decreasing rate with *TU*. However the presence of a significant and positive term in the cube of the turnover means that the relationship may be more complex. Moreover, the market and regional dummies are positive and significant at 5%.

## **5. Conclusions**

The paper examines the relationship between the innovation activity and the firm size. This research administers a questionnaire- based survey developed from the UK Innovation Survey (CIS). The survey covers quantitative and qualitative information addressing the innovation activities in the small and medium sized firms in Egypt during the period 2010-2012. The sample covers manufacturing firms in different regions in Egypt such as north, middle and Upper Egypt as well.

This paper has found that there is a positive relationship between the size firm and innovation. The chief conclusion concerns the results provide solid evidence on of the innovation-firm size issue and the patterns emerging across firm size in Egyptian manufacturing small firms.

Moreover, our study has suggested improvements in the econometric techniques that are most appropriate to detect whether turnover has an effect on the innovation activity of both product and process innovations.

The main policy implications of these results are that innovation policies should explicitly identify their major objective and target group of firms. Efforts for stimulating new products should favour the strategies of market expansion by firms, through, for instance, an expansionary demand policy, organisation of new markets and targeted procurement. At the same time, when innovation in small and medium sized firms is targeted, the effectiveness shown by patenting in the introduction of new products suggests a strong policy potential of actions stimulating research and invention efforts by SMEs.

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