Entrepreneurship Capital, Output and Growth in Iran's Manufacturing Industries

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Abstract
The objective of this article is to examine the impact of entrepreneurship on the performance of Iran's manufacturing industries using time series data over the period 1974-2006. More specifically, entrepreneurship capital measures are calculated and included in the production function of manufacturing industries using a specification of the Cobb-Douglas functional form as a basis for analyzing growth determinants. To evaluate this, two alternative measures of entrepreneurship capital are considered. They comprise self-employments and enterprises that hire labor force.

Cointegration analysis of time series approach is carried out to examine the factors affecting output and growth in manufacturing industries with an emphasis on entrepreneurship indicators. To understand the current state of entrepreneurship and economic situation of the country, a comprehensive review of pertinent statistics related to entrepreneurship, output and growth is examined to find major stylized facts in the economy.

The findings of this paper indicate that entrepreneurship capital is a significant and important factor shaping output and growth in Iran's manufacturing industries. The results confirm that enterprises measure of entrepreneurship has positive and significant impacts on output in both the long run and short run. Therefore, the evidence from this paper points to an additional factor - entrepreneurship capital - that also plays an important role in the production function and growth model in this sector. These results suggest a new direction for policy that focuses on instruments to enhance entrepreneurship capital. It may be that policies focusing on enhancing entrepreneurship capital can prove to be more effective than those targeting the more traditional factors such as capital and labor.

Keywords: Entrepreneurship; Manufacturing Industries; Endogenous Growth Model; Time Series; Iran

JEL Classification: O14; L26; C32; O53

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1. Introduction

The role of entrepreneurship on economic growth began with the ideas of Adam Smith (1776) whose overriding goal was to understand the wealth-creation process whereas division of labor is limited by the extent of the market. However, entrepreneurship has not played a central role in economic theory. Traditionally, the economic output of a country is seen as a function of capital and labor inputs. Solow (1956) introduces production function in which economic output is a function of the sum of labor and capital inputs, and the level of technological progress. In the Solow model, the growth rate is completely determined by advances in knowledge or the technological progress determined exogenously. In this model of economic growth, investment in capital, labor and technology is sufficient to realize economic growth. Consequently, this growth model failed to explain the origins of growth as technological change remained exogenous to the economic context. Endogenous growth theory solved this issue by including mechanisms that link human capital to the creation of new technologies so that technological progress is no longer determined outside the model but, rather, it is determined by the characteristics of the economy described by the model (Jovanovic and Rob, 1989 and Romer, 1990). Nelson and Pack (1999) point out that the new models of economic growth see these investments as a necessary complement to entrepreneurship, but not as a sufficient explanation for economic growth.

However, the last two decades have witnessed a wealth of studies analyzing entrepreneurship in growth model. The consequences of entrepreneurship, in terms of economic performance, have generated an extensive literature. However, this literature has generally been restricted to two units of observations – that of the establishment of firm, and that of the region. More specifically, a large literature has emerged analyzing the impact of entrepreneurship on economic performance at the level of the firm. These studies typically measure economic performance in terms of firm growth and survival (Audretsch, 1995; Caves, 1998 and Sutton, 1997). A small literature exists linking measures of entrepreneurial activity to the performance of sectors and aggregate economies. In addition, this literature is mainly based on developed economies rather than developing economies. Noticeably absent are studies linking the impact of entrepreneurship on performance for the unit of observation of sectors and aggregate economies.

Empirical studies on the role of entrepreneurship in economic growth show mixed evidence since there is much heterogeneity in both the types of entrepreneurship and the kinds of economic contexts in which economic growth takes place. Divergent findings about the relationship between the degree of entrepreneurial activity and output and economic growth posed something of a puzzle. The empirical analyses suggest that entrepreneurship have an effect

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2Base on the literature, entrepreneurship has at least two meanings. First, entrepreneurship refers to owning and managing a business. This is the occupational notion of entrepreneurship. Within this concept of entrepreneurship, a dynamic perspective focuses on the creation of new businesses, while a static perspective relates to the number of businesses owners. Second, entrepreneurship refers to entrepreneurial behavior in the sense of seizing an economic opportunity. This is the behavioral notion of entrepreneurship. Entrepreneurs in the behavioral sense need not be business owners. At the crossroads of behavioral entrepreneurship and the dynamic perspective of occupational entrepreneurship, a new focus has arisen that considers new venture creation as the hallmark of entrepreneurship (Acs, 2007, p. 17). In this study I use the operational definition of entrepreneurship: the entrepreneur is someone who specializes in taking judgmental decisions about the coordination of scarce resources.
on economic growth differently in low income countries and high income countries. So, it is important to examine this relationship in Iran as a developing country.

The objective of this article is to examine the impacts of entrepreneurship on the performance of Iran's manufacturing industries using time series data over the period 1974-2006. More specifically, entrepreneurship capital measures are included in the production function of manufacturing industries using a specification of the Cobb-Douglas functional form as a basis for analyzing growth. To evaluate this, two alternative measures of entrepreneurship are considered. They comprise self-employments and businesses which hire labor force. Cointegration analysis of time series approach is carried out to examine the factors affecting output and growth in manufacturing industries with an emphasis on entrepreneurship indicators. To understand the current state of entrepreneurship and economic situation of the country, a comprehensive review of pertinent statistics related to entrepreneurship, output and growth is examined to find major stylized facts in the economy.

The next section reviews literature. The section that follows it describes main stylized facts of the economy focusing on manufacturing industry. Section four introduce methodology and empirical model and explains the data, including key explanatory variables and control variables Section five presents empirical results. Section six presents discussion and finally, section seven presents conclusion and policy implication.

2. Theory and empirical evidence

This section reviews comprehensively theoretical and empirical literature related to the role of entrepreneurship and economic growth. The role of entrepreneurship on economic growth began with the ideas of Adam Smith (1776) whose overriding goal was to understand the wealth-creation process whereas division of labor is limited by the extent of the market. However, entrepreneurship has not played a central role in economic theory. A major leap forward in understanding growth stems from the work by Solow (1956) and Swan (1956). They proposed a general equilibrium solution to growth, based on an aggregate production function exhibiting traditional properties (constant returns to scale, substitutability among production factors, etc.). Solow (1956) introduces production function in which economic output is a function of the sum of labor and capital inputs, and the level of technological progress. In the Solow model, the growth rate is completely determined by advances in knowledge or the technological progress determined exogenously. In this model of economic growth, investment in capital, labor and technology is sufficient to realize economic growth. The Solow’s (1957) production function is specified as follows.

\[ Y = K^α (AL)^{1-α} \]  

(1)

where Y represents output, K is the stock of capital, L is labor force and A is the stock of knowledge capital. The capital accumulation function of Solow model is \( \dot{K} = sY - δK \) where s is saving rate and δ is the depreciation rate of capital.

One of the reasons that entrepreneurship disappeared from economic theory is that it played no role in the neoclassical growth model as developed by Solow (1970). An important characteristic of this growth model is that technological improvements are exogenous and therefore independent of economic incentives. Consequently, this growth model failed to explain the origins of growth as technological change remained exogenous to the economic context.
Endogenous growth theory solved this issue by including mechanisms that link human capital to the creation of new technologies so that technological progress is no longer determined outside the model but, rather, it is determined by the characteristics of the economy described by the model (Jovanovic and Rob, 1989 and Romer, 1990).

According to Mincer (1974), an additional year of schooling or an additional year of experience should increase wages proportionally. That is, the relationship between wages and schooling or experience is a semi-log form. Bils and Klenow (1996) emphasize this microeconomic regularity in building a model of human capital and growth. Barro and Lee (1993) introduce human capital in growth model. This can be shown as follows:

\[
Y = K^a H^b (AL)^{1-a-b}
\]

The entrepreneur still does not exist in the Solow model. Romer (1986) critiques the Solow approach. The first wave of endogenous growth models (Romer 1986, Lucas 1988, Rebelo 1991, and others) emphasize the influence of knowledge spillovers on growth without specifying how knowledge spills over. Romer along with Lucas and others argue that knowledge is an important factor of production, along with the traditional factors of labor and capital, but because it is endogenously determined as a result of externalities and spillovers, it is particularly important. A unifying character of these models, which also distinguishes them fundamentally from the Solow model, is that knowledge is modeled as being endogenous. Growth is generated by investments in knowledge and the models outline the determinants of investment decisions in knowledge. However, there is no explicit entrepreneur in Romer (1986, 1990) and Lucas (1988).

New models of economic growth see these investments as a necessary complement to entrepreneurship, but not as a sufficient explanation for economic growth in its own right (Nelson and Pack 1999). As points out by Romer (1990), since the growth rate of knowledge is exogenously given, growth is modeled by assuming its existence. Economic growth in the traditional growth models is achieved by capital accumulation and exogenous technological progress, both of which leave little room for any entrepreneurial role whatsoever (see, for example, Baumol, 1968).

The more recently developed endogenous growth models also support the idea that improvements in technology have been the key force behind perpetually rising standards of living. This has generated the development of endogenous growth models. Furthermore, Lucas (1988) differentiated between physical and human capital. This implies that the relative importance of capital could be substantially more important than acknowledged by the Solow model, especially if there are positive externalities in human capital accumulation. While there are different types and sources of technology or knowledge, such as basic scientific research, R&D, innovation or learning by doing, the entrepreneur does not hold an explicit position in endogenous growth models such as Romer (1986, 1990) and Lucas (1988).

Throughout history, the entrepreneur has worn many faces and fulfilled many roles (Hébert and Link, 1989). There are three entrepreneurial roles in the literature, emphasized by Schumpeter, Kirzner and Knight. A first is the role of innovator. Schumpeter (1942) is the economist who has most prominently drawn attention to the innovating entrepreneur. He carries out new combinations called enterprise. The individuals whose function it is to carry them out called entrepreneurs (Schumpeter 1934, p. 74). Schumpeter points out that entrepreneurship occurs when there is innovation in the introduction of a new product, organization or process. In Schumpeter’s point of view, the function of the entrepreneur consists of the recognition and
realization of new economic opportunities. Opportunities are not just potential products but also potential production processes and opportunities in marketing. Schumpeter's emphasis on innovation implies that risk and uncertainty are implicitly part of entrepreneurial opportunity. Yu (1997) concludes that Schumpeter's objections to the orthodox system relate to the use of equilibrium models and static analysis as well as the assumptions of rational behavior and profit maximization.

A second is the role of perceiving profit opportunities. This role is labeled as Kirznerian (or neo-Austrian) entrepreneurship (see, for instance, Kirzner, 1997). The peculiar characteristic of the Austrian entrepreneur is the ability to perceive profit opportunities. Kirzner (1973) depicts entrepreneurs as people who are alert enough to spot previously unseen profit opportunities and then act on them. He suggests that the connection between entrepreneurship and economic growth is founded on the entrepreneur spotting and profiting from a situation of disequilibrium by improving on market inefficiencies or deficiencies. For instance, those with training in mechanical engineering are more likely to spot potential profit opportunities in the design of internal combustion engines than those with training in law.

In this regard, Holcombe (1998) argues that these opportunities must come from somewhere, namely the insights of other entrepreneurs. Entrepreneurship creates changes, and changes lead to more opportunities for entrepreneurship. Thus, entrepreneurship generates more entrepreneurship. The discovery exploitation matrix gives us four ways in which to exploit an opportunity, depending on the individual's desire to exploit the opportunity on behalf of someone else. The four options are new firm formation, corporate venturing, acquisition, and finally a spin-off (Shane, 2003). The individual needs to make a decision to use a market, an existing firm, or a new venture.

A third is the role of assuming the risk associated with uncertainty. This role is labeled as Knightian entrepreneurship. When an individual introduces a new product or starts a new firm, this can be interpreted as an entrepreneurial act in terms of each of the three types of entrepreneurship. The individual is an innovator and has perceived a till then unnoticed profit opportunity and he takes the risk that the product or venture may turn out to be a failure. Arrow (1962) argues that new knowledge is intrinsically uncertain in its potential economic value. Therefore, transforming generally available new economic knowledge into viable new products or technologies requires investments with uncertain outcomes. This links to Knight (1921) who distinguishes this incalculable uncertainty from calculable risks. Knight argues that the entrepreneur is the economic functionary who undertakes the responsibility of dealing with uncertainty. Uncertainty is also a cornerstone of Kirzner's theory of entrepreneurial opportunities. In fact, according to Kirzner (1997), discovery of entrepreneurial opportunities requires vision and alertness. Holcombe (1998, p. 60) claims that the engine of economic growth is entrepreneurship. He has extended Kirzner's theory by linking present entrepreneurial opportunities to past entrepreneurial behavior.

This long-term growth process is assumed in many endogenous growth models to be determined by purposive and profit-seeking investment in knowledge (Grossman and Helpman (1994, p. 24)). The act of seeking profits by shifting resources to achieve improvements in technology can be seen as an entrepreneurial act because the outcome of the investments is uncertain. However, it is not common for endogenous growth models to explicitly address the issue of entrepreneurship as a driving force of technological and economic development.

Wennekers and Thurik (1999) attribute economic growth through entrepreneurship to three main processes or entrepreneurial activities, enhanced competition, innovations, and employment
growth through firm start-ups. The knowledge spillover theory of entrepreneurship posits that entrepreneurial opportunities emerge from a society’s investment in human capital, research and development (Audretsch et al., 2006). These investments generate knowledge that spill over and is used by other economic actors, stimulating economic vitality through the birth and growth of new firms (Agarwal et al., 2007 and Eliasson, 1996). Karlsson (2005) classify knowledge in three main categories as follows:

- Scientific knowledge such as scientific principles that can form a basis for the development of technological knowledge.
- Technological knowledge including implicit and explicit blueprints which are in the form of inventions.
- Entrepreneurial knowledge that comprises business-relevant knowledge about products, organization, markets, customers, etc.

The third category - entrepreneurial knowledge - comprises specific knowledge tied to the market and the functioning of an economy. It actually closely connects to what is required in order to introduce an innovation such as a new product, a new process, a new market, a new source of supply or a new organization (Schumpeter, 1911).

Endogenous growth theory rests on the assumption that technology-based growth is driven by investments in new knowledge (Romer, 1990). Knowledge spillover theory posits that growth is contingent on the technology dependence of industries, forming the landscape for technology entrepreneurs to launch and grow new ventures. Endogenous growth theory allows for several mechanisms for new knowledge and technologies to be transformed into economic growth. However, it does not explain how knowledge filters through from publicly available knowledge to knowledge that might be commercialized, and thus possibly spur economic growth. This is discussed by Acs et al. (2004) who specifically identify entrepreneurship as the missing link between publicly available and economically relevant knowledge. New knowledge often brings about opportunities in large firms that are left unexploited due to the uncertainty of their potential value, information asymmetries between employees and managers, the bureaucratic structure of incumbent firms, or gaps between new ideas and the perceived core competence of incumbents (Acs and Varga, 2005; Audretsch et al., 2006; Klepper and Sleeper, 2005).

In recent decades, there are extensive literature on modeling entrepreneurship and growth. The first is the Aghion and Howitt’s (1992, 1997) model of creative destruction. The second is the endogenous market structure model by Peretto (1998, 1999a, 1999b) and the third is the imitation model developed by Schmitz (1989). However, among these models, the Aghion and Howitt model has been the most influential.

Aghion and Howitt introduce the notion of Schumpeterian creative destruction into a growth model by having firms investing resources in research to achieve a new product that renders the previous product obsolete. Capital is excluded from the basic model and growth results from technological progress, being a result from competition among firms that generate innovations. Firms are motivated by temporarily the prospect of monopoly rents after a successful innovation is patented. A next innovation will again destroy these rents as the existing good is being made obsolete by the Schumpeterian entrepreneur.

Porter (1990) points out that entrepreneurship is at the heart of national advantage. Audretsch et al. (2006) introduce a production factor called entrepreneurship capital, arguing that this is related to the more general concept social capital. Entrepreneurship capital reflects a number of different legal, institutional and social factors and forces. Audretsch and Thurik (2004) have a different approach and distinguish three ways in which entrepreneurial capital affects growth (see also Audretsch, Keilbach and Lehman, 2006). The first way is by creating knowledge
spillovers. Romer (1986), Lucas (1988, 1993), and Grossman and Helpman (1991) established that knowledge spillovers help to drive economic growth. The second way in which entrepreneurship capital generates economic growth is through augmenting the number of enterprises and increasing competition. Jacobs (1969) and Porter (1990) argue that competition is more conducive to knowledge externalities than local monopolies. A third way in which entrepreneurship capital generates economic output is by providing diversity among firms (Cohen and Klepper, 1992). Not only does entrepreneurship capital generate a greater number of firms, it also increases the variety of firms in a geographic space.

Having presented the fundamental theories, I can now review empirical studies. It should be noted that this studies are mainly based on developed economies rather than developing economies. Empirical studies on the role of entrepreneurship in economic growth show mixed evidence Audretsch et al. (2002) and Carree and Thurik (1999) find that OECD countries exhibiting higher increases in entrepreneurship also have experienced greater rates of growth. In a study for the OECD, Audretsch and Thurik (2002) undertook two separate empirical analyses to identify the impact of changes in entrepreneurship on growth. Each one uses a different measure of entrepreneurship, sample of countries and specification. This provides some sense of robustness across different measures of entrepreneurship, data sets, time periods and specifications. The first analysis measures entrepreneurship in terms of the relative share of economic activity accounted for by small firms. It links changes in entrepreneurship to growth rates for a panel of 18 OECD countries spanning five years to test the hypothesis that higher rates of entrepreneurship lead to greater subsequent growth rates. The second analysis uses a measure of self-employment as an index of entrepreneurship at the country level between 1974 and 1998. The different samples including OECD countries over different time periods reach consistent results – increases in entrepreneurial activity tends to result in higher subsequent growth rates and a reduction of unemployment.

In a different study, Acs et al. (2004) and Braunerhjelm et al. (2007) find a positive relationship between entrepreneurship and growth at the country level examining 20 OECD-countries for the period 1981-2002. The impact is considerably stronger in the 1990s than in the 1980s, while the importance of R&D seems to diminish in the latter time period.

Audretsch and Fritsch (1996) use new business startups in Germany to examine whether a greater degree of turbulence leads to greater economic growth. They find that the opposite is true for Germany during 1980s. In both manufacturing and the service sectors, a high rate of turbulence in a region leads to a lower rate of growth. They conjectured that one possible explanation for the disparity in results between the U.S. and Germany may lay the role that innovative activity, and therefore the ability of new firms to ultimately displace the incumbent enterprise, plays in new-firm startups. However, Audretsch and Fritsch (2002) find that different results emerge for the 1990s. Those regions with a higher startup rate exhibit higher growth rates, which suggest that, in fact, Germany is changing over time, where the engine of growth is shifting towards entrepreneurship as a source of growth.

Stam (2008) investigate the effect of entrepreneurship on economic growth at the country level. The empirical analyses suggest that entrepreneurship does not have an effect on economic growth in low income countries, in contrast to transition and high income countries where especially growth-oriented entrepreneurship seems to contribute strongly to macroeconomic growth. The presence of growth-oriented entrepreneurs seems to be more important for achieving GDP growth than general entrepreneurship especially in transition countries.
Bunyasrie (2010) mentioned that in transition economies high growth opportunities are more widely available and hence, a higher number of growth-oriented entrepreneurs are willing to act on these opportunities may be particularly fruitful for achieving growth in these countries. In contrast, entrepreneurship in low income countries is mainly driven by necessity where self-employment is often the only occupational choice given rarity of other sources of employment (Acs and Amoros 2008 and Bosma et al. 2008). The actions of most of the entrepreneurs in low income countries are not likely to have an effect on the restructuring and diversification of the poor economies thus the rates of growth-oriented entrepreneurship is marginal in these economies. Therefore, it is expected that the level of growth-oriented entrepreneurship in a country is a more relevant driver of economic growth than the mostly used indicators of entrepreneurship like the self-employment and new firm formation. In contrast to developed countries, entrepreneurship in low income countries is mainly driven by necessity (Bosma et al. 2008). Most entrepreneurs in these economies do not start a firm because they desire independence or because they want to increase their income as compared to being an employee, which are dominant motives in rich countries. While entrepreneurs in low income countries most often start a business because they have no other way of earning a living. These entrepreneurs are not likely to be involved in a process of self-discovery. Their actions are not likely to have an effect on the restructuring and diversification of the poor economies (Rodrik, 2007).

3. Stylized facts

To understand the current state of entrepreneurship and economic situation of the country, a comprehensive review of pertinent statistics related to entrepreneurship, output and growth is examined to find major stylized facts in the economy. The manufacturing statistics are obtained from central bank of Iran’s databank. Now I start describing the growth rates of the economy and manufacturing industry, since it gives a better picture of the welfare in the society. As can be seen form Figure 1, manufacturing (GPI) and while economy (GPY) per capita growth rates are generally declining characterized along with high volatility over the period 1960-2006. Therefore, these trends show a clear cyclical pattern in the both growth rates.

The time series graph in the figure appears to reveal two distinct facts in Iran’s economic growth history. The first fact is related to the lower growth rate and the second is characterized by the higher volatility in the economic growth rate. So, this can be considered as a paradoxical picture of plenty in Iran.

Table 1 presents a comparison of descriptive statistics of the economy and manufacturing indicators over the whole and sub sample periods. This table contains the mean, maximum, minimum and standard deviation of the growth rate in the economy and the manufacturing industries sector in both aggregate and per capita. The aggregate growth rates of the economy and manufacturing sector are 2.36 and 5.61 percent per annum, respectively, over the whole period. Moreover, as can be seen from the table, standard deviation of manufacturing growth rates is obviously higher than a standard deviation of GDP growth. This means that the manufacturing sector has been even more volatile than the rest of the economy in Iran over the whole period.
Figure 1 Manufacturing (GPI) and economic (GPY) per capita growth rates in Iran: 1960-2006

\[ GPY = -0.1869T + 7.0697 \]

\[ GPI = -0.0865T + 7.934 \]

Table 1 Descriptive statistics of the growth rates in Iran: 1960-2006

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Average annual growth rate</td>
<td>GDP</td>
<td>4.93</td>
<td>11.07</td>
<td>2.57</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>8.69</td>
<td>13.65</td>
<td>6.80</td>
</tr>
<tr>
<td>per capita average annual growth rate</td>
<td>GDP</td>
<td>2.36</td>
<td>9.37</td>
<td>-0.43</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>5.61</td>
<td>9.34</td>
<td>4.01</td>
</tr>
<tr>
<td>Maximum growth rate</td>
<td>GDP</td>
<td>17.73 (1976)</td>
<td>16.29 (1972)</td>
<td>17.73 (1976)</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>30.03 (1976)</td>
<td>18.34 (1973)</td>
<td>30.03 (1976)</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>-12.89 (1979)</td>
<td>5.65 (1964)</td>
<td>-12.89 (1979)</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>-9.28 (1979)</td>
<td>2.81 (1964)</td>
<td>-9.28 (1979)</td>
</tr>
<tr>
<td>Standard deviation of growth rate</td>
<td>GDP</td>
<td>7.09</td>
<td>3.60</td>
<td>7.11</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>8.95</td>
<td>3.78</td>
<td>10.06</td>
</tr>
<tr>
<td>Standard deviation of per capita growth rate</td>
<td>GDP</td>
<td>6.82</td>
<td>3.42</td>
<td>6.21</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Sector</td>
<td>7.28</td>
<td>4.15</td>
<td>8.00</td>
</tr>
</tbody>
</table>

Notes:
- Per capita are calculated by dividing workers.
- The number in the bracket represents the date.
Since the 1970s, changes in the price of oil have been an important source of economic fluctuations, as well as a paradigm of a global shock, likely to affect many macroeconomic indicators in Iran. More specifically, this process has resulted in the lower growth and higher inflation characterized every resource-based economy after the mid 1970s.

Following the simplified way of the Rostow’s looking\(^3\) at the development of modern economies, Porter (2002) has provided a modern interpretation of this approach by identifying three stages of development: (1) a factor-driven stage, (2) an efficiency-driven stage and (3) an innovation-driven stage. This can be seen from Figure 2. Zoltan, Acs and Szerb (2009) point out that the factor-driven stage is marked by high rates of agricultural self-employment. Entrepreneurship in factor-driven economies may be desirable, more basic requirements such as primary education are necessary and should have priority, as entrepreneurship is unlikely to contribute substantial improvements in wealth creation if basic requirements are in bad shape. To compete in the efficiency-driven stage, countries must have efficient productive practices in large markets, which allow companies to exploit economies of scale. Industries in this stage are manufacturers that provide basic services. Entrepreneurs with high aspirations fare better in countries with a stable economic and political climate and well-developed institutions. In other words, entrepreneurship should certainly not be discouraged, but improving the entrepreneurial framework conditions should perhaps not attract too many financial resources in this phase of economic development if it is at the expense of basic requirements.

The efficiency-driven stage is marked by decreasing rates of self-employment. When capital and labor are substitutes, an increase in the capital stock increases returns from working and lowers returns from managing.

Following Porter’s approach to analyze the development states of economy, I employed the approach to time series data. Figure 3 presents relationship between enterprise (E1) as the first measure of entrepreneurship and manufacturing value added (Y) in Iran. As can be seen, there is

\(^3\) In his classic text, Rostow suggested that countries go through five stages of economic growth: the traditional society, the preconditions for take-off, the take-off, the drive to maturity and the age of high mass-consumption.
S-curve trend between enterprise and manufacturing value added, as a proxy for economic development in Iran. Entrepreneurship is a key mechanism for economic development in every phase and the impact of entrepreneurship on development is likely to differ in each phase.

**Figure 3 Relationship between enterprises (E1) and manufacturing value added (Y)**

\[
y = -6 \times 10^{-10}E1^3 + 9 \times 10^{-05}E1^2 + 0.4742E1 + 31897
\]

\[R^2 = 0.9906\]

**Figure 4 Relationship between self-employment (E2) and manufacturing value added (Y)**

\[
y = -9 \times 10^{-10}E2^3 + 5 \times 10^{-05}E2^2 + 9.6752xE2 + 238683
\]

\[R^2 = 0.9729\]
4. Methodology and empirical model

Cointegration analysis of time series approach is carried out to examine the factors affecting output and growth in manufacturing industries with an emphasis on entrepreneurship indicators. This paper considers cointegration analysis within an autoregressive distributed lag (ARDL) framework, since this approach is a more statistically significant approach for determining cointegrating relationships in small sample. Due to limitation in industry-level outcome variables, the time period of investigation is limited for estimates of industry production function and growth model. In addition, ARDL is the major workhorse in dynamic single equation regressions.

An advantage of the ARDL approach is that, while other cointegration techniques require all of the regressors to be integrated of the same order, it can be applied irrespective of their order of integration.\(^4\) It, therefore, avoids the pretesting problems associated with standard cointegration test. The ARDL model takes sufficient numbers of lags to capture the data generating process in a general to specific modeling framework. Moreover, its popularity in applied time series econometrics has even increased, since it turned out for nonstationary variables that cointegration is equivalent to an error-correction mechanism (see Granger's representation theorem in Engle and Granger, 1987). By differencing and forming a linear combination of the nonstationary data, all variables are transformed equivalently into an EC model with stationary time series only. Finally, in order to determine the optimal lag length incorporated into the model and selects the ARDL model to be estimated, this study employs the Akaike Information Criterion (AIC). The general form of a linear ARDL model is as follows:

\[
y_t = \sum_{i=0}^{p} \beta_i X_{t-i} + D_t + \varepsilon_t
\]

(3)

where \(Y_t\) is dependent variable and \(X_t\) is a vector of explanatory variables and \(\varepsilon_t\) is the error term. A vector of dummy variables is included to capture the effects of shocks effected the relevant variables.

To illustrate the role of entrepreneurs in growth, I take the model of Romer (1990) as the departure point. I outline the basic structure of the knowledge-based growth model and then introduce the “genuine” entrepreneur into this model. Therefore, there exist four factors of production: physical capital (K), human capital (H), entrepreneurship capital (E) and labor force (L). Based on the findings of literature review and stylized facts of the economy, a production function model including different measures of entrepreneurship capital is specified for Iran’s manufacturing industries. This production function can be formally written as follows: \(^5\)

\[
Y = K^\alpha H^\beta E^\gamma L^\delta
\]

(4)

By including a random error term:

\[
Y = aK^\alpha H^\beta E^\gamma e^\varepsilon
\]

(5)

Taking the logarithm:

\[
\]

---

\(^4\) Pesaran et al. (2001)

\(^5\) See, for example, Audretsch and Thurik (2001)
\[
\ln Y = \ln a + \alpha \ln K + \beta \ln H + \lambda \ln E + \varepsilon
\]  

(6)

Output (Y) is measured as gross value added of the manufacturing industries. The stock of physical capital (K) used in the manufacturing sector. Labor (L) is expressed as the number of employees in the manufacturing industries. This data is published by the central bank of Iran. Two measures of entrepreneurship capital are used in the empirical models. They comprise self-employments and enterprises which hire labor force.

Salgado-Banda (2005) point out that the number of self-employed or business owners seems to be a logical variable to measure entrepreneurship. For studies who have used self-employed to proxy for entrepreneurship, see for example, Audretsch and Thurik (2001), Blanchflower (2000), Blanchflower et al. (2001), Bruce and Holtz-Eakin (2001), Carree et al. (2000), Evans and Leighton (1989) and Georgellis and Wall (2002). Self-employed people who lead an unincorporated business and in most of the cases do not receive a salary but enjoy a share of direct profits instead and who have complete responsibility for the business. However, self-employment takes her/his own financial and job risks. So, it is arguably not an appropriate measure of entrepreneurship. Instead, enterprise (excluding self-employment) takes both her/his risk and others people’ risk who work in such firm. The latter measure is relatively closer to the definition of entrepreneurship.

5. Empirical results

Two different models are used to examine the relationship between entrepreneurship and manufacturing industries performance based on two measures of entrepreneurship. Using the model presented in equation 6, the following short run results are obtained:

\[
Y_t = -3.00 + 0.77K_t - 0.49K_{t-1} - 0.59E_{1t} - 0.21E_{1t-1} + 1.17E_{1t-2} + 0.52H_t + 0.15TB70 \\
(5.63) (4.70) (-3.75) (-1.55) (-0.36) (3.30) (4.45)
\]

(7)

\[n = 33 \quad R^2 = 0.968 \quad S = 0.0559\]

\[\chi^2_{SC}(1) = 0.53[0.47] \quad \chi^2_{FF}(1) = 0.51[0.47] \]

\[\chi^2_N(2) = 0.78[0.68] \quad \chi^2_{ARCH}(1) = 1.11[0.29] \]

A set of the diagnostic tests is conducted to ascertain the goodness of fit of the ARDL model. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the model. The short-run diagnostic test results are very satisfactory with an absence of first order serial correlation. Error term is normally distributed along-with no autoregressive conditional heteroscedasticity. Ramsey’s Reset test for functional form confirms that there is no specification problem in the short run model. Since there is outlier,
one outlier is identified and included in the model. \( TB70 = 1 \) if \( t = 1970 \) and 0 otherwise. The long run relationship is estimated as follows:

\[
Y_t = -3.00 + 0.28K_{t-1} + 0.37E1_{t-1} + 0.52H_t + 0.15TB70 \\
(-5.63) (4.06) (2.30) (4.45) (2.61)
\]

The cointegration result shows that the variables are cointegrated and significant at the 5 percent level. Thus, these results suggest that a long run and stable relationship between the variables exists. Further, the results indicate that the coefficients of physical capital, human capital and entrepreneurship capital have positive and significant long run impact on the manufacturing value added at the 5 percent level.

The long run effect of the entrepreneurship capital on the manufacturing industries output is estimated at 0.37 with a t-statistic of 2.30, hence significant at \( \alpha=0.01 \). Thus an increase in entrepreneurship capital by one percent increases output by 0.37 percent. The effect of human capital is estimated at 0.30 with a t-statistic of 4.45. This means an increase in human capital by one percent increases output by 0.52 percent. The third explanatory variable included in the model is physical capital. The estimated coefficient for this variable is 0.28 with a t-statistic of 4.06 which is significant at \( \alpha=0.01 \).

In summary, the estimation results provide evidence in favor of the hypotheses defined in this paper. The results indicate that using the first measure of entrepreneurship capital generates a positive and statistically significant coefficient, suggesting that entrepreneurship capital is an important addition to the model of the production function.

According to Engle and Granger (1987) a system of cointegrated variables can be represented by a dynamic error correction model. Thus, I proceed to test for error correction by using the above results:

\[
\Delta Y_t = -0.12 + 0.37\Delta Y_{t-1} + 0.40\Delta K_{t-1} - 0.934\Delta E1_{t-1} + 3.14\Delta H_{t-1} - 0.12TB61 + \\
(-2.18) (2.96) (2.65) (-2.56) (2.16) (-2.39)
\]

\( 0.18TB70 - 0.09D5767 - 0.97ECT1_{t-1} \)

\(-3.12) (-2.05) (-6.18)\)

\( n = 33 \)

\( \bar{R}^2 = 0.612 \)

\( S = 0.04820 \)

\( F = 7.32 [0.000] \)

The results of estimates show that the model passes all diagnostic tests and supports the overall validity of the short run model. The estimated model confirms that the main determinants of manufacturing industries growth comprise entrepreneurship capital growth, human capital growth and physical capital growth. The error correction term indicates the speed of adjustment to restoring equilibrium in the dynamic model. The ECM coefficient confirms how quickly or slowly variables return to equilibrium and it should have a statistically significant coefficient with a negative sign. The estimated equation shows that the coefficient of \( ECM_{t-1} \) is equal 0.97 and highly significant. It suggests that deviation from the long run GDP path is corrected by
around 0.97 percent over the following year. This means the adjustment takes place much quickly.

**Second model:**

\[
Y_t = -2.28 + 0.69Y_{t-1} - 0.43Y_{t-2} + 39K_t - 0.71E2_t - 0.89E2_{t-1} + 0.43H_t - \\
(-3.06) (4.69) (-3.09) (5.25) (-2.18) (-3.08) (4.02)
\]

\[
0.12TB82 - 0.11D7888\]

\[
(-2.33) (-2.38)
\]

\[
n = 33 \quad \bar{R}^2 = 0.974 \quad S = 0.0501
\]

\[
\chi^2_{SC}(1) = 0.35 [0.55] \quad \chi^2_{FF}(1) = 2.58 [0.11]
\]

\[
\chi^2_{N}(2) = 0.34 [0.84] \quad \chi^2_{ARCH}(1) = 0.11 [0.74]
\]

A set of the diagnostic tests is conducted to ascertain the goodness of fit of the ARDL model. The short-run diagnostic test results are very satisfactory with an absence of first order serial correlation. Error term is normally distributed along-with no autoregressive conditional heteroscedasticity. Ramsey’s Reset test for functional form confirms that there is no specification problem in the short run model. One outliers and one dummy variable are identified and included in the model. The outlier is TB82 = 1 if t = 1982 and 0 otherwise. The dummy variable is D7888 = 1 if t = 1978-1988 and 0 otherwise. The long run relationship is estimated as follows:

\[
Y_t = -3.09 + 0.53K_t + 0.24E2_t + 0.58H_t - 0.17TB61 - 0.15D5767\]

\[
(-4.92) (5.60) (1.17) (8.87) (-2.21) (-2.26)
\]

The cointegration result shows that the variables are cointegrated and significant at the 5 level. Thus, these results suggest that a long run and stable relationship between the variables exists. Further, the results indicate that the coefficients of physical capital and human capital are significant at the 5 level in the production function while the coefficient of self-employment as the second measure of entrepreneurship capital is not significant at the 5 level. The results indicate that using the second measure of entrepreneurship capital- self employment - generates a positive but statistically insignificant coefficient, suggesting that the measurement of entrepreneurship capital is important in empirical studies. Error correction model are estimated by using the above results:

\[
\Delta Y_t = -2.28 + 0.43\Delta Y_{t-1} - 0.39\Delta K_t - 0.71\Delta E2_t + 0.43\Delta H_t - 0.13TB61 - \\
(-3.06) (4.69) (3.09) (-2.18) (4.02) (-2.38)
\]

\[
0.11D5767 - 0.73ECT^2_{t-1}\]

\[
(-2.37) (-5.36)
\]
The estimated equation shows that the coefficient of $ECM_{t-1}$ is equal 0.73 and highly significant. This means the adjustment takes place quickly.

6. Discussion

The effects of entrepreneurship on economic performance are extensively examined in developed countries. The results of these are a mixed bag and are not even very robust because of differences in definitions, times periods, quality of data and estimation methods. Entrepreneurship seems to impact on growth in different ways in different contexts. Some find outright that entrepreneurship does not matter for growth. For example, Wong et al. (2005) find evidence for the existence of entrepreneurial activities that do not contribute to economic growth. While Audretsch et al. (2002) and Carree and Thurik (1999) find that OECD countries exhibiting higher increases in entrepreneurship also have experienced greater rates of growth. Nevertheless, the evidence from this paper points to an additional factor - entrepreneurship - that also plays an important role in the production function and growth model. These results suggest a new direction for policy that focuses on instruments to enhance entrepreneurship capital. It may be that policies focusing on enhancing entrepreneurship capital can prove to be more effective than those targeting the more traditional factors such as capital and labor.

Knowledge spillover theory posits that growth is contingent on the technology dependence of industries, forming the landscape for technology entrepreneurs to launch and grow new ventures. International trade is theoretically considered as a carrier of foreign technology embodied in capital goods. Following Eaton and Kortum (1996), international patenting is another technology diffusion channel. In addition, Benhabib and Spiegel (1994) use the Nelson – Phelps (1966) specification which postulates that technology diffuses in disembodied form from technology-leading countries to technology-following countries at a rate that increases with the technology gap between them and with the human capital level of the technology-following countries. Therefore, trade can be considered one of the main channels that the entrepreneurs transfer knowledge to economy.

Iran is a country that has benefited from technological inventions of foreign countries, since statistics in Iran confirm that approximately 85 percent of total imports are intermediate and capital goods during the last decades. This means the enterprises transfer knowledge to the economy through imports of those goods. The movement of knowledge from one location to another is central to economic growth. Argote and Ingram (2000, p. 152) define knowledge transfer as the process through which one unit (e.g., individual, group or division) is affected by the experience of another. This working definition is consistent with much of the knowledge transfer literature and its empirical focus on understanding the transfer of knowledge. Hargadon and Sutton (1997) summarize a process model of knowledge transfer based on organizational learning and memory perspectives (Huber 1991, Walsh and Ungson 1991). They include the stages of acquisition, storage, and retrieval. An increase in trade openness stimulates foreign patent inflow and also results in more imported capital goods that embody foreign technology, leading to beneficial technology spillover effects in countries such as Iran.
It is also possible that human capital is valuable if it lets a country’s businesses understand and exploit technology developed elsewhere. Becker (1962) regards human capital as a critical input to production as well as innovation. Therefore, human capital can be considered as a main factor of technology transfer or technology catch-up in the process of technology diffusion either by imitation or innovation. Among various measures of human capital, entrepreneurship measure is an importance one to transfer knowledge and adopt it in production process. Nelson and Phelps (1966) propose a hypothesis that the rate of technology diffusion depends upon educational attainment and upon the gap between the existing technology level and the technology frontier, such that education speeds the process of technology diffusion. Benhabib and Spiegel (1994) find evidence supporting the Nelson–Phelps hypothesis. A recent paper by Engelbrecht (2002), using a sample of 61 developing countries to re-estimate the models of Coe et al. (1997), they identify a positive role for human capital in the absorption of international knowledge spillovers in favor of the Nelson–Phelps hypothesis. However, in Iran, the ratio of the number of higher educated employees to the total number of the labor force is 16.1 percent in 2006. This means that the country must first provide suitable conditions to be able benefit from trade and openness.

There is another channel to transfer foreign knowledge to domestic economy. It is believed that domestic firms can benefit from the presence of foreign multinationals through productivity spillovers. Giving the positive role of entrepreneurship in Iran’s manufacturing industries, domestic firms may improve their productivity if there are positive externalities emanating from multinationals. It appears that conditions in the host country seem crucial for whether or not there are positive spillovers. In particular, the absorptive capacity of domestic firms, that is their ability to utilize spillovers from multinationals to improve their productivity, has been found to be an important determinant for whether or not domestic firms benefit from foreign direct investment (FDI). It is, of course, difficult to assess the size of the actual effect of FDI on growth. However, Iran have taken steps to encourage FDI flows by setting up foreign investment promotion agencies, or even by offering tax and fiscal incentives to foreign firms that invest in the country. Nevertheless, the basic requirement such as complimentary domestic R&D and human capital is not suitable to customize the technology and benefit from FDI.

7. Conclusion and policy implication

This article has examined the effect of entrepreneurship on the performance of Iran's manufacturing industries using time series data over the period 1974-2006. Major literature in the context of growth theories has been reviewed and main findings of relevant and related empirical studies have been presented. Although entrepreneur does not hold an explicit position in endogenous growth models, a recent model has contributed to the endogenous growth literature by introducing entrepreneur in the production function and growth model. However, empirical studies on the role of entrepreneurship in economic growth show mixed evidence.

The findings of this paper indicate that entrepreneurship capital is a significant and important factor shaping output and growth in Iran’s manufacturing industries. The results confirm that enterprise’s measure of entrepreneurship capital has positive and significant impact on output and growth in the long run. Therefore, the evidence from this paper points to an

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6 There exist three channels that FDI effect economies. First, FDI represents the availability of additional financial resources. Second, FDI represents the availability of additional foreign exchange and third, FDI could promote productivity change in the recipient economy via technology transfer.
additional factor, entrepreneurship capital, that also plays an important role in the model. These results suggest a new direction for policy that focuses on instruments to enhance entrepreneurship capital. It may be that policies focusing on enhancing entrepreneurship capital can prove to be more effective than those targeting the more traditional factors such as capital and labor.

Given the positive and significant role of entrepreneurship in the process of growth performance in manufacturing industries, policy makers can play a crucial role by providing investment guarantees for entrepreneurs to encourage experiments with new types of economic activity, facilitating creation links and networks, creating forms of social innovation, proposing incentives to firms and knowledge institutes, stimulating special and functioning of labor.

Since the ratio of capital and intermediate goods value to total trade value is relatively higher, the country benefits from different sources and different forms of international technology spillovers, and that economic policies play a significant role in determining both the amount and form of foreign technology spillovers. Nevertheless, since the appropriate human capital and the complementary R&D capital are not existed in the economy and the ratio of FDI over GDP is lower, the country is not able to benefit significantly from R&D spillover of the foreign countries. Consequently, the productivity of imported capital and intermediate goods is lower compared to those goods produced in the country. Therefore, the economy can adopt foreign technologies only after having reached a certain level of human capital and a certain degree of trade openness, that is, the catching-up process is conditioned by the presence of a minimum level of both factors.
References


