International Journal of Sustainable Development & World Policy
2014 Vol. 3, No. 2, 45-54.
ISSN(e): 2305-705X
ISSN(p): 2306-9929

THE ENTREPRENEURSHIP, KNOWLEDGE SPILLOVER AND ECONOMIC GROWTH

Seyed Hashem Kamyab[1]

[1]*Department of Economics, University of Kerala, Kerala, India*

ABSTRACT

The purpose of this study is to test the knowledge spillover channel and introducing the Innovation as a channel for Knowledge spillover. Endogenous growth theory assumes that the knowledge spillover occur directly and lead to economic growth. In this paper, we suggest that the spillover of knowledge may not occur automatically as typically assumed in models of endogenous growth. We propose a model by incorporating the new variable based on the patent data to proxy for productive innovation. The empirical model estimated using a panel of data from 60 developed and developing selected countries for the period of 1990 to 2011. The empirical results provide evidence that in addition to measures of research & development and human capital, innovation also serves to promote economic growth. On the other hand innovation is identified as one such mechanism facilitating the spillover of knowledge.

Keywords: Entrepreneurship, Knowledge spillovers, Innovation, Economic growth, Panel data.
JEL Classification: L26.

1. INTRODUCTION

The empirical growth literature has suggested a large number of economic and non-economic variables that may influence economic growth (Sala-i-Martin, 1997; Bleaney and Nishiyama, 2002). The entrepreneurial activity has not been on the center attention in mainstream (theoretical) economics for a while.

Kirzner (1973) observed that the neo-classical model constrained the decision making of the entrepreneur, in terms of product quality and price, technology, within limits wholly alien to the context in which real world entrepreneurs characteristically operate.

Entrepreneurship affects economic growth from different channels. Entrepreneurs may introduce important innovations by entering markets with new products or production processes (Acs and Audretsch, 1990; 2003). Entrepreneurs may increase productivity by increasing competition (Nickell, 1996). They may enhance our knowledge of what is technically viable and what consumers prefer by introducing variations of existing products and services in the market.

The resulting learning process speeds up the discovery of the dominant design for product-market combinations. Knowledge spillovers play an important role in this process (Audretsch and Feldman, 1996; Audretsch and Keilbach, 2004).

Lastly, they may be inclined to work longer hours and more efficiently as their income is strongly linked to their working effort.

The publication of Solow (1956) seminal article triggered a major literature linking the traditional factors of production, capital and labor, to economic growth. Knowledge was added to the traditional factors by the development of the endogenous growth theory (Romer, 1986; Lucas, 1988). Based on the Zoltan *et al.* (2012) an important motivation for starting a new firm is to commercialize ideas that otherwise might not be commercialized in the context of an incumbent firm. In this way, entrepreneurship serves as a channel for the spillover of knowledge, thereby contributing to economic growth. The purpose of this paper is to suggest and empirically test one such mechanism that facilitates the spillover of knowledge, which should therefore generate additional economic growth.

The remaining of the paper is as follows. In Section 2, the views on the relationship between entrepreneurship and growth discussed. In Section 3, we will describe empirical model for the empirical analysis. In Section 4, the results of our empirical analysis are presented. Finally, in Section 5, we discuss the outcomes and draw some conclusions.

2. ENTREPRENEURSHIP AND GROWTH

The relationship between entrepreneurship and economic growth is one of the most interesting and challenging issues faced by economists and other social scientists. Entrepreneurship is widely credited with playing a crucial role in economic growth. When someone, for instance a politician, argues that: “for the economy to develop further, it does need to be more entrepreneurial and innovative”, everybody seems to agree with such statement. However, most people have only an imprecise idea about what is meant by entrepreneurship. To put it clearer, some people might see entrepreneurship in someone who starts her/his own new small business, say a coffee shop, nevertheless this new venture would hardly be seen as something innovative.

Solow (1956) reported increases in growth over time could not explain by the contributions of additional labor and capital. After accounting for the contributions provided by increased labor and investment, he attributed that unexplained effect to technical progress (the “technical residual”). Notwithstanding the importance of Solow’s observation, the mechanisms that resulted in technical progress and knowledge accumulation were still unspecified (Kaldor, 1961; Denison, 1967; Rostow, 1990; Barro and Sala-i-Martin, 1995). That gap was bridged by the knowledge-based-endogenous-growth theory developed in the late1980s (Romer, 1986; 1990; Lucas, 1988).

While, there are doubt and various conflicting about the exact mechanisms of spillovers, the contribution of knowledge spillovers to economic growth has been demonstrated by several authors (Griliches, 1992; Soete and TerWeel, 1999).

In the endogenous growth models, profit-maximizing firms produce knowledge in one period, which is used as inputs in subsequent periods. Part of the new knowledge at the firm level spills over into an aggregate knowledge stock that becomes potentially accessible to other firms and agents within a country. At the same time, knowledge production at the firm level is assumed to be characterized by diminishing returns to scale. Thus, knowledge is only partially excludable, and all firms benefit from spillovers originating in aggregate knowledge investments (Zoltan *et al.*, 2012).

In the knowledge-based model, the channel through which knowledge is converted into growth is explained as general externality (Arrow, 1962) that feeds into the production function of incumbent firms. Hence, while knowledge was exogenous in the neoclassical growth models, the diffusion of knowledge is exogenous in the endogenous growth models.

According to Audretsch *et al.* (2006) 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 (Eliasson, 1996; Agarwal *et al.*, 2007). Finally, it is mentioned that remained a very important question to be answered. That question is, whether knowledge spillovers generated by skilled employees launching new firms eventually generate economic growth (Winter, 1984).

3. EMPIRICAL MODEL

In the economic literature based on the models such as Solow (1956) growth models, endogenous growth model, knowledge-based model and the entrepreneurship theory, growth function written as

$$g = f(A, R, E, \lambda) \tag{1}$$

where A is the existing stock of knowledge, R is expenditure on R&D, E is the level of entrepreneurship and λ refers to all other variables influencing growth (capital, labor, institutions, etc).

This model is tested by incorporating a measure of entrepreneurship to the traditional factors that have been linked to economic growth. While empirical estimations of growth models have typically specified investments in new knowledge as exerting a direct impact on economic growth, following Zoltan *et al.* (2012) we include knowledge transmitted through entrepreneurial activities by estimating the following model,

$$g_{i,t} = \alpha_1 + \alpha_2 A_{1,i,t} + \alpha_3 E_{i,t} + \alpha_4 \lambda_{i,t} + \varepsilon_{it} \tag{2}$$

where the subscripts i and t refer to countries and years, respectively. The dependent variable is economic growth while the variables explaining economic growth are investments in new knowledge (A), entrepreneurship (E), and a set of other variables represented by the vector λ.

The dependent variable in equation (2) is specified as the growth of GDP per capita (EG). In Salgado (2004) the variable, based on patent applications, henceforth referred to as PAT, is much more closely related to productive entrepreneurship. The patent variable is divided by the total labor force for each country considered, referred to as PAT. PAT could be interpreted as a measure of the degree of innovativeness of different nations. Two variables are very popular for proxy as a knowledge in empirical growth literature. The first is the total expenditures on research and development as a percentage of GDP (R&D) and the second is the mean years of schooling in the population (over 25 years old), (EDU).

Following Zoltan *et al.* (2012), we include a set of control variables that have been shown to influence growth in previous empirical work. First, we insert is the share of government expenditures in GDP (GEXP). An important qualification is that the role of new and small firms has long been hypothesized and found to be influenced by economic growth (Mills and Schuman, 1985; Storey, 2003). To control for the possible endogeneity of entrepreneurship and the simultaneous relationship between economic growth and entrepreneurship, we insert the unemployment rate (UNEMPL).Furthermore, following Zoltan *et al.* (2012),the share of the population living in urban regions (URBAN) included in the model to shown the impact of entrepreneurial effort on growth. Finally, the empirical model can be written as follows:

$$EG_{i,t} = \beta_0 + \beta_1 PAT_{i,t} + \beta_2 R\&D_{i,t} + \beta_3 EDU_{i,t} + \beta_4 GEXP_{i,t} + \beta_5 UNEM_{i,t} + \beta_6 URBAN_{i,t} + U_{i,t}$$

where $U_{i,t}$ is the error term.

4. EMPIRICAL RESULTS

If individual effect u_i (cross-sectional or time specific effect) does not exist ($u_i = 0$), ordinary least squares (OLS) produces efficient and consistent parameter estimates.

$$y_{it} = \alpha + X'_{it}\beta + \varepsilon_{it} \qquad (u_i = 0)$$

If individual effect u_i is not zero in longitudinal data, heterogeneity (individual specific characteristics like intelligence and personality that are not captured in regressors), may influence some assumption of OLS. In particular, disturbances may not have same variance but vary across individual (*heteroskedasticity*) and/or are related with each other (*autocorrelation*). This is an issue of *nonspherical* variance-covariance matrix of disturbances. The violation of those assumptions leads to biased OLS estimation. Then panel data models provide a way to deal with these problems.

Panel data models examine group (individual-specific) effects, time effects, or both in order to deal with *heterogeneity* or *individual effect* that may or may not be observed. These effects are either fixed or random effect. A *fixed effect model* examines if intercepts vary across group or time period, whereas a *random effect model* explores differences in error variance components across individual or time period. A *one-way model* includes only one set of dummy variables, while a *two-way model* considers two sets of dummy variables.

The role of dummy variables is the core difference between fixed and random effect models. A parameter estimate of a dummy variable is a part of the intercept in a fixed effect model and an error component in a random effect model. Slopes remain the same across group or time period in either fixed or random effect model. The one-way fixed and random effect models are presented as follows:

Fixed Effect Model: $y_{it} = (\alpha + u_i) + X'_{it}\beta + v_{it}$

Random Effect Model: $y_{it} = \alpha + X'_{it}\beta + (u_i + v_{it})$

Where u_i is a fixed or random effect specific to individual (group) or time period that is not included in the regression, and errors are *independent identically distributed*, $v_{it} \sim IID(0, \sigma_v^2)$.

Fixed effects are tested by the F test, while random effects are examined by the Lagrange multiplier (LM) test (Breusch and Pagan, 1980). If the null hypothesis is not rejected in either test, the pooled OLS regression is favored. The Hausman specification test (Hausman, 1978)compares a random effect model to its fixed counterpart. If the null hypothesis that the individual effects are uncorrelated with the other regressors is not rejected, a random effect model is favored over its fixed counterpart.

4.1. F-Test for Fixed Effects

The null hypothesis in a regression of $y_{it} = \alpha + \mu_i + X'_{it}\beta + \varepsilon_{it}$, is that all dummy parameters except for one for the dropped are all zero, $H_0 : \mu_1 = \cdots = \mu_{n-1} = 0$. The alternative hypothesis is that at least one dummy parameter is not zero. The F test is applied for testing this hypothesis. This test contrasts least squares dummy variable (LSDV) (robust model) with the pooled OLS (efficient model) and examines the extent that the goodness-of-fit measures (SSE or R^2) changed.

$$F(n-1, nT-n-k) = \frac{(e'e_{pooled} - e'e_{LSDV})/n-1}{(e'e_{LSDV})/nT-n-1} = \frac{(R^2_{LSDV} - R^2_{pooled})/n-1}{(1-R^2_{LSDV})/nT-n-1}$$

If the null hypothesis is rejected (at least one group/time specific intercept u_i is not zero), you may conclude that there is a significant fixed effect or significant increase in goodness-of-fit in the fixed effect model; therefore, the fixed effect model is better than the pooled OLS (Park, 2011).

The computed of F statistics for considered model is 8.13 that is larger than the critical value at 0.05 significance level. Thus the null hypothesis is rejected and we conclude that there is a significant fixed effect and the fixed effect model is better than the pooled OLS.

4.2. Breusch-Pagan LM Test for Random Effects

Breusch and Pagan (1980) Lagrange multiplier (LM) test examines if individual (or time) specific variance components are zero, $H_0 : \sigma_u^2 = 0$. The distribution function of the LM statistic is chi-squared.

$$LM_u = \frac{nT}{2(T-1)}\left[\frac{T^2\bar{e}'\bar{e}}{e'e} - 1\right]^2 \sim \chi^2(1)$$

Where e is the $n \times 1$ vector of the group means of pooled regression residuals, and $e'e$ is the SSE of the pooled OLS regression.

If the null hypothesis is rejected, you can conclude that there is a significant random effect in the panel data, and that the random effect model is able to deal with heterogeneity better than does the pooled OLS.

The computed of LM statistics for considered model is 340.85 with the large chi-squared that we reject the null hypothesis. Thus, we conclude that there is a significant random effect in the panel data.

4.3. Hausman Test for Comparing Fixed and Random Effects

The Hausman specification test compares fixed and random effect models under the null hypothesis that individual effects are uncorrelated with any regressor in the model (Hausman, 1978). If the null hypothesis of no correlation is not violated, LSDV and GLS are consistent, but LSDV is inefficient; otherwise, LSDV is consistent but generalized least squares (GLS) isinconsistent and biased (Greene, 2008). The estimates of LSDV and GLS should not differ systematically under the null hypothesis. The Hausman test uses that "the covariance of an efficient estimator with its difference from an inefficient estimator is zero" (Greene, 2008).

$$LM = (b_{LSDV} - b_{random})'\hat{W}^{-1}(b_{LSDV} - b_{random}) \sim \chi^2(k),$$

Where $\hat{W} = Var[b_{LSDV} - b_{random}] = \text{var}(b_{LSDV}) - \text{var}(b_{random})$ is the difference in the estimated covariance matrices of LSDV (robust model) and GLS (efficient model). Keep in mind that an intercept and dummy variables should be excluded in computation. The distribution of this test statistic is chi-squared distribution with *k* degrees of freedom.

The formula says that a Hausman test examines if "the random effects estimate is insignificantly different from the unbiased fixed effect estimate" (Kennedy, 2008). If the null hypothesis of no correlation is rejected, you may conclude that individual effects u_i are significantly correlated with at least one regressor in the model, and thus the random effect model is problematic. Therefore, you need to go for a fixed effect model rather than the random effect counterpart. A drawback of this Hausman test is, however, that the difference of covariance matrices *W* may not be positive definite; Then, we may conclude that the null isnot rejected assuming similarity of the covariance matrices renders such a problem (Greene, 2008).

The computed statistics for Hausman test is 0.72 that is not large enough to reject the null hypothesis at the 0.05 significance level. Thus we conclude that the random effect model can explain the data generating process better than the fixed effect model. So, in the next section we presented the results of the random effect estimation of our empirical model.

4.4. Model Estimation

We use the annual data from 1990 to 2011 for the set of 60 selected countries[1]. The data series come from the World Bank Database (WB), World Development Indicator dataset (WDI) and the World Intellectual Property Organization (WIPO). The growth of GDP per capita (EG) is dependent variable and the explanatory variables contains the patent variable divided by the total labor force (PAT), total expenditures on research and development as a percentage of GDP (R&D), mean years of schooling in the population (over 25 years old), (EDU), the share of government expenditures in GDP (GEXP), unemployment rate (UNEMPL) and the share of the population living in urban regions (URBAN).

The results of the random effect model estimation for the empirical model reported in Table 1. Based on the results all estimated coefficients have a significant effect on growth at the 1% and 5% level of significance. All Variables except government expenditure and unemployment rate

---

[1] - Norway, Australia, Canada, Ireland, France, Japan, Finland, USA, Austria, Spain, Denmark, Belgium, Italy, New Zealand, UK, Germany, Singapore, Hong Kong, Greece, South Korea, Slovenia, Portugal, Czech, Slovakia, Israel, Switzerland, Luxembourg and Cyprus from the developed countries and the countries of Argentina, Bahrain, Bangladesh, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Egypt, India, Iran, Jordan, Kenya, Lebanon, Libya, Malaysia, Mali, Mexico, Nepal, Nigeria, Oman, Pakistan, Panama, Peru, Romania, Russia, Sri Lanka, South Africa, Tanzania, Thailand and Syria are from developing countries.

have a positive impact on economic growth. In this regard, the estimated coefficient for the R&D shows the positive effect on economic growth, indicating that the investment in R&D lead to technology improvement, reduce the costs and increase the productivity.

The estimated coefficient of the education variable (EDU) is 2.01 and significant at 1% level of significance. Based on the previous theories, education has a positive effect on economic growth through the improvement in human capital. The positive and significant coefficient of education shows that this result is in line with previous studies. In addition, the positive and significant estimated coefficient of urbanization rates (URBAN) implies a positive effect on economic growth which is due to the development in the industrial part of the economy.

The positive and statistically significant coefficients of both R&D and education indicating that economic growth tends to respond positively to investments in research and human capital, as the models of endogenous growth suggest,

Table-1. The Results of the Random Effect Model Estimation for the Empirical Model

Variables	Coefficients	T-stat	P-value
β_0	0.31**	4.82	0.000
PAT	1.12**	2.94	0.006
R&D	0.41*	2.40	0.02
EDU	2.01**	4.47	0.000
GEXP	-0.18*	-2.05	0.05
UNEM	-1.08**	2.61	0.01
URBAN	2.15*	2.64	0.02
F-stat	12.38		
R^2	0.71		
D.W	2.07		

Note: ** and * denote significance at the levels of 1% and 5%, respectively.

The main and important variables to analysis in the considered model is innovation variable (PAT). The estimated coefficient of PAT is 1.12, positive and significant at the 1% level of significance, indicating the positive impact of innovation on economic growth. Importantly, the study explains and interprets the effective channels of knowledge spillovers on economic growth.

Based on the theoretical and empirical findings from previous studies such as Zoltan *et al.* (2012) Innovation through increasing the individual productivity, increases the production and then followed by improvement in economic growth. In other words, the use of science and increasing the level of professional skills, enhance productivity and labor and capital efficiency which enhance the economic growth through introducing new ideas, patents and commercializing the knowledge. So, we can conclude that, unlike the endogenous growth models, the knowledge spillovers does not occur directly but through the mechanisms such as entrepreneurship and innovation. In this regards, the entrepreneurship can be an important factor to the growth and development of society that can increase production and lead to higher per capita income in the economy.

5. SUMMARY AND CONCLUDING REMARKS

The importance of knowledge spillovers for the processes of innovation and economic growth gets the core attention in recent decades. The performance of firms can be improved by implementing innovative ideas that were not originally developed by firms. In this way, without using additional labour and capital inputs in economies may grow.

Endogenous growth theory assumes that the knowledge spillover occur directly and lead to economic. In this paper, we suggest that unlike the endogenous growth models, the spillover of knowledge may not occur automatically. For this aim, the model with the new alternative measures of productive entrepreneurship based on patent applications introduced. The proposed model estimated using a panel of data from developed and developing selected countries for the period of 1990 to 2011. The empirical results provide evidence that such knowledge spillovers may not, in fact, be automatic, but rather depend on important spillover mechanisms, such as entrepreneurial activity and innovation. Thus, the empirical evidence is consistent with the view that entrepreneurship and innovation can serve as a conduit for the spillover of knowledge and is, thereby, conducive to economic growth.

REFERENCES

Acs, Z.J. and D.B. Audretsch, 1990. Innovation and sman firms. Cambridge, MA: MIT Press.

Acs, Z.J. and D.B. Audretsch, 2003. Innovation and technological change, in: Z.J. Acsand D.B. Audretsch (Eds.), Handbook of entrepreneurship research. Boston, MA: Kluwer Academic Publishers. pp:55-79.

Agarwal, R., D.B. Audretsch and M.B. Sarkar, 2007. The process of creative construction: Knowledge spillovers, entrepreneurship, and economic growth. Strategic Entrepreneurship Journal, 1(3-4): 263-286.

Arrow, K., 1962. The economic implication of learning by doing. Review of Economics and Statistics, 80: 155–173.

Audretsch, D.B. and M. Feldman, 1996. R&D spillovers and the geography ofInnovation and production. American Economic Review, 86: 630-640.

Audretsch, D.B. and M. Keilbach, 2004. Entrepreneurship capital and economicperformance. Regional Studies, 38: 949-959.

Audretsch, D.B., M.C. Keilbach and E. Lehmann, 2006. Entrepreneurship and economic growth. Oxford, UK: Oxford University Press.

Barro, R.J. and X. Sala-i-Martin, 1995. Economic growth. New York: McGraw Hill.

Bleaney, M. and A. Nishiyama, 2002. Explaining growth: A contest between models. Journal of Economic Growth, 7: 43-56.

Breusch, T.S. and A.R. Pagan, 1980. The lagrange multiplier test and its applications to model specification in econometrics. Review of Economic Studies, 47(1): 239-253.

Denison, E.F., 1967. Why growth rates differ. Washington, DC: The Brookings Institution, Oxford and New York: University Press.

Eliasson, G., 1996. Spillovers, integrated production and the theory of the firm. Journal of Evolutionary Economics, 6(2): 125-140.

Greene, W.H., 2008. Econometric analysis. 6th Edn., Upper Saddle River, NJ: Prentice Hall.

Griliches, Z., 1992. The search for R&D spillovers, scandinavian. Journal of Economics, Supplement, 94: 29-47.

Hausman, J.A., 1978. Specification tests in econometrics. Econometrica, 46(6): 1251-1271.

Kaldor, N., 1961. Capital accumulation and economic growth. In F.A. Lutz & D.C. Hague (Eds.), The theory of capital. London: MacMillan.

Kennedy, P., 2008. A guide to econometrics. 6th Edn., Malden, MA: Blackwell Publishing.

Kirzner, I.M., 1973. Competition and entrepreneurship. Chicago: University of Chicago Press.

Lucas, R., 1988. On the mechanics of economic development. Journal of Monetary Economics, 22: 3-39.

Mills, D.E. and L. Schuman, 1985. Industry structure with fluctuating demand. American Economic Review, 75: 758–767.

Nickell, S.J., 1996. Competition and corporate performance. Journal of Political Economy, 104: 724-746.

Park, H.M., 2011. Practical guides to panel data modeling: A step-by-step analysis using stata. Tutorial working paper.Graduate school of international relations International University of Japan.

Romer, P., 1986. Increasing returns and economic growth. American Economic Review, 94: 1002–1037.

Romer, P., 1990. Endogenous technical change. Journal of Political Economy, 98: 71–102.

Rostow, W., 1990. Socialism and democracy. New York: Harper and Row.

Sala-i-Martin, X., 1997. I just ran two million regressions. American Economic Review, 87: 178-183.

Salgado, B.H., 2004. Measures and determinants of entrepreneurship: An empirical analysis. Chapter 3, PhD Thesis, University of London.

Soete, L.L.G. and B.J. TerWeel, 1999. Innovation, knowledge creation and technology policy: The case of the Netherlands. De Economist, 147: 293-310.

Solow, R., 1956. A contribution to theory of economic growth. Quarterly Journal of Economics, 70: 65-94.

Storey, D., 2003. Entrepreneurship, small and medium sized enterprises and public policies. In Z. J. Acs& D. Audretsch (Eds.). Handbook of entrepreneurship research. Boston: Kluwer. pp: 473–514.

Winter, S.G., 1984. Schumpeterian competition in alternative technological regimes. Journal of Economic Behavior Organization, 5(3-4): 287-320.

Zoltan, A., A. David, B. Pontus and B. Carlsson, 2012. Growth and entrepreneurship, small business economics. Springer, 39(2): 289-300.