INTERNATIONAL JOURNAL OF
CURRENT MULTIDISCIPLINARY STUDIES
Available Online at http://www.journalijcms.com
VOL. 2, ISSUE, 4, PP. 185-190, APRIL, 2016

IJCMS

RESEARCH ARTICLE

SUPPLY SIDE BASIS OF ENDOGENOUS GROWTH

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ARTICLE INFO

Received 15th, January, 2016
Received in revised form 28th, February, 2016
Accepted 16th, March, 2016
Published online 28th,April , 2016

Keywords:

knowledge accumulation, knowledge embedded in people/in goods, supply basis, monopolistic profit, scientific studies.

ABSTRACT

The theory emphasizes the significance of human capital for innovations in which the knowledge accepted as a production factor. Beside the level of human sources, the other key factor affect to the innovations is seen as the technological absorptive capacities of the firms. Within the context of innovations, "accumulation of the new knowledge" has the key importance that increases as the creative activities accelerated. During the R&D activities internal and external knowledge which embedded in people and goods interact each other by which the creative knowledge forms as a result. While the internal knowledge comprise of firms own technological stocks and skilled human sources, foreign trade and direct investment ventures are functioning as the major ways of utilizing the external knowledge with the aim of facilitating into the innovative efforts. Besides, firms' "profit making necessities", and universities/research institutes' "methodical scientific studies" are also considered as major conditions that economically and socially effect to the R&D investment decisions. Thereby, such fundamental factors and requirements of the knowledge accumulation process which give impetus to the innovations reflects "the supply side basis of innovative activities and endogenous growth".

INTRODUCTION

While endogenous growth theory presents the significance of human capital for innovations, the studies of Schneider and others (2010:187), Antonelli (2009), Kurtoğlu (2006), knowledge discussed and accepted as a production factor. Introduction of innovations by the firms, to the current production system, changes the structure of the current system then this in turn effects the conduct of agents.

The fundamental determining factor lying behind this changes is the generated new knowledge and the reaction of the agents to the new products in the market place. Value and/or size of accumulated innovative knowledge vary with the existing knowledge stocks acquired in the past, and size of the economy. The major affecting factors to the accumulation of knowledge, and realizing the innovations arises at the result of the creative activities and increases in the absorptive capacities of the economies. With in this context, profit making necessities of firms and statutory obligations in university studies and other research institutions effects positively to the innovation processes. Technological knowledge considered, in Patrucco (2009) as a collective good when it's the result of the integration between internal resources and the absorption of external knowledge.

Gainin the advantages from external knowledge requires 'specific investment and communication' and has a certain financial cost to the firms.

The financial possibilities in Gorodnichenko and Schnitzer (2010) revealed as the factor that firms' innovative activities strongly influenced by financial means. Effect of R&D not perceived immediately because of the time lag between R&D investment and the benefit. A certain amount of R&D cost, should be taken into consideration that the money devoted to research activities could have deposited otherwise (De Liso and Filatrella, 2008: 597). Actually, large firms plays the major role both of productive innovative activities and spillover processes of new technologies. For example, in Wright and Shih' (2010) study, leading firms have found efficient in developing and disseminating commercial technologies in agricultural sector in the U.S.A.

Patents protect innovations and measures the inventive output that the value determine through citations (Lenzi, 2009: 170). As the share of sectoral patents increase, not only the possibility of citations rise and but also knowledge accumulation should have positively affected. The pre-conditions here, the absorption capacity of firm to internalize the previous period's patented knowledge. Higher the accumulated knowledge corresponds to a higher interaction

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level with the innovation activities. On the other hand, insufficiencies in property rights such as patent protection, discourage the firms to decide the new R&D investments due to losses in the R&D returns for a certain time, against initial R&D spending. While patent protection together with the standardization act as an engine of economic growth they can also limits the use of new technologies by retard the innovations (Acemoglu and the friends, 2010). Lack of technological opportunities/competence and R&D suitability appropriately also should have similar deterrent effect on industry R&D intensities (Yang Lee and Noh, 2009).

The internal environment to the firms such as human capital capacity and technological absorption capabilities, utilization of information and communication technologies (ICTs), and financial sources seen as the major requirements in the innovation process. In the same context, the external environment, and diffusion of technological knowledge via trade, foreign direct investment (FDI), and license agreements has also significant impact on the R&D processes. R&D works are the processes that most of the time, internal and external knowledge interacts each other. During the innovator firms' activities both of the internal facilities and external environment conditions has interacted and contributed in different size that vary with the peculiarities of the sectors. Cost reducing, profit and market share increasing advantages of the innovations reflects the innovator firms' frontier position compare to the firms who do not innovate. There by, these are considered as the major and fundamental factors that effects the innovations which forms as the knowledge embedded in goods and people. The conditionals as such, reflects the supply side basis of R&D and innovative activities, and the supply basis characteristic of endogenous growth theory which is the main subject of this article.

On the other hand, demand-based effects on innovations including market size which given uncertain in a theoretical model provided in Guerzoni (2010), is not taken into consideration in this study.

Herein, knowledge factor accumulation, internalizing the external environment, and complementary conditions analyzed in section 2, and then in section 3, supply basis of endogenous growth theory discussing in detail. In last section the concluding remarks given.

The Knowledge Factor Accumulation, and Internalizing the External Environment

Knowledge Embedded in Goods

Herein the equation the accumulated new knowledge embedded in goods which internalized in the firm, denoted through imports including patent citations, and FDI.

Kn t + f (1)

Trade, FDI, and patent imitation through license agreements are the major ways of facilitating the external knowledge in order to improve the productive capacity of the firm. Firms, via spillover effect internalize and accumulate the previously created knowledge which embedded in goods but foreign to the firm. In this process the contribution of human capital sources and absorption capacity such as organizational structure including ICTs, and financial sources of the firms plays key role.

Technological levels of knowledge stock in content changes with FDI and trade. While FDI improves the intermediate goods technologies, and new technology final goods produce in the country, with trade country should have finished products which contains only previous period' technology. The impact of this difference on technological level, and to the economic growt rate should be determined by the trade-off between final goods trade and investment due to imported intermediate input cost.

According to Keller (2009: 44-45), firms benefit from trade because of the requirement of higher product quality standards on export products compare to domestic market. The stronger effect of the initial schooling on growth in schooling-intensive industries has found in Ciccone and Papaioannou (2009 :67-68) in countries where trade liberalized. Thereby, 'an acceleration of skilled-labor augmenting efficiency growth at the world frontier leads countries with abundant human capital to specialize further in human capital intensive industries'. Ito and Lechevalier (2009: 408), explains that 'internationalized firms serving as the most productive ones becomes more productive in time and may be the source of productivity dispersion'. Ciccone and Papaioannou (2009: 75) evaluates the schooling effect on schooling-intensive industries and get the results that "the effect of schooling improvements on growth in schooling-intensive industries is stronger in open economies." Following these ascertainments it could be conclude that free trade contributes positively to accumulation of new knowledge.

Higher the FDI in generally provided with convenient absorptive capacity in related sectors higher the technological contribution occurs to the host countries. In Keller's study (2009: 32-34,36) for example, a positive relation between FDI and domestic productivity growth found which is stronger in the richer than in the poorer countries (Keller, 2009). "Foreign R&D activities have become important vehicles to access the local technologies and to develop new technologies and innovations"(Belderbos and friends, 2009: 370). In Ito and Lechevalier (2009: 408), FDI and R&D expenses considered as complementary sources of technical change.

While FDI and trade strongly related activities, multinational firms plays important role, both the cases of R&D investments and technology transfers. Keller gives the figures (2009: 2) about multinational parents, for example, that they willingly to transfers the technology to their affiliates abroad which those are made 83% of all manufacturing R&D in the United States in 1999. "US multinationals increased R&D spending abroad from 5.2 billion US dollars in 1987 to 14.1 billion US dollars in 1997. In Belderbos and friends researh (2009: 370), R&D expenditures by foreign owned affiliates given as much as more than doubled in OECD area in 1995-2003 period."

An increase in spillovers leads to an improvement of a firm's technological absorptive capacity which determined by the "firms' R&D sources". R&D investments with increased absorptive capacity, enables the firm to gain more externally

available knowledge, by imitating the other firm's research. But, the amount of R&D that produces original results, inventive R&D, decreases as spillover rises (Hammers chmidt, 2009: 423, 424). Accumulation of knowledge or the firm' knowledge production function "through diffusion effect" determine by both the available part of the external knowledge and absorptive capacity of firm. While technology spillovers allows the technology frontier in a certain industry is available to all firms, the R&D ability of the firms effects adopting the new technology by absorbing the created knowledge (Ilyina and Samaniego, 2009: 6-7).

However, restrictions on foreign trade or foreign direct investment constraint these knowledge diffusion activities by increasing cost of technologically improved final goods imports or entering the advanced technology intermediate goods into the country. Negative diffusion effect causes to decrease in demand for employing skilled human capital and the complementary effect does not influencial on innovations. In that case, the effect of external environment to the technological improvement efforts should be eased.

Collaboration and Complementarity

R&D activity fields plays fundamental role on knowledge accumulation process, and collaboration and complementary between different scientific fields /skills vitally important to the success of the R&D investment. According to Antonelli (2009: 627, 628), innovation activities viewed as the product of a collective activity, shows interdependence structure, and is a specified process that variety of heterogeneous agents interacts. Since R&D personel work together during research program, complementary between skills and innovation (Dujowich, 2009: 207) is relevant, and due to such complementary, firm size and R&D expenditures are strongly positively correlated. Beside organizational learning have also important role on innovation process because of the firm management' complementary function to the studies of scientists and engineers.

While collaborations with universities, public R&D centers, rivals, consultants, agencies, customers, and suppliers forms as the major requirement, the complementary among participating parties or R&D activities itself, requires exchange of technical information and/or equipment. For example; 'Biotechnologies can be applied to a wide range of industries and activities such as pharmaceuticals, food and beverages, agricultural and chemical products (Patrucco, 2009: 304). Within this respect , absorption capacity of the firms is the major determining factor such a collaboration that later enables the firms to complement the specified R&D project.

While interaction between less productive firms and leading technology firms occurs through technology diffusion and human capital, complementary effects of knowledge together with the convenient external conditions contributes to the formers to improve their productivity. On the other hand, effect of collaboration and complementary on innovative activity or on R&D returns in the case of interaction within the less productive firms supposed to be different from the technology leaders. This happens due to the interaction conditions which superior in the leaders case compare to the latter. Thereby, the impact of collaboration and complementary is greater in innovation activities of technology frontier companies.

Facilitation of collaboration and complementary and interaction effects contributes to the successfully completed R&D process, then the received return from innovative activity assumed to be higher than the R&D investment cost. This happens, because required level of knowledge factor input from different scientific disciplines facilitates efficiently during the R&D works.

The Environment Internal to the Firm, and the Supply Basis

Large incumbent firms, by having been more convenient possibilities to arrange the inputs of innovative R&D activities such as human capital, ICTs and financial resources which the sources internal to the firms acting as the pioneers of the innovative activities. For example, the firms, via utilizing advanced-innovative ICTs and software programs, determine the sources of inefficiencies. Then, they should be able to prepare the proper ground to prospective adequate improvements in order to gaining competitive power and expanding the market share.

Innovation in Bowman (2008: 573, 574), for example explained as the production of composite consumption good that uses the latest stock of total knowledge, Cobb-Douglas technology, and high and low skilled workers. Frontier knowledge defined in Bowman, (2008) as the high-skilled specific knowledge formed from the difference between total knowledge and adoptive knowledge. According to the author, invention adds to total and frontier knowledge while innovation helps diffuse "frontier knowledge" (or high-tech sector) into "adoptive knowledge" (low tech sector) with a one-period lag. In second-period productivity of the low-tech sector began to improve. Adaptation of transferred new technologies has certain amount of cost that called as the imitation cost, and found as 65 percent of the cost of the original cost of 48 product innovations in four major industries; chemical, drug, electronics, and machinery. On the other hand, there should be the gap with respect to generating the new knowledge and the growth rates between the leading innovators and the followers that persist (forever) due to the differences in stocks of human capital (Martins da Silva 2009: 146-150, 158).

Knowledge embedded in people

Knowledge embedded in people could be symbolized as the following;

$$Kn=c+m+x \quad (2)$$

Knis the skilled human capital with c tacit knowledge, m is mobility/ transfered skilled labor, x is explicit knowledge including the other knowledge facilities transferred other than tacit one and, as training, education at seminars, conferences etc.

The relationship between human capital and innovations, both in theoretical approach and empirical evidence significantly examining in growth literature which sets out the supply side nature of endogenous growth theory. The knowledge obtained

from research activities is largely tacit in nature even conveyed from scientific publications or patent documents (Coad and Rao, 2009:128). Sectors with a high share of highly skilled employees as engineers, scientists and managers should have higher innovation propensity and engage in above average product innovation. For example, technical skills in Schneider and others (2010:187) are accepted as the key factor of profitable innovations. Because, employing more the higher educated-skilled human capital, more the tacit knowledge should have been utilized which embodied mainly within skilled human capital (Patrucco, 2009: 305). Then, higher the original innovation, stronger the importance of a highly qualified workforce (Schneider and others, 2010:188).

Patenting growth quantified in Kerr and Lincoln' (2010: 6,13,24) study, due to temporary immigration category of the U.S.A., especially for science, engineering and computer-related occupations, during the period of 1995-2008. The study clearly shows that, a certain rise in skilled human capital have positive impact on creativity. Within this respect, educational attainment can be considered as a measurement of skill. Then, higher the educational level equates higher the level of knowledge input to endogenous in R&D works and realizing the innovation necessitate. "Value-added and employment growth in schooling-intensive industries was faster in countries with greater improvements in schooling" (Ciccone and Papaioannou, 2009: 74).

Lenzi (2009: 161, 162), emphasize the importance of human capital with respect to the function that acts during moving actions from one firm to another. The mobility of skilled workers is considered as one of the most influential channels of knowledge flow and also empirically a positive relation found between productivity and skilled labour mobility. Because, knowledge is largely tacit and embodied in individuals which transfer through the channel of workers' mobility activities.

The Role of Profit Making Firms and R&D Institutions

The creative studies of scientists, engineers, and entrepreneurs in Mina (2009, 449); taken as the engine of innovation processes. With in the respect to the innovations, universities, public and private research centers, and profit seeking firms, emerging as the major research and product improving centers. In theoretical term technological innovations occurs at the result of new knowledge generating process which accumulates in a competitive market environment. As it's emphasized in Schumpeterian approach (Antonelli, 2009: 619); "competition drives firms to introduce innovations." As innovations allows to increase in productivity (Antonelli, 2009: 615, 616) this in turn leads to an increase in demand due to decline in marginal cost of labor. Actually, the profitable operations are basic necessities to the firms in order to be staying in the market, and having been competitive. Even, in a duopoly case, dealt in Hashmi and Biesebroeck (2010: 3) firms ought to involve innovation activities due to necessity of stimulating the market demand. Therefore, firms whether large incumbents or new start-ups seeks to make a certain range of profits. To realize such a profit, R&D and innovative activities supposed to be inevitable for the competitive firms.

On the other hand, for an attractive R&D investment, having been "the return to innovations" ought to be higher than the market interest rate. As its explained in Aghion and Howitt; innovators takes "the monopolistic profits" until the next innovations realized. The monopolistic markup in the patent-protected industries creates profits higher than the marginal product of capital (Chu: 2009, 56-57). The output which patented as an innovated good, protected by the intellectual property rights regulations, then the innovative firm earns monopolistic markup at least for a certain period. Such monopolistic profits have a crucial role to support the R&D process and arise as the major economic driving force lies behind the knowledge acquisition attempts of firms and research institutes.

Innovative firm supposed to search the market needs in very detail whether the conditions convenient or not for developing the prospective new products, and then intuitively decide to begin the R&D investment. Thereby, they always takes the market risk. Avoiding and/or securing the market risk related R&D cost should be possible merely with a successfully resulted innovative process via gaining the monopolist profits under the patent protections.

Profit making innovative firms could be accepted as the firms, beside human capital, having been convenient financial possibilities and information and communication technology facilities which are the most required inputs in the innovation process. Profit maximizing financial entrepreneurs for example, plays crucial role by acquiring and processing information about R&D investments before they are funded (Michalopoulos and others, 2009: 4-6). Despite large firms in Dujowich (2009: 217), finance R&D projects with in-house funds or use the capital market to raise capital, a powerful link between technological and financial innovation has found. Thereby, financier firms plays a central role in the process of endogenous growth.

While universities influence the productivity of firms, they also influenced by the firms' activities, capacity and workers in the presence of spillover (Kantor and Whalley, 2009: 4-5). By its nature, continual developmental structure of universities due to academic personal engages in career studies and necessity of profitability in competitive firms are forming as the major fundamental basis for the current and future innovative activities. Thereby, both of these components i.e. "monopolistic markups" and "scientific studies"; forms as the key fundamental "supply basis" that enforces the innovative activities as the real causalities in an economy. Even existence of a large enough market but with incompetent number of firms seeking the monopolist price markup, and research institutes without sufficient human capital sources, the conditions in the economy should not contribute adequately to the improvement of the innovative activities.

CONCLUDING REMARKS

Knowledge stock in the economy comprise of mainly with the knowledge embedded both in goods and human sources, which internal and/or external to the firm. Theoretically production of

new knowledge considered as the engine of innovations that function as the efficiency efforts and learning inputs of R&D works. Since the nature of innovations has dynamic structure, knowledge accumulation process plays major role in order to gaining efficiency in R&D works and continuity in economic growth. The created knowledge should have acquired at the result of innovation process, via interaction of the knowledge improved previous period with high-skilled researchers. There by, an increase in the new technologies and knowledge stock are consistent with higher R&D investment and higher gross national product.

During the R&D works explicit and tacit knowledge stimulates, contributes, complements and collaborates each other in which the creative knowledge forms. In this process, conditions to the both internal and external environment in the means of knowledge input, should have linked directly to the success of innovation targeted R&D activities. Despite having been required level of internal environment in the case of deficiency in external environmental conditions, innovation sectors should have negatively affected.

Past ideas as being accumulated in the knowledge pool; embedded in goods and transferred via trade, direct investment, and imitation over time, reflects the public good characteristics of knowledge which contributes also to the generation of new knowledge. Thereby, diffusing the external knowledge as such, acts as one of the major ways of utilizing knowledge in innovative efforts. Because, use of knowledge does not reduce its utility to another agency that reflects the peculiarity of endogenous growth theory and knowledge factor by having been increasing return. The other major factor affects the innovative activities is the internal knowledge comprise of firms own technological capacity and skilled human sources. Besides, firms' profit making necessities, and statutory obligations of universities and research institutes taken as the effective factors on R&D investment decisions and innovations. Such conditions and requirements of the knowledge accumulation process are considered as the fundamental factors that contributes positively to the innovative activities, and reflects the importance of supply side basis of endogenous growth models.

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