Knowledge Input as a Productıon Factor and the Competıng Power

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Abstract

Knowledge argued as a production factor, and human capital considered as the major determining component of the created ideas or innovations that the approaches empowered from the endogenous growth theory and the recent growth models. Marginal revenue of knowledge factor contemplated higher than the ones conventional inputs of capital and labour, under the assumption of having been increasing rate of return. This feature of knowledge input, via allowing the increasing scale effect, makes it's function crucial for the economic agencies to the means of gaining the competitive advantage and achieving higher economic growth rates. This, together with the assumption of the higher demand elasticity of income to the innovated goods which is suppose to be effective , ensures that the "substitution elasticity of knowledge input to capital" becomes bigger than unity in the long run.

When the knowledge input taken into consideration as the production factor, "there might be the factor market for the human capital", as the major determiner, in which the market equation, apart from the labour market in conventional terms, would be determined with the interaction of supply and demand conditions. The paper reviews the innovation process, and the cost and return to the human capital with respect to the knowledge or human capital market equilibrium, and discuss the effectcs on competition.

1. Introduction

Increased competition and faster technological developments engendered from globalization, fosters introduction of knowledge through sectors. Global competition, enforcing the firms to increase their innovative capacity**,** in the means of developing new technologies in which the knowledge input used as the major production factor. Succeding in innovative interferences should allow the firms to create and gaining the competitive advantage in the global markets. Within this context, the initial requirement of improving the competitive power is seen as the creation of "the implementable new ideas", which makes possible firms to move progressively beyond the current production techniques they have. Hiring the skilled labour those have adequate education, training and experiences, arise as undispensible pre-condition to this process. Skilled labours have employing mainly the areas such as to improve the quality, efficiency and productivity in production process, management, organisation, financial services, personnel administration, marketing, research and development activities.(Nahuis and Smulders, 2002: 138-139) 'Skills can be acquired in two ways: by investing in education and training, and by learning on the job.(L.Ellis and Roberts, 2002:89)

The "implemented new ideas" , forms by gathering and processing the knowledge, sourced by either way of the expilicit and the tacit ones which plays crucial function as an input in each stages of the economic activities through the research and development, desing, production and marketing processes. While the former could be exchanged, bought and sold, the availability of the latter should be possible just yet under the specific conditions and environments that allows micro working groups, 'within the framework of a good knowledge management system'.

The created ideas, as the major source of knowledge input, examining in the next section. Knowledge input and the human capital market are subject to section 3. Then, the supply and demand conditions of human capital is going to be discussed in section 4, and concluding remarks are given in remained section 5.

2. Created and Implemented Ideas as the Major Source of Knowledge Input

Innovations necessitates the firms and foundations to organize and facilitate the research and development (R&D) operations. The efficiency of this process depends upon to the skilled labours' contribution during the R&D works who use the specific knowledge stock that the company have already had and knowledge acquired from external sources through spillovers. Thereby, it should be emphasized that the production of new knowledge positively related with the knowledge stock and the number of research workers. (Abdih & Joutz, 2005:26) Within this framework, skilled human capital, as the major component of inventions and the creator of new knowledge would act as the most crucial contributor and the engine of knowledge production process or so called the knowledge input.

Knowledge discussed as an input with respect to the cost and return terms, In the recent growth literature, that's subject to the following sections of this study.

2.1. The Cost and Return to the Knowledge Input and the Effects on Competition

R&D based models of endogenous growth theory suggests that the existing supply of knowledge ultimately effects the production level of new technologies. According to these approaches; existing knowledge enters linearly into the technology production function and cost of invention determines extent of the innovative activity(Keely, 2002: 284).

When knowledge input considered in terms of the cost and benefit, hiring skilled labour would be profitable up to the point where marginal cost of hiring(LMC), equals to its' marginal product (LMP). Nahuis and Smulders (2002) defining the role of skilled workers as such that they engage in either research and development or management, organisation, marketing, financial planning activities.

This also equals to the shadow value of the knowledge that reflects the marginal amount of knowledge generated by the skilled labour. In other words, the value of the marginal increase in knowledge, created by human capital equals to the marginal product of the skilled labour. The upper bound to the knowledge return determined by the cost of source of the knowledge, that is the marginal cost of investment in human capital, interest rate in financial markets.

"Employment of the skilled workers beyond that equation point, cause to fall both of marginal product of labour and return to investment in knowledge, due to diminishing returns in knowledge. An increase in human capital investment expenditures requires increase in capital expenditures, and capital cost-interest rates, that is in return, higher interest rates results decrease in investments in firm-specific knowledge"(Nahuis and Smulders, 2002:142-147). In Dinopoulos and Waldo, (2005:146) total labour costs of producing in R&D activities taken equal to the stock market valuation of monopoly profits at the time of discovery.

That is;

$$\mathbf{LM_C = LM_P = I\,L_{sk} = r} \qquad \mathbf{(2.1)}$$

where;

$I\,L_{sk}$ = Marginal cost of investment to skilled-knowledge intensive labour
r = Interest rate in financial markets

The equation (2.1) explains that the marginal cost or return to skilled and unskilled workers are different. The skilled-knowledge intensive workers suppose to employed mostly in R&D and management activities, (details given below in explanations of equations 2.5 and 2.6 respectively) where the unskilled labour works directly into the production process.

While the marginal cost or marginal return to the former group of workers determining by the interest rates, as it's analysed in Ellis & Roberts (2002) and Nahuis & Smulders(2002); which is suppose to be higher than, the latter group's marginal cost or wages that determined with the interaction of supply and demand conditions in the labour market. Then, accordingly to this explanation the realization to the skilled workers' wages should be taken higher than the unskilled ones.

"Higher the marginal productivity of the skilled or knowledge intensive workers, used in the sectors; ensures, higher the competitive advantages gained, compare to conventional sectors". Following this, it could be argue that if the new "knowledge" created by the skilled labour, which is innovative one and or implementable into the production process, should be considered as an "input" or a 'production factor'. Functionally, using knowledge input expectedly provides fundamental increases in efficiency and productivity in return would be the major reason on gaining and/or having been the competitive advantage in the knowledge intensive industries. Besides, due to increasing rate of return to the knowledge created by human capital, that originates from the relevant assumption, the increased revenue should be received by using the knowledge input also.

The analyses put forwarded in above mentioned studies on human capital investment decisions, concerns only to the cost of capital, within the given stationary period of time. Rather, not only the costs but 'the other demand and supply conditions' soppose to relevant directly as a determining factor to the human capital investment decisions. However, either way, under certain conditions, the assumed outcomes of the knowledge input, such as "having been higher return, and the crucial role playing on the competitive power", doesn't change.

The equilibrium point in equation (2.1) represents the upper level of the demand for human capital in the economy at a given period of time. Increase in the demand for 'skilled workers', requires improvements on the certain conditions given in equation (2.3) below. This improvement necessitates and requisite continuity to the increasing returns knowledge input in actual terms. Further analyses on the supply and demand conditions of human capital is going to examining in sections 4.2 and 4.3.

2.2. The Reasons Why the Substitution Elasticity of Knowledge Input to Capital Becomes Bigger than Unity

As the competiton increases and faster the technological changes becomes in the world markets, the renewing requirements of the current technologies with new innovated or renewed products, are increasing and becomes obligatory. In the mean time, innovations that requires making necessary R&D activities, and could be possible with hiring the skilled labour only. "The knowledge input", by definition (equation 2.3), causing the higher marginal revenue compare to the conventional factors marginal cost, allows the increasing returns to scale.

From equation (2.1) we get,

$$\mathbf{LM_C = r = MC_K} \qquad \mathbf{(2.2)}$$

where;

MC_K = Marginal cost of capital in conventional manufacturing industries.

Then, under the assumption of that the input share of knowledge in total production factors (TF) higher compare to the physical capital share, i.e. (Iid/TF) > (K/TF).

$$\mathbf{MR_{Iid} > MR_K} \qquad \mathbf{(2.3)}$$

where;

$MR_{\mathbf{Iid}}$ = Marginal revenue of knowledge factor in "knowledge input intensive sectors".

$MR_{\mathbf{K}}$ = Marginal revenue of physical capital in the capital intensive and/or in the labour intensive / conventional manufacturing industries.

Higher the skilled worker's wages, employed in R&D process, higher improvevements to the value added in the final goods and services, parallel with the share of 'knowledge input' used in the production process. Thereby, the advanced technology sectors in where most of the new products developed and the knowledge input intensively used, would have both higher rates of return and competitive advantage.(1) In Moore and Ranjan (2005:394-395), the relative demand of skilled intermediate good to unskilled intermediate good, (X/Y), taken as a decreasing function of relative price, p, of skilled goods in terms of unskilled ones. Thus, the relative demand depends on technology parameter, a, since it affects the ratio of marginal products, if technological progress is skill-biased, i.e., $(X/Y) / a > 0$, then an increase in a, implies an increase in the relative demand at each 'p'.

This in return, allows increases in the competitive power of the firms, operating in knowledge input intensive industries, compare to the conventional capital and labour intensive ones. The increased value of new products is defining as a markup in Comin (2004:395, 399) that is; "Innovators can charge a markup above the marginal cost of production either because they earn a patent or because they keep secret the blueprint of the innovation." These higher markups, in a sense, considered as a kind of monopolistic power to the patent owners that have reasoned from the higher initial costs as major part of the marginal cost of production for innovated goods compare to the conventional sectors. This, examining in McCalman (2002), within the context of patent-induced R&D as; "R&D will result in a process innovation, yielding a present discounted value of extra profits". This R&D revenues determine by the size of innovation and the level of the patent protection. In O'Donoghue and Zweimüller, (2004:99) the leading innovative firms supposed to consolidate market power and create market profits.

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(1) In economics theory, the marginal cost/revenue structure or factor intensity accepted as the major determining indicator to the product price differences in sectors.

Such goods and services by having being with higher marginal revenue, should be considered as the goods with higher demand elasticity of income**,** responsive to the definition for the industrial products in the economics theory. This empowers the approach to "the knowledge factor intensive sectors", parallel to their share in the economy, becomes not only the major source of higher income stability, but the engine of the economic growth also".

Higher the demand elasticity of income to the knowledge intensive new technology products, allows both higher the R&D wages and the prices in related sectors. Thereby, higher the marginal rate of return, i.e., the effect of equation (2.3), together with higher the demand elasticity of income, makes possible to having been the increasing scale economies in these sectors. In other words, 'the increasing returns to scale cases' should be operative in the industries in which skilled labour hired both in R&D and other production and management activities.

On the other hand, the terms of 'increased returns to scale economies' comprises; "from the beginning period of the applying the new innovation to the replacing time with the renewed one".

Besides the higher marginal rate of return and increasing scale effects, the spillover effect of the new innovated ideas, should contribute positively to the efficiency and productivity increases in the economy also. Arora and Vamvakidis (2004:10) argue that 'the countries, those are export to relatively more advanced countries grows faster which is driven by the specialization in technologically more advanced sectors. The specialization may also result in positive spillovers to other sectors in the economy'. Gökovalı, (2005:37) deals the subject as "the spillover effects from high-tech to low and medium-tech industries are more intensive and high-tech industries posses higher learning potential". As the use of knowledge input increases, the cost of acquiring should decrease and it augments as much as shared and used in the economic activities while the things were reverse for the capital input in which depreciates as it's used.

Beyond the replacing point, given in equation (2.1), with new products, previously implemented knowledge should be added to the knowledge stocks in the economy. And by involving into the knowledge stock, "the augmenting effect" continue to serve indirectly to the economy as a partial contributor element in the knowledge production factor.

As it's stated above, the goods produced in knowledge input intensive sector; with higher marginal revenue, higher demand elasticity of income, increasing return to scale, and spillover/augmenting effects, should allow to increase in "the substitution elasticity of knowledge input to phsysical capital" which is become higher than unity in the long run. Thereby, higher the substitution elasticity of innovated final goods to total output, 'higher the knowledge input substitution elasticity to physical capital input' becomes. Knowledge input intensive sectors suppose to be developed more in the countries where the demand elasticity of income relatively higher. Under these assumptions, it could be said that "the knowledge input becomes the most effective production factor, determines both of the competitive power and different economic growth rates between countries".

This implies also higher the economic growth rates allows higher incentives to invest in knowledge and higher returns to get from the firm-specific researches.

As the supply of skilled workers increase, research capital stocks or firm-specific knowledge or productivity of research increases. (Nahuis and Smulders, 2002:146, 151) Parallel to the continuous improvements of the innovative technological developments; both the rise in the accumulated knowledge and the skilled human capital, as the complementary and/or as a component of knowledge production factor, allows to increase the share of knowledge input intensive sectors in the economy. (2)

Continuity to the improvements in both productivity and the scale economies conditions, contributes more to increase in substitution elasticity of knowledge input to capital. Following this, it chould possible to get such a result that the requirements of using knowledge input in economics sector should have increase. Because, as it's stated in Tiwana, (2000:108,110) 'the competition rules has been forcing the firms to increase the knowledge input, in their production activities.'

2.3. Knowledge Assets and Implemented Ideas-Innovations

Knowledge stock and spillover effects discussed in the economic growth literature, quite details in; Keely, 2002:299, L.Ellis and Roberts, 2002:107 and Nahuis & Smulders, 2002:138-142. Patents as the measure of the knowledge stock growth rate, thoughted as that they covers only a portion of innovation. Alternatively, in some papers, the accumulation of knowledge have connected with the total factor productivity (TFP) growth. The sectors those are having and creating relatively higher TFP, seen as the sectors containing also high rates of accumulated human capital.

The knowledge input, which is developed by skilled labour, could be formed from the sources such as 'the current firm-specific knowledge stock' and 'the explicit knowledge received from external sources'. In Nahuis & Smulders (2002) the skilled workers build further into the existing knowledge stock that has already been accumulated within the firm, either through out improving the personel skills or additions to the firm's knowledge stocks directly. Thus, the knowledge developed today, becomes input for the future production operations due to the increases in the size and value of the firm-specific knowledge.

Thereby, knowledge stocks and spillover effects, together with the level of skillled workers, should be considered as the knowledge asset or the knowledge base. Here in equation (2.4), "the definition of the knowledge asset" is stated in a specific time period under the steady state conditions in the economy that does not includes the ongoing R&D and process improvement works.

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(2) The aggregate demand and supply of the innovated goods should determined by; a) the elasticities of aggregate demand and supply to the new products which is formed with the effect of the production cost and market price of new product, b) consumer utility preferences .

$$\mathbf{K_a = BS_{sa}} + Pt1\text{-}a + \mathbf{L_{sk}}b \qquad \textbf{(2.4)}$$

where;

K_a = Accumulated knowledge assets, including embodied knowledge through patents at a given period in time, i.e., in means of static term.

BS_s = The knowledge or the technology stock at the firm level and/or in the economy overall, in the steady state conditions.

P_t = Technology stocks embodied through the total number of patents.

L_{sk} = Number of skilled or knowledge intensive labour, t hose are graduates of vocational schools and the universities already have had whether employed or not.

The parameters(a) and (b), gives the knowledge assets' elasticity of BS_s, Sp and L_{sk}

Nevertheless, the equations (2.5) and (2.6) given below, deals to the knowledge assets in dynamic terms, rather than a static term as it's given in equation (2.4) The knowledge, dependent variable taken here as in the means of 'production factor' which formed, by created and implemented ideas through utilization of the related factors which facilitated by the employed skilled labour.

$Iid_{R\&D} = f(BS_s, Lh, Sp, TK, K_{ti}, e)$ **(2.5)**
where;

$Iid_{R\&D}$: Innovations, implemented ideas or new products, created by skilled/knowledge intensive workers in R&D activities at a given point in time.

Cost of R&D investments considered as the marginal cost of the R&D labour which is taken equal to the financial market credit rate parallel with the equation (2.1). Here, in this study, it's considered as a production factor that would be facilitate as an 'input' in the production fuction. Similiar to our above equation's (2.3) interpretation; definition of "the new knowledge" has given in Abdih and Joutz, (2005:11) as 'the knowledge created by researchers and reflected as to the output of the knowledge production function.'

BS_s, Sp : Knowledge stock and technology spillovers, respectively, i.e., 'explicit knowledge', utilized in the R&D process.

Lh : Skilled or knowledge intensive labour; works in R&D activities.

TK : Tacit Knowledge, formed and facilitated during R&D process.
In order to improve the formation of knowledge, existing knowledge stocks and innovative activities, the requirement of convenient atmosphere in the economy would be the fundamental feature. For example, a properly working knowledge processing environment or market conditions, by facilitating the private skills, contributes to turn the private tacit knowledge into the "production knowledge**.**

K_{ti} : Physical capital stock-materials etc. utilized in R&D activities.

e : The uncertainty related with R&D investment.

The similiar conditions other than R&D activities, related with the equation (2.5), should be relevant for the cases in which the knowledge input used, analyzing in below equation (2.6).

$Iid_{Q_0} = f(BS_s, Lh_q, Sp, TK, K_{ti}, e)$ **(2.6)**
where,

Iid_{Q_0}: Implemented ideas which is used via existing skilled / knowledge intensive workers, with the aim of cost reductions, and quality and efficiency improvements in the activities such as; production of final goods, organisational and management structure, financial services, personel administration and marketing, at a given point in time.

Lh_q : Skilled labour, works with the aim of cost reductions, and improvements to the efficiency and productivity of the firm, in the activities such as; production of final goods, organisational and management structure, financial services, personel administration and marketing.

BS_s, Sp, TK, K_{ti} : Knowledge stock, technology spillovers, tacit knowledge and physical capital stock-materials etc., espectively, employed in above mentioned activities.

e : The uncertainty, related with production and related activities.

Then,

If we put the "knowledge input" (Iid) into the Cobb-Douglas type production function, it becomes;

$L_{Yt} = f((A + k, L_y (K_t), I_{id}))$ **(2.7)**

L = Total workforce parameter
Y_t = Real GDP per capita to labour
A = Total factor productivity or available stock of technology (constant)
k = Physical capital parameter

L_y = Unskilled labour hired in production activities
K_t = Capital stock to per labour works in production
I_{id} = Implemented ideas or knowledge input created by knowledge intensive labour, or new addition to (A)

What should be the conditions to ensure the required amount of knowledge input in the economies? To find the convinient reply to this question; there should be the least requirements to fullfill. Settling the properly working knowledge market conditions should be the first conditionality, and then secondly to search the effect of determining variables to the human capital supply and demand conditions which is going to examine in the remaining sections of this paper.

3. Knowledge Input and the Market

The knowledge worker defined as the person who 'commits to delegation, contacts with the key personnel, shares the knowledge, programmes his own working plans, makes team working, collaboration, monitoring, and implementing, having vision, and being coherent. In recent terms, the knowledge taken into account as a production factor in 75 percent of companies, and the knowledge factor's share is indicated as at least 60 percent of the created value added.(Yeniçeri and İnce, 2005:58-61,75)

Following the statement that since the skilled workers considered as the major source and determining factor of the "knowledge input"; it could be argue that an increase in the supply of skilled labor, cause to increase the implementable ideas in the knowledge market. Then, as it's discussed in Nahuis and Smulders (2002:138-140), more skilled labor implies a larger market possibilities for the available knowledge input.

While the rate of return to investment in human capital depending on the growth rate of innovations, in return; "the returns from the innovation targeted R&D investment process", closely related with the growth rate of human capital. Such a bilateral interaction should be seen as a major reason and the source for the "human capital accumulation" and "innovation", those are considering as the 'twin engines of growth' (L.Ellis and Roberts, 2002).

When 'the knowledge' is considered as the production factor it should follow, in the economics term; that "there might be the market place for this factor" in which the equilibrium should be determined with the interaction of supply and demand in the market conditions. In the market place, it's expected that the integrated working conditions, in the means of maintaining the efficiency and productivity improvements, suppose to be settled. To settling such a convenient market conditions in which the knowledge factor affected by; the market should have to be regulated to meet and facilitate the supply and demand requirements, accordingly to the peculiarities of the related sectors. Within this framework, for example, the existence of legal orders in force, relevant to the entry and exist from market, patents and protection of other industrial and intellectual property rights should be accepted as the crucial regulations. Creation of such an environment, helps and contributes positively to the efficiency in innovations and production processes, by improving the R&D and process innovations, for both of the firms and the macro economic activities.

Under the effective certain legal regulations; the investment to the innovative activities should continue, as it's indicated in equation (2.1), up to the point that the return to investment on skilled labour, i.e. wage of R&D workers, equalize to the rate of return of capital in the financial markets. L.Ellis and Roberts(2002:93, 99, 104), has further analysis to the subject, that making similiar emphasize to the wages and the labour market as the followings;

- Marginal rate of expected returns to innovation that's taken equal to the R&D worker's wage suppose to not less than maximum wage of production workers.
- This allows to reach the equilibrium in the labour markets.
- An individual's wage increasing rate depends on the rate whatever he learns compare to the growth of the most recent graduates.

On the other hand, sectoral breakdowns of the economic activities has crucial importance, related with the settling and determination of the knowledge market regulations, because of the structural differences between industries in which they've quite different factor intensities.

Relatively new and newly developing sectors such as;

- information and communication technologies (ICT) on either manufacturing or services such as software, network and related industries,
- digital industries (cameras, entertainment/music systems and apparatus),
- nano technologies,
- genetic technologies / biotechnologies,
- hydrogen energy and related industries,
- pharmacy and healt science,
- space and aircraft industries

appears as the sectors using 'the knowledge input intensively' as the major production factor, through out either R&D and/or production, management/organizational and marketing related activities, compare with the traditional manufacturing and other industries and sectors.

As it's initiated in the equations (2.5) and (2.6) the knowledge input qualifyed and facilitated by the skilled or knowledge intensive labour. The independent variables in equation (2.5) suppose to be taken as the fundamental components of the supply and demand interaction in the knowledge market formation process.

The interaction processs of the determining variables with respect to supply and demand of skilled labour should be examined within the following contexts: a) The knowledge stock should be taken as a given and relatively stable variable in a specified period at the time. b) The effect of the knowledge spillovers should be considered at the steady state conditions of the economic activities. c) However, human capital, as the major source and determining factor of the tacit knowledge and due to the contributing function on the created and implemented ideas during the innovation process, have to be accepted as the crucial and the most dynamic factor for both of forming the knowledge input and the knowledge market. d) Skills as a part of tacit knowledge, acquired through school education, training and on the job learning is considered as sticky with and the main contributor to the human capital.

The above mentioned conditions are the main reasons behind our approach herein, why "the human capital", has been puting into the centre of discussion to "forming the knowledge market". The supply and demand conditions of human capital suppose to interact bilateraly, under the certain circumstances in where they relevant and works in such a discreted market environment. So, how the market conditions should reach the equilibrium? Under certain conditions, Dinopoulos&Waldo (2005:146) replies the question as; "since prices and wages are accepted flexible, the aggregate demand for labour equals its supply at each instant in time and full employment of labour prevails. .." Here in this study, rather, searching the equilibrium conditions, we try to exert the determining variables of supply and demand for human capital.

4. Supply and Demand Conditions in Human Capital

'Human capital' should be define as the person who had denoted with 'his own knowledge', and has a specified social cost and recreating/renewing cost. If we put this definition into the equation, we can write;

$$\mathbf{h = f (K_o, K_{rc})} \qquad \mathbf{(4.1)}$$

where,

h = human capital
K_o = Personel knowledge, whatever he knows/learned at the time being
K_{rc} = Recreating/renewing cost of the knowledge that he had

4.1. Human Capital Supply Equation

What kind of variables should effect, as determining factors of human capital supply and how would be managed to increase the number of skilled workers. Related with the equation (4.2); the supply conditions of human capital together with the determining variables and the related explanations given in detail below.

$$\mathbf{Sh = f (W_{Sk}, Sub, Edu, L, Y, Reg, Govn)} \qquad \mathbf{(4.2)}$$

where;

- **'Sh'** is the supply of 'knowledge intensive human capital'. Here, the human capital, by definion, taken as the changes in the number of educated people that contained from graduates of vocational and technical schools, and higher educational institutions.
- $\mathbf{W_{Sk}}$ is the wage of skilled or knowledge intensive labour. The wages, affected not only by the labour demand, but personal adequacy, ingenuity and capability should effects also. While higher wages positively affecting the 'Sh', in return, by allowing higher the marginal costs of skilled labour, cause to decreases in R&D investment and labour demand, after the certain level of employment. Marginal rate of return to R&D investments that equated with interest rates in the financial markets, suppose to determines the net effect of 'the wages' on 'Sh'. The opportunity cost of difference between current and future wages, definitely effect the 'Sh'.
- **Sub** is the subsidies and related policies that directly affects 'Sh'. Subsidy policies, such as the ones to encouraging education, training, learning on the job, and R&D would allow permanent increases in the supply of human capital. This kind of subsidies should be considered as an incentive to the accumulation of the research labours (h). Lower the current cost of education, compare to the return from R&D investment, contributes positively to the increment of 'h' and "Sh" by encouraging increases in the number of skilled people in the country. Such an environment would have positive effects on productivity and encourages higher innovative activities which in return allows increases in current and the future wages and positively effected 'Sh' would be again. The share of education expenditures to general budget, should be taken as the explanatory indicator to find the effect of the variable in the equation.
- **Edu,** gives the changes in school enrollment. Higher the initial stock of enrollment and the changes, higher the 'Sh' affected assumed.
- **L** is the number of employed people over the age of 15; higher the number of employees, together with large population, implies the possibility of having more skilled people and positive effects to the increases in "Sh".
- **Y,** refers to the per capita national income; as one of the major indicator of the economic and social developments of the country that is also reflects both of the stock and flow levels of industrialisation, technology, education, knowledge etc. Higher the per capita income coincides with higher the education demanded that should have a positive effect in "Sh".
- **Reg** is the existing national regulations, in the means of legislations that effects the working conditions of free market economy. The equal and widened implementations of the competition rules through "the laws of competition, capital market, banking, privatisation and intellectual and industrial property rights" should promotes the increaces in 'Sh'. The major reason to this, regularly working legislations effects positively to increases in competition rules and innovation requirements. Besides, the current legislations for the service sectors in general and skilled human capital movements in particularly, whether allowing free movements or having some strict regulations, effects the level of 'Sh' also. For example, a strict immigration law in global terms, which doesn't permits to enter the foreign skilled emigrants into the country, would have negative effects on the accumulation of 'Sh'. Searching for the effect of "regulations" in the growth equation, "the level of trade openness" whould be use.
- **Govn**, is refering the governance. Good governance, allows further improvements in basic macro economic indicators by reducing corruption and increasing accountability for public expenditures.(Baldacci and others, 2003:15, 27) Under this assumption and with acceptance of the unregistered economic activities; here, it's supposed that higher the tax rates, by causing the increase on money demand, allows the more unregistered economy biased. Therefore, as the representing indicator of unstable governance, changes in the rate of tax revenues to GDP would be taken as the explanatory variable in the equation.

4.2. Human Capital Demand Equation

Demand for human capital and the variables affecting, are going to examining in equation (4.3).

Dh = f (RD, I, PPI, MRI, Reg, Sub, Sh, BS_s) **(4.3)**

Where,

- **Dh** is the demand for 'knowledge intensive human capital'. Here, in certain circumstances, it's considered less than what the 'Sh' level is; in which effectual the conditions to the natural rate of unemployed skilled labour in the economy.
- **RD** refers to the research and development purchases as the percentage of the GDP. Higher the share, positively effected 'Dh' would be. When technological improvements become faster, this makes skilled workers more productive due to a large pool of new ideas to built on. Similarly, R&D and innovations, as the major factors or processes in creation and implementation to the 'new ideas' are positively related with the accumulation and demand for skilled workers. R&D based innovations makes the skilled R&D workers crucial for the producers and other profit making companies, those are working under severe competition rules in each sectors of the economy. As the result, such an economic structure which sectoral breakdown have biased relatively more advance technological products, encourages more skilled workers demanded for hiring. The markets of developed countries, with the higher sectoral shares of advanced technologies, should be more favourable markets for the skilled workers due to the higher level skilled workers employment requirements of the firms.
- **I** denotes the ratio of aggregate investment to GDP. Higher the investment ratio implies, higher the positively effected expectations on "Dh" would be.
- **PPI** is the producer price index, represents the macroeconomic stability that lower fluctuated economic activities allows more positive effect to demand for skilled human capital.
- **MRI** refers to the marginal return to innovation; which determined by the cost of skilled labor used in R&D activities. Firms invest for human capital who works on R&D related activities, up to the point that the marginal revenue of innovation, equal to the wage of skilled worker. Thus, higher the MRI, causes higher the 'Dh' in initial terms, but the effect ease by the time goes, because of the diminishing returns to knowledge in the steady state conditions, the effect becomes lesser later on. Thereby, MRI is subject to 'the supply and demand constraint of innovated goods' in market conditions where meets the producers possibilities and consumers preferences that effects the level of 'Dh'. Otherwise, as the industry stays in monopoly competition structure, i.e., if the increasing rate of returns ensured due to knowledge renewing conditions secured, so DH is positively effected also.
- **Reg** refers to the legal regulations that aims proper working competitive market conditions in both of the good/service sectors and capital/labour markets. The scope of structural conditions such as the trade barriers, legal and administrative restrictions on market entry, regulations and implementation of the perfect competition rules plays important role on free market stability. Facilitating of these common and the least required conditions of regulations, by settling required competition rules, creates favorable environment for increased innovative activities and 'Dh'.
- **Sub** refers subsidies to the skilled workers employment that reduces the employment cost. Education, tax and credit subsidies or incentives which directed to hiring the skilled labour would encourage demand for the human capital employment.
- **Sh**, refers available educated people comprise of the graduates to the vocational and technical schools, and higher educational institutions. Higher the stock and increase in the number of graduates, higher the available skilled workers for demanding firms, would increase the predictability and lower the cost of hiring. As the result, this encourages and would have positive effects on 'Dh'.

- **BS_s** denotes the level of total knowledge stocks in the economy which have gained in the past periods. BSs effects the formation of skills positively, through either ways of the method of learning by doing in the evaluation of existing knowledge capital stocks on the job, and because of the contributions on R&D processes of innovative activities. Thereby, higher the BSs, higher the effects on formation of skills and the knowledge ready to utilization for economic activities which reflects developed and larger economic structure.. Then, positively affected 'Dh' would be. The changes in the stock of granted patents should be taken as the explanatory variable in calculations. (3)

5. Concluding Remarks

In this article the knowledge has examined as the major production factor compatible with the assumption that human capital creates the innovated products during R&D activites and makes contributions to the production and the related processes. This approach have originated from the endogenous economic growth theory which explains the human capital as the source of created higher values due to internalizing the technology.

Having been the increasing rate of return to the knowledge input, at least during the patenting term, bring about that the marginal revenue of knowledge factor becomes higher than the ones conventional inputs of capital and labour. This makes the knowledge input's function crucial for the economic agencies, in the means of achieving higher scale economies and gaining the competitive advantage and economic growth rates. When it's considered together with the higher demand elasticity of income to the innovated goods, the knowledge factor assures that the substitution elasticity of knowledge input to capital becomes bigger than unity.

On the other hand, supply and demand for human capital, as the major determiners to the knowledge factor and created ideas would be interact each other in the market place in which the equilibrium constitutes accordingly with the impact of affecting variables.

As the concluding remarks to this study, it should be said that aggregate demand and output elasticities of innovated goods would be determined by the supply and demand conditions of both of the knowledge input and the new products.

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(3) Searching the effects of the related variables in. numerical analysis on 'Sh' and 'Dh', given in equations (4.2) and (4.3), beyond this study, would be the subject of another.

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