Noetic Capital and the Economics of Productivity

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Productivity Research Paper

Noetic Capital and the Economics of Productivity

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Abstract

Our study examines the potent interrelationships between learning, productivity, and the intellect (*intelligence*) to show how improvements in our noetic (*intellectual*) capabilities could help boost productivity in the economic sense. The goal is to make learning more outcome-based to have its effects felt on the broad aspects of development that can positively modulate our productivity levels.

Keywords: *Noetic capability, productivity, capability approach, noetic capital.*

JEL Classification Codes: O11, D7

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I. Productivity and Noetic Capital

Far back in ancient times, the great philosopher Aristotle believed that all productive sciences are "capacities."[3] In simple words, it means science produces things of value. Human beings have been endowed with the power of productivity, which is the rational capability that enable us to create and produce things of value and utility. Therefore, productivity is a *capability*. This approach to productivity being a capability may be further explained in terms of Amartya Sen's capability approach[4].

"In this paper, we examine the interrelationship between learning, productivity, and the intellect, and show how improvements in noetic (intellectual) capabilities of the mind can help boost productivity in economic sense."

ibid

Similarly, we can propose that the productivity growth of a country is a national priority. Alan Newell (1982) held a view that *the state of the society determines the growth and evolution of science*, and therefore, of its citizens. The dynamicity of an economy is dependent on the growth and productivity of the productive forces of the sectors. And the beginning of productivity is *effort*: i.e., the effort devoted toward *productive* activities. In this research, productivity (and its *noetic* components) is our object of study. By noetic capability, we mean herein our cognitive abilities related to intellectual functions of the minds, including the power to reason and think critically. The study of human productivity is an interesting endeavor, since it highlights the

[3] See, for instance, Aristotle, *Metaphysics*. Heidegger, M. (1995). Aristotle's Metaphysics 1–3: On the Essence and Actuality of Force. Indiana University Press. See also Coope, U. (2021). Aristotle on productive understanding and completeness. Productive Knowledge in Ancient Philosophy, Cambridge, 109-130.

[4] Walker, M. (2005). Amartya Sen's capability approach and education. Educational action research, 13(1), 103-110.

practical implications for productivity research for management policy making and strategic decision making of organizations. It is no less relevant at the individual level, too. In this paper, we examine the interrelationship between learning, productivity, and the intellect, and show how improvements in noetic (*intellectual*) capabilities of the mind help boost learning and productivity in the economic sense. Hence, "learning" is an important variable to consider while modeling human productivity and outcome.

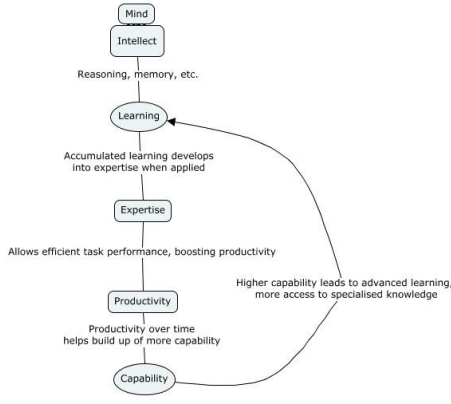

Fig. 1. The "Learning-Productive-Capability Cycle" in Noetic Space. Note: The *feedback loop* is shown connecting capability with learning.

The economic study of productivity is necessary in this respect, because, productivity fluctuations may cause anomaly in aggregate economic activities (Davis, 1987), and at the individual level, it may hamper individual efficiency and output. In this research, we examine the causes that result in the fluctuations in human productivity and try to identify the key drivers of intellectual and industrial outputs. Figure 1 above depicts the interrelationship between learning, intellect, and productive capabilities. It establishes important connections and explains the effect of improvement in one variable on the other, thus exemplifying the basic canons of *Learning-Productivity-Capability Cycle*.

The three basic 'Canons' of *Learning-Productivity-Capability Cycle* could be stated as follows*:*

> ***Canon 1***: In actions lie our fortune. If we control our actions, we shape the effects as well.
>
> ***Canon 2***: We can control actions by controlling *development* of actions.
>
> ***Canon 3***: Productive prospect is a possibility. *Possibility presupposes some existing actualities*. If there's a possibility to become productive, then there must be some way to do so.

Intellectual or cognitive output at the individual level which we call noetic, and industrial (business) productivity at the collective level are both relevant, since fluctuations in any one or both of these could result in aggregate economic fluctuations that may result in microeconomic disturbances. The role of allocative disturbances in generating aggregate economic fluctuations cannot be overlooked for the reason that reallocation of specialized resources, i.e., capital transfer (or removal) from one to other affect business cycles, productivity, and output (Davis, 1987).

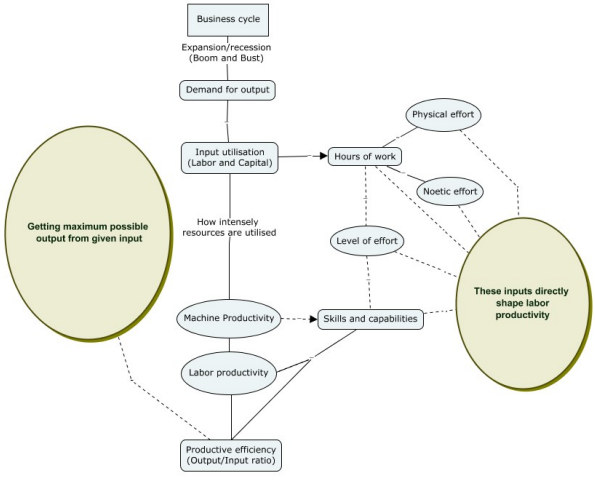

Fig. 2 Business Cycle, Productivity, and Productive Efficiency

A finer, subtle relationship can be drawn out between business cycles, productivity, and productive efficiency given the key parameters that constitute the dynamic driving forces of business productivity (see Fig. 2). The key parameters that fluctuate are both exogenous and endogenous in nature, having a wider impact on the economy. The endogeneity may arise from differences in the factors of input: hours devoted to productivity, level of effort, and other measures of human capital, i.e., *skills* and *abilities*. Now there are other factors that might help explain any variations in productivity. These may result from differences among individuals in their productiveness, allocation of effort, human capital, (Becker, 1977), differences in leadership, inability to tap hidden potential, ineffective team management, constraints to learning in organizations, or some combination of all of the above.

In this paper, we introduce the concept of noetic capital and examine its relationship with human productivity. But first, it would be necessary to explain the concept of noetics in terms of economics of productivity. Noetic science is the science of thinking and knowing (Krader and Levitt, 2010). The word noetics has its genesis from the Greek word *noesis*—which means cognition; i.e., the outcome of learning, thinking, and reasoning. But how it might be correlated to productivity? Productivity economics has long remained one of the core and interesting subjects for researchers and economists to examine how productivity is correlated to economic growth at the macroeconomic scale. Our attempt is to relate noetic (intellectual) capital with productivity, and establish a causal relationship between human capital, intelligence, and productivity.

In fact, Chatterjee (2024) has set forth the basic foundation of noetics in relation to learning and productivity, giving it its unique but much desired metaphysical piquancy. Hence, a brief account of the noetics of productivity in quantum relativistic framework as previously introduced by Chatterjee (2024), may, insofar, be considered as a groundwork laid for an interesting inquiry into the subject matter of noetic science in relation to productivity economics. This will help expand the domain to bring new lights for us to understand in a better

way the economics of productivity at a greater depth than what has been attempted before.

II. An Analysis of Human Productivity

The contribution of basic economic research to the study and analysis of human productivity and potential are limited to a fewer studies in the past, except that of Schultz (1961), Gellerman (1963), Becker (1975 & 1977), David (1987), among others. Whereas, recent studies by Gordon (2010) have addressed the problem of fluctuations in productivity cycles in relation to Real Business Cycles (RBC) models. The nature of relationship between expenditures on R&D to productivity growth has been closely examined by Griliches (1986). Besides, Lovell (1993) previously wrote much about being productively efficient, and studied the relationship between efficiency and productivity, heralding a unique domain of productivity economics. The significance of *productive efficiency* was stressed by Lovell (1993), who analyzed and reinforced this concept by bringing forth the primary determinants of producer performance, as measured by efficiency and productivity factors. Analysis of human effort followed soon after as industries were quick enough to adopt the concept of "productive efficiency" to measure employee productivity that heralded the rapid development of both *quantitative* and *qualitative* frameworks of workforce performance appraisal systems (See, for instance, Boice & Kleiner,1997; Brown & Heywood, 2005).

More recent studies have taken up the issue of productive dynamics and productive efficiency seriously in the light of organizational practice (Pashkevich & Haftor, 2020). The role of intellect now seem to be more relevant in current contexts of knowledge society being powered by Artificial intelligence and AI-based tools, which not only have increased productivity levels, as claimed by many studies (Al Naqbi, Bahroun, & Ahmed, 2024), but are found to be effective noetic machineries to promote economic growth, productivity, and efficiency at both individual and firm level (Czarnitzki, Fernández & Rammer, 2023; Gao & Feng, 2023).

Contribution of basic research to productivity growth, therefore, have been few, contrary to applied research which has

however taken the front seat as a more important component of R&D. Many researchers, including Griliches (1986), have studied and analyzed the causes of a large productivity slowdown, which has largely been attributed to technology shocks as of later, as cause of business cycle fluctuations (Gordon, 2010). However, very few macroeconomists have studied the noetic (i.e., intellectual) components that have definite role to play in cyclical productivity fluctuations, the phenomenon having its effects on the demand-driven output cycles. In this paper, we exactly intend to do so, i.e., to examine the *noetic* elements of human capabilities and how they might relate to productivity, output, and efficiency at the individual level.

III. Productive Capital

In relation to the aforementioned theme, we devote our analysis to investigate how can the "quality" of human effort be greatly improved, i.e., and knowledge and skills per se. This approach although aligned to Schultz's (1961) study of human capital and productivity, a more advanced given the current context when we are at the crossroads of Artificial Intelligence-enabled technology being in use in almost all the sectors of the economy and society in question.

The role of productivity in boosting capital formation, and that of productivity and knowledge itself playing a greater part in our exposition of knowledge as a form of intangible capital, will help inspire policy makers in investing more in noetic capital development. This constitute the core aspect of the knowledge acquisition process in relation to expenditures in research for development as well as in R&D activities for the promotion of productivity growth (Griliches, 1986). The more R&D-intensive sector of the economy, i.e., high technology, ICT and AI, all fall under this scheme. These constitute the most useful aspects of investments in human capital formation, which has been highlighted in the previous research on *Knowledge Resource Inequality*, aka KRI (Chatterjee, 2023), in which it has been shown that grave misallocation and even under allocation of resources devoted to education for the underprivileged section of the economy could produce rebound effects in the form of technology shocks and shocks to productivity growth. The issue of inequality due to under-investment

in productive education for the noetic (*intellectual*) development of the masses has to be addressed as well[5].

Investments in useful skills and knowledge acquisition by means of education of the workforce constitute a greater area of exploration—an interesting avenue to examine the characteristic nature of human productivity. According to Becker (1977), the measures of human productivity must take into account the various aspects of human capital and its formation. Human capital formation is implicitly correlated to productivity and productive efficiency at the individual and organizational level, both. Investment in human resources boosts productivity, as it is a proven fact observed from the studies of on-the-job training programs that help boost worker productivity (Black & Lynch, 1996; Jain, 1999; Ognjenović, 2015; Ma, Nakab & Vidart, 2024).

Any decline in productivity, as observed by Gordon (2010) leads to reduction in aggregate work hours, which is nothing but useful effort. But a decrease in organizational productivity have many other causes: e.g., demand shocks, decrease in production efficiency, technology shocks, inefficient management and operational constraints, economic contraction, decline in growth rate, falling and low sales volume and inventory buildup, etc. Therefore, it can be concluded that reduction in aggregate productivity level can lead to decline in aggregate output. This results in supply-driven fluctuations in real output, which occurs due to periodic fluctuations in productivity cycles. In RBC models, this is referred to as productivity shocks which are treated as exogenous. But what about the shocks that we relate to decline in noetic capabilities? This, we recount as one of the causes which is “endogenous” to a firm or an individual. On the other hand, a decrease in individual productivity may also be due to as many other causes. In fact, Gellerman (1963) pointed out that purposes affect productivity and the ways effort is made. The motives of people at work affect productivity as well. The study of work motivation that stimulates

[5]See, for instance, 7. Chatterjee, S. (2021). Knowledge Resource Inequality. *IUP Journal of Knowledge Management*, 19(3).

productivity is an important area for research since it entails the creative aspects of human productivity.

IV. Productivity, Creativity and Investment in Human Capital

Both Schultz (1961) and Becker (1975) have stressed on the necessity of investment in education as a promoter of productive actions for future wellbeing. We consider it—in our terminology—investment in human resources to nurture *noetic capital*. By noetic capital, we refer to the cognitive resources of the mind that we already have at hand: e.g., *ability to reason*, *doubt*, *create*, *think critically*, and *solve problems*. It is our continued goal to search for better methodologies that enhance and promote productivity, creativity, and our noetic or intellectual capabilities. The effects are far fletched, meaning that intellectual capabilities are unlimited that can be nurtured with efficient methods of training and learning. Based upon all past as well as recent developments in economics of productivity, we propose an idea and the concept of "noetic productivity":

> *"…our ability to tap into methods of doing… (things), i.e., to develop more efficient methods of noesis that involves our cognitive and intellectual resources will enhance productivity, and stimulate creativity."*

To achieve a higher level of efficiency in work practice, we should use the readily available resources that our cognition supports, through our ability to reason and think outside the box in order to achieve a greater success in our productive endeavors. This would help drive creativity and promote innovation—the key parameters of economic growth of a nation. We are not stressing on non-conventional thinking models, but limit our approach to scientific methodologies to help us generate new ideas, and seek solutions to already existing as well as emerging problems. Of course, *critical thinking* is a part of this noetic productivity framework. Now, the growth of physical capital is limited by availability of material resources. But there is no such limit to the growth of noetic capital. The latter is an intangible entity. Not unusual, since, Becker (1975) considered human capital, along with technological change (or inertia) as less tangible entities.

V. The Model

We propose a simple theoretical model of productivity that which mathematically represents a microeconomic system of production function. We take into consideration several variables and parameters of interest. Let's define the theoretical model along with its dynamic specifications, as well as the variables included as such. This is not a real business cycle (RBC) or stochastic dynamic equilibrium model (DSGE) but a model of productivity functions incorporating cognitive domains of the mind. The model as such examines the effects of investments in human productive capital, necessary to nurture noetic resources that would further contribute toward *noetic efficiency*. By noetic efficiency, we mean the efficiency of the productive methods and techniques applied to enhance our cognitive capabilities.

The variables thus included are as follows: Learning (l), methods of teaching (m) which may be interactive, inquisitive, online, lecture-based, self-learning, observational, hybrid, etc. Other variables of interest are change in skill levels or capabilities (ΔS), motivation (m) characterized by self-interest, degree of engagement, attendance, interaction, etc., and productivity (k) as measured by efficiency and output, and productivity increase following learning. The interrelationships are made clear as learning depends on methods, motivation, knowledge resources, capabilities, instruction models, and techniques (taking aid of tools, i.e., AI systems, etc.). Productivity, too, is reliant on learning, capabilities, skill levels, and motivational level.

A simple econometric specification for modeling the functional equation of *learning* is given as:

$$l_i=\alpha_0+\alpha_1 p_i+\alpha_2 \Delta S_i+\alpha_3 m_i+\varepsilon_{1i} \qquad \text{eq. 1}$$

Wherein, α_1 denotes the effectiveness of teaching methods, α_2 the impact of capabilities/skill improvements, α_3 signifies the role of motivation in learning, and ε_{1i} the error term (individual unobserved factors).

Again, econometric specification for modeling the functional equation of *productivity* is gives as:

$$k_i=\beta_0+\beta_{1li}+\beta_2\Delta S_i+\beta_3 m_i+\varepsilon_{2i} \quad \text{eq. 2}$$

Wherein β_1 denotes the effect of learning on productivity, β_2 role of capabilities, β_3 signifies motivational effects (e.g., in applying knowledge), and ε_{2i} denotes productivity-specific error term. There may be other unobserved factors not included in the model, which may signify endogeneity, which may affect both learning and productivity. These factors, otherwise, could have their influence on the outcome of learning that modulates productivity levels of individual workers. This model requires instrumental and fixed variables to elicit the random effects which can be applied to panel data.

Let us define some instrumental variables to construct an equation in order to define a system of learning l_{i} in noetic space with intellect i, expertise θ_{i} and noetic capabilities c_{i} as variables, and an error term ε_{i}.

$$\boldsymbol{p = \alpha_0\, x + \alpha_1\, \theta_i\, (\beta_0\, l_i + \beta_1\, c_i)^{\frac{1}{x}}} \quad \text{eq. 3}$$

Now, solving for θ_{i}, we derive

$$\theta_{\mathrm{i}} = \frac{\left((-\alpha_0)\, x + p\right)(\beta_0\, l_{\mathrm{i}} + \beta_1\, c_{\mathrm{i}})^{-\frac{1}{x}}}{\alpha_1} \quad \text{eq. 4}$$

Now, by plotting the equation, we derive a curve function as follows:

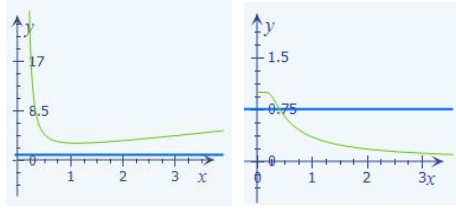

Fig. 3 a&b Productivity curve functions.

In Fig.3a above, the equation function is defined in terms of productivity (p) and the effect of learning, expertise, and capability development on productivity level in noetic space. With increase in

learning using better methods that are efficient, the errors may remain low and the effect may directly be observed in enhanced productivity levels at the individual and organizational level, or both. Now, from the above model, we derive the final equation no.5 of productivity function curve as follows, which is plotted in Fig. 3b:

$$p = 1 - (l_{\mathrm{x}} + c_{\mathrm{i}})^{1-\theta^{\frac{1}{x}}} \qquad \text{eq. 5}$$

This modelled equation is s simplistic representation of a learning system aimed to boost productivity (p) given that the variables noetic capabilities c_{i} and expertise $\theta^{\frac{1}{x}}$ have their full effects felt on the model. Given a theoretical threshold of desired (*optimum*) productivity on the y-axis as 1, the maximum attainable productivity could be boosted by an increase in learning l_{x} complemented by development of expertise $\theta^{\frac{1}{x}}$ at full scale. This is represented in Fig. 4 below as the *learning-expertise-noetic capability* curve function.

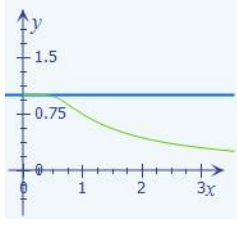

Fig. 4 The *Learning-expertise-noetic capability* curve function

VI. Results and Discussion

Our simplistic model with two functional equations examines the role of *learning* as a function of various inputs, e.g., teaching models, instruction models, motivational component, skills and capabilities. Besides, it helps determine *productivity* as a function of learning (and outcome as well) with other inputs affecting productiveness that are similar to those variables already included in the first equation. This is an example of a structural econometric model (SEM) of learning and productivity with inclusive variables and error terms. The error term counteracts lack of sufficient data that might limit the analysis of variables.

The equations 3 & 4 describing the model of learning-based productivity enhancement has important implications. First, it can help examine and explain output in terms of productivity relative to noetic inputs (i.e., larning, training, cognitive exercises, and by using various tools of acquiring knowledge that enrich the intellect with necessary knowledge of processes, methods, etc.). Path of least resistance can be determined using the equation, whereas the magnitude of changes in intellect due to learning relative to a frame of standard with respect to time can be plotted by the graph as well. The noetic capabilities ensure the individual to discern between most proactive ideas relative to those that are inefficient and less worthy. Other tools that help enhance noetic productivity levels may have positive impact on the structural model, but are not included in this study. Therefore, reflection on productive capabilities bring to light the key variables that are necessary in boosting human productivity levels through augmentation of the intellect. The intellect is, however, itself the most effective tool, and proper methods of training it by means of imparting knowledge and expertise would have positive effect on productivity.

A continuous buildup of intellectual (noetic) capital directly contributes to positive productivity and increased productiveness (Chatterjee, 2024). It also contributes toward an increase in productive efficiency (Lovell, 1993). This buildup of capital resources occurs as a result of learning, knowledge acquisition, expertise development, and conceptual understanding of knowledge thus acquired. The noetic productivity framework reinforces the value in the power of factors (variables) that are included in the model, contributing towards dynamicity in human productive thought and action. There may arise issues that might hinder acquisition of knowledge from inadequate learning, which may discreetly influence productivity levels. Buildup of noetic capital is of prime importance to help thwart any such influences that may adversely constrain human efficiency.

Emendation in techniques of knowledge acquisition would go a long way towards building a positive environment supportive of higher productivity by learning. By any means deemed appropriate, *noetic efficiency* must be maintained at all levels of organizational practice. It would help streamline productive processes, although some

unavoidable issues may arise as problems that need be solved. In that case, observance and adherence to protocols and guidelines would provide the much needed direction to overcome evolving issues. Skills, expertise, and knowledge need be sought that give strength and dexterity required for diverse organizational operations including idea generation, turning ideas into actions, and actions into productive endeavors. The barriers to deep, productive learning must be removed as well to bring efficiency in acquiring the necessary knowledge for higher productivity, for the reason that the model represents productivity as a *function* of learning.

VII. Conclusion

It is said that in our actions hide our fortune. Economic study of human productivity is an interesting subject having far reaching implications for the economy. This study examines how improvements in human noetic (intellectual) capabilities could help boost productivity in economic sense. In this paper, we have introduced the idea and concept of *noetic capital* and examined how it relates to the promotion of positive human activity: *productivity*. Using a simple model of functional equations, we describe the role of intellect in augmenting productivity levels, and how "learning" contributes to the development of productive efficiency—which is a measure of the degree of effort and activities that one puts into effect in achieving viable ends.

Productivity is a determinate factor of efficiency, and there are many tools inherent to, and exogenous to it that promote positive activities. Our intellectual—aka *noetic* capacity is primal toward understanding how innate human resources could be tapped and channelized to make us become more productive. Learning, expertise development, and skills are indispensable towards enhancing our productivity levels, as it directly modulates economic fluxes and collectively moderates business cycles at the macroeconomic level. On this regard, we have modeled the *Learning-Productivity-Capability Cycle* as an enabler of positive development that powers the workforces in delivering the required output for productive actions.

Declaration of AI and AI-assisted technologies in writing the paper

The authors hereby declare that they have neither used nor taken help of any AI systems while conceiving, writing, or drafting this research paper.

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