Introduction to Comparative Models for Innovation Theory. (Review of Chapter 14; Introduction to Modern Economic Growth by Daron Acemoglu, 2008)

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Kasun D. Ramanayake
Department of Economics, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura.

Abstract:

This review paper introduces basic endogenous technological change models based on comparative innovations with research and development (R&D). Mainly this paper explains three endogenous growth models. Those are The Baseline Model of Competitive Innovations, One-Sector Schumpeterian Growth Model, and Step-by-Step Innovations Model. The methodology of this paper based on the review paper structure and referenced to the book: Introduction to Modern Economic Growth by Daron Acemoglu written in 2008. Also, qualitative review concepts have meaningfully integrated into this study. This review has identified, these models were relatively interconnected with the R&D and Innovations. These all models have identified technology is generating new machine, and machines are working in the production process with skill labors in R&D field. Machines have been utilizing in production. It has been working to either improve the quality of an existing product or lower production costs. However, innovation is not the same as creating machines. Because innovation has been increasing quality and reducing costs in the production using the replacement impact, which should be more involved in the Research and Development process (R&D) than those who make just machines. In conclusion, the replacement impact has based on the previous version of the technology. Simply replacement impact is a comparative replacement. This replacement has basted on the R&D. Therefore, this deference is made by comparative innovations.

Keywords: ***Baseline Model, One-Sector Model, Step-by-Step Model***

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Introduction

Technological advancement does not always imply the addition of new products or machinery. It also emerges of higher-quality productivity. These quality products are a mandatory condition for the economic growth of a country. Innovation is the process of practices. Global production practices are generating innovations. These practices are a continuous process of the development of vintage production. Vintage production is old technology used productions in the firms. Innovation is comparative development of the replacement impact of the vintage technology or machine. For Example, if you introduce a higher performance computer into your production process, it will work much effectively than your vintage computer. This change has identified by the continued practices in the production field. Therefore increase in the varieties of computer types is important since economic growth is driven precisely from the production function. Simply, Innovations have been driving by the economic growth in the future positive economics. Therefore, this paper illustrates developing tractable models of economic growth with competitive innovations. Furthermore, this paper presents fundamental models of competitive innovations, which were initially introduced by Aghion and Howitt (1992) and then further extended by Grossman and Helpman (1991a,b) and Aghion and Howitt (1992;1998). Also this study presents these models in a way that replicates the mathematical structure of expanding varieties models, emphasizing the similarities while also highlighting the contrasts.

The literature presents a baseline model of competitive innovations based on Aghion and Howitt's work (1992). Segerstrom, Anant, and Dinopoulos (1990), as well as Grossman and Helpman (1991), developed similar models (1991a,b). Aghion and Howitt (1998) present a comprehensive overview of different Schumpeterian economic development models and their expansions. Uneven growth and prospective growth cycles have discussed by Aghion and Howitt (1992). Aghion and Howitt are the first to investigate the impact of creative destruction on unemployment (1994). Francois and Roberts (2001) and Martimort and Verdier (2001) address the consequences of creative destruction for firm-specific investments (2003). In Aghion, Harris, Howitt, and Vickers (1999) and Aghion, Harris, Howitt, and Vickers (1999), step-by-step or cumulative advances were studied (2001). Acemoglu and Akcigit (2006) give a simplified version of their model, which includes a comprehensive study of the consequences of intellectual property rights regulation and licensing in this class of models. More competition may stimulate economic growth and technical advancement, according to Blundell (1999), Nickell (1999), and Aghion, Bloom, Blundell, Griffith, and Howitt (2005). Greater competition may increase development in step-by-step models of invention, according to Aghion, Harris, Howitt, and Vickers (2001) and Aghion, Bloom, Blundell, Griffith, and Howitt (2005). Another factor for expansion, according to Aghion, Dewatripont, and Ray (2000), is competition. Competitive forces boost management incentives and efficiency in their model.

Today growth economics have mainly based on quality and cost-effective products. For that R&D, comparative innovations and technology-based production have been

taking the key role. Therefore this paper has generated a significant introduction for the readers to flow up the main reference for their studies.

1. The Baseline Model of Competitive Innovations

The assumptions have based on the close economic conditions. The economy has been working with R&D and expanding the machinery. The model has revealed the fundamental economic differences that arise as a result of competitive innovations. Time *(t)* has given in continuous conditions. Population is constant at *L* and labor is supplied by constant amount in given time *(t)* Machines used to produce final goods.

$$C(t) + X(t) + Z(t) \leq Y(t) \qquad 1$$

Where *C(t)* is consumption, *X (t)* is aggregate spending on machines, and *Z (t)* is total expenditure on R&D at time *t.*

If the machines have not expanded, the input rate is equal to 1, quality of the machine line is $v \in (0,1)$, and innovation is the engine of the economic growth. Innovation works for improving the quality of machines. Let *q (v, t)* be the machine line quality at time *t.* For each machine type, we assume the following "quality ladder."

$$q(v,t) = \lambda n(v,t)\, q(v,o) \qquad 2$$

Number of innovations are represented by *n (v,t)* and $\lambda > 1$. These innovations are working in the machine line, machine line situated between time 0 and *t* and $\lambda > 1$. Innovations have been improving the quality of the machines, and it is the leader of economic growth. Under these conditions, aggregate production function has derived. It has given below,

$$Y(t) = \frac{1}{1-\beta}\left[\int_0^1 q(v,t)x\,(v,t/q)^{1-\beta}dv\right]L\beta \qquad 3$$

If *v* is quality of the machine and *q* is the quantity of used for the production *x(v.t | q)* s the total quality machines have used for the production. Herewith, apply an assumption, any given time quality level has not changed. The equilibrium level represents the higher level of quality machines that have used.

New machines have invented by the R&D. Also new Machines have developed according to the grid of the vintage machine difficulties. Ex; *v* is machine line. It has *q(v t)* at a given time *t*. R&D has been working for the improvement of the quality of the *v*. Let suppose the firm has spent *Z(v t)* units for the final good. Then production function generate *nZ(vt) / q(v.t)* innovations. These innovations are the leader of the economic growth and quality of the productions.

There were some critics of this model. The main criticism is this model has not applicable to developing countries. Because of that, R&D is an expensive task for

developing countries. Therefore this model is relatively applicable for the advanced economies in the world. Also, R&D cost is a higher risk for new firm in the economy. Because R&D makes benefits in the last stage of the production process. Simply last stage means, the firm can replace their machines with themself. A new firm in the economy cannot be replaced by machines themself in a short time.

2. A One-Sector Schumpeterian Growth Model

This section discusses a model more closely related to the original Aghion and Howitt (1992) thoughts. The previous model has based on the quality improvement of the machines. Also, innovations have been working as a factor of the production inputs. But this model explains labor supply of the R&D field in the production process.

Let us assume that, same previous assumptions have grounded here. Also rational propels are working in the market. Only deference that consumers are risk neutral. Under that conditions, aggregate production function is given below,

$$Y(\iota) = \frac{1}{1-\beta}\, x(\iota/q)^{1-\beta}\,[q(\iota)L_E(\iota)]^{\beta} \quad 4$$

q (t) is the quality of the machine in production. But deference about the previous model and this, these machines have labour access. It calls labour-augmenting a unique machine. *x (t/q)* is the quantity of this machine given at time *t* and *LE (t)* denotes the amount labor used in production at time *t*, which is less than *L*, since *LR (t)* workers will be employed in the R&D sector. According to these conditions, equation 5 explains the market clearance request,

$$LE\,(t) \mid LR\,(t) \leq L \qquad 5$$

Machines are involved in production at the constant marginal cost ψ in terms of the final good. After that point, production has been continuing by the labors using R&D and innovations. In particular, each worker employed in the R&D sector generates a flow rate η of a new machine. When the current machine used in production has quality *q (t)* the new machine has quality *λq (t)* Simply, after the point of the $\psi \equiv 1 - \beta$, Production has been governing by the skilled labors working in the R&D field. As a result, this study shows that the core findings of Aghion and Howitt's (1992) one-sector Schumpeterian model are quite similar to the baseline model of competitive innovations presented in the previous section.

3. Step-by-Step Innovations

This model is also highly appreciating the quality improvements of productivity. But deference is this model has undertaken innovation of any machine in the process. This means previous models have undertaken only innovations of the machines line in the productivity. But here this model has considered any machine in the process without

having developed any know-how on a particular line of business. This model is useful in providing a different conceptualization of the process of competitive innovations. Also analysis of the effects of competition and intellectual property rights policy. Consider time is continuous at given by *t*. Final productivities have allocated to economic contribution. Individuals with 1 unit of labour endowment populate the economy, which they offer inelastically. We assume that the instantaneous utility function has a logarithmic shape to make the calculations easier.

Let Y(t) is the aggregate production at the given time t. Production has been working on the closed economy, and consumption has based on final good only. Which means C (t) = Y (t). According to these conditions, economic growth function is given below,

$$g(t) \equiv \frac{\dot{C}(t)}{C(t)} = \frac{\dot{Y}(t)}{Y(t)} = r(t) - \rho \qquad 6$$

The equation defines g (t) as the growth rate, and r (t) is the interest rate at date t. The final good Y is produced using a continuum 1 of intermediate goods according to the Cobb-Douglas production function.

$$\ln Y(t) = \int_0^1 ln\, y(v,t)dv \qquad 7$$

Equation 7 shows aggregate production, where *y (v, t)* is the output of *v* th intermediate at time *t. v* is the final good price of at time t by *X (v, t)*. Where *y (vt)* based on the, l *i (v, t)* is the employment level of the firm and qi (v, t) is its level of technology at time *t.* This relationship is given below,

$$y(v,t) = qi(v,t)\, li(v,t) \qquad 8$$

This model explains, R&D and labor in the R&D field by the leader or the innovation. , also undertake R&D to catch up with the frontier technology. Because this innovation is for the follower's variant of the product and results from its R&D efforts.

Conclusion

In conclusion, this review paper introduces basic endogenous technological change models based on comparative innovations with research and development (R&D). Mainly this paper explains three endogenous growth models. These models were based on the "competitive innovations" to underline the role of company competition in both the invention process and the product market and labor in the R&D field. Competitive innovations result in a creative destruction process, in which new items or machines replace older versions, and therefore new enterprises replace ineffective ones. Also, technological progress does not always correspond to new products or machines. It emerges in many ways, R&D, skill labors working in the R&D field, and innovations are the key economic growth inputs in the future world. Also this study concludes the replacement

impact has based on the previous version of the technology. Simply replacement impact is a comparative replacement. This replacement has basted on the R&D. Therefore this deference is made by comparative innovations. Finally, these models might provide useful frameworks for the analysis of a range of industrial policies, R&D policies for future positive economies.

This paper important for study for understanding positive economics with policies, innovative practices, and growth theories. Therefore this review paper has motivated researchers to study comparative innovation theory for future economic development.

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