**Allyn Young, 1928, "Increasing Returns and Economic Progress"**
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## I. Introduction

This discussion note is a summary of the paper by Young (1928) about increasing returns and economic growth. Although in the same year Frank Ramsey made an important contribution on how economy's output time path evolves, the contribution by Young was quite different and is forerunner of what we call modern theories of endogenous growth, and Poverty Traps. Hence, to evaluate the argument of Young in light of developing countries, it is necessary to summarize his idea briefly. We then present the idea formally, and windup it with some remarks about his contribution.

## II. Summary of his analyses

He begins his analysis with consideration of the representative firm as a mechanism through which economies achieved in the industry are channeled to the market and shown in the price of the product the representative firm produces.

He claimed that industrial progress implied in the Marshalian distinction of internal and external economies is partial though this view better clarifies issues related to increasing returns. This can easily be realized if we consider that external economies in an industry are greater than the sum of internal economies of firms in an industry.

He then goes on challenging the classical view of exogenous improvements, i.e. the view that claims "improvements occur because they occur". Rather he followed the line of Smith's link between division of labor and market to explain how improvements occur. BUT NOT WITH THE CONCEPTION OF SMITH ABOUT DIVISION OF LABOR!!!!!!

Division of labor is broader than splitting occupation and emergence of experts due to specialization on jobs. He deals with two related aspects, namely, the growth of roundabout methods of production and division of labor among industries though his main focus seems the first.

### 2.1 Economies from Indirect/ roundabout method of Production

By roundabout method of production we mean capitalistic mode of production using capital input so as to enhance the future productivity of inputs. It is "a term devised by economists to describe the capitalistic, production process whereby capital goods are produced first and then, with the help of the capital goods, the desired consumer goods are produced" (http://www.mises.org/easier/R.asp)

He argued that with division of labor, set of complex processes are transformed in to simpler and simpler processes at lease for some through the use of capital inputs namely machinery which will in turn leads to further division of labor.  However, such economies due to the further division of labor are limited by the extent of the market. However, there are also economies accompanying such a division of labor, i.e. economies of second order. Such economies of second order create demand throughout the industry when firms buy inputs. If the firm, through indirect method of production, produces large units of output, then its derived demand will also be high creating demand in the economy.  With roundabout production costs fall as output rises and the economies generated through such a production method are becoming quantitatively large.

He then emphasized on two points: first, increasing returns is manifested in capitalistic economies or economies manifesting indirect method of production. **Here is, we believe, one of the most essential points of Young.  If increasing returns are characteristics of roundabout methods, then increasing returns require the tradeoff of current consumption for capital accumulation! The crux is**

**externalities from capital accumulation are the very source of economic progress!!!** To quote from him, in page 533 he said the following.

> Not only new or adventitious elements, coming in from the outside, but elements which are permanent characteristics of the ways in which goods are produced make continuously for change. Every important advance in the organisation of production, regardless of whether it is based upon anything which, in a narrow or technical sense, would be called a new " invention," or involves a fresh application of the fruits of scientific progress to industry, alters the conditions of industrial activity and initiates responses elsewhere in the industrial structure which in turn have a further unsettling effect. Thus change becomes progressive and propagates itself in a cumulative way.

To emphasize the importance of such externality, even in the absence of labor force growth and technical change due to new invention or application of basic science, increasing returns from externalities sustain economic progress, Young said the following.

> Even with a stationary population and in the absence of new discoveries [2] in pure or applied science there are no limits to the process of expansion except the limits beyond which demand is not elastic and returns do not increase.

However, such a progress due to increasing returns can be impeded due to several factors, such as it is not economically managed, and partly dependent up on trial and error. Basically realization of sustained progress from such coordinated investment by firms faces the following challenges.

First, Resources can't be easily transferred from one production activity to the others. Second, there is some minimum level of capital required to realize the economies which in turn requires time. But, Young believes that the discovery of new natural resources, technological progress, and population growth [while noting it is controversial] would enable an industry reach the stage where it can realize economies. But, he believes that MARKET SIZE IS THE MOST IMPORTANT FACTOR THAT ENABLE INDUSTRY REALIZE EXTERNALITIES FROM THE INVESTMENT OF FIRMS.

Second, externalities from indirect production are extremely dependent up on the extent of the market than any other forms of division of labor. However, Young argues, the usual " rational reorganization of industry" is not sufficient condition to have increasing returns due to large scale operations and mass production. He said, "Taking a country's economic endowment as given, however, the most important single facto in determining the effectiveness of its industry appears to be the size of the market." By large market, he pointed, is the capacity to buy and absorb large amount of output, which in turn depends on the capacity to produce, which he meant "... the size of the market is determined and defined by the volume of production."

### 2.2 Economies from Division of labor among Industries
He pointed out that industrial differentiation, as opposed to industrial integration, is associated with increased output. This can be noticed by looking the variety of products offered to consumers, growing diversification of intermediate inputs, and further diversification of manufacturing of special products which

totally sum to the growing complexity of life. Such a complication requires division of labor among industries. A computer manufacturer is not required to produce everything required for the production; rather, it can only produce part of the hardware in an industrial division of labor. There are also economies of increasing returns generated as a result of the division of complex tasks in to simpler tasks by firms across industries. He said

> The successors of the early printers, it has often been observed, are not only the printers of to-day, with their own specialised establishments, but also the producers of wood pulp, of various kinds of paper, of inks and their different ingredients, of type-metal and of type, the group of industries concerned with the technical parts of the producing of illustrations, and the manufacturers of specialised tools and machines for use in printing and in these various auxiliary industries. The list could be extended, both by enumerating other industries which are directly ancillary to the present printing trades and by going back to industries which, while supplying the industries which supply the printing trades, also supply other industries, concerned with preliminary stages in the making of final products other than printed books and newspapers.

Hence the specialization of industries creates demand for the products of firms, enable greater specialization in the management of industrial production, greater geographical distribution that involve nearness to raw materials, market, and lower transportation costs which ultimately create aggregate economies that is generated from the further division of labor among firms across different industries. Most importantly, division of labor across industries enables fuller realization of the externalities associated with indirect methods of production.


**2.3 Formal Presentation**
So as to formalize Young (1928) idea of increasing returns due to externalities from capital accumulation, let's assume the simplest framework. We assume a representative firm in an industry with neoclassical production function augmented by externalities. Although formalizing his idea with general production function and exogenously growing population enriches the formalization, we prefer to concentrate on stationary population and Cobb-Douglas' production function due to the time limit we have.

The production function of firm "i" is given by

$$Y_i = AK_i^{\alpha}L_i^{1-\alpha}K^{\lambda}, \forall \lambda \in [0, \infty)................(1)$$

Where $Y$[1] represents output, A is the state of knowledge which is assumed to be constant overtime so as to illustrate the crux of Young's point, $K_i$, is capital stock of the "$i^{th}$" firm, $\alpha$ is as usual the output elasticity of capital and K is the aggregate capital stock in the industry with elasticity of $\lambda$. The value of $\lambda$ represents the extent of externality in the industry. As described above, he believes that the externalities are limited by

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[1] As we deal with economic progress, each variable is implicitly assumed to be a function of time though it is not stated formally.

the extent of markets. The mechanisms through which economies or increasing returns realized are the growth of indirect /roundabout methods of production and division of labor among industries. Division of labor leads to the transformation of complex production processes to simpler and simpler processes. But, this further leads to division of labor which is determined by the extent of the market. Hence, from the growth of the roundabouts methods, there are first order economies, caused by the decline in per unit costs of production, and second order economies, caused by the boosted derived demand resulting in increasing returns. The causal arrows are spelled out as follows.

Initially, increased supply by a firm creates new demand within the industry through the mechanism of reciprocal demand principle of John Stuart Mill and Jean Baptist Say. But, the progress realized by the economies can be impeded by some factors such as change resistant nature of human materials. Moreover, realization of economies requires accumulation of capital which in turn needs time, and "natural scarcities, limitations or inelasticies of supply". However, he believes that, these problems can be removed through the investing above the critical minimum accumulation of capital. As it is not clear from Young how an industry joins from the low output low market trap to the virtuous circle of high output and increased demand, it is innocuous to assume that movement from the inefficient Nash equilibrium to the efficient is natural and simply follows as time passes.

In addition he believed that, the discovery of new natural resources, population growth and technological progress also play their own role in mitigating the problems till the industry reaches passes the critical minimum amount of capital stock needed to generate industry wide externality. Thus we assume (1) as production function in the mind of Young after the critical minimum level of capital is reached. By rewriting (1) in per unit of labor, we have

$$Y_i = A k_i^\alpha k^\lambda L_i L^\lambda ...............(2)$$

Firms in the industry are assumed to operate in a perfectly competitive market by following his suggestion "the principal economies which manifest themselves increasing returns are the economies of capitalistic or roundabout methods of production." At equilibrium, each firm will have the same capital labor ratio with any scale as this follows from neoclassical production function in a perfect market. Hence, (2) reduces to,

$$Y_i = A k_i^{\lambda+\alpha} L_i L^\lambda ...............(3)$$

Hence the production function of the representative firm in an industry can be rewritten as

$$Y = A k^{\lambda+\alpha} L^{\lambda+1} ...............(4)$$

Which finally is reduced to the industry wide production function in (5); obviously, as long as $\lambda$ is positive the production function in (5) illustrates increasing returns to capital accumulation.

$$Y = A L^{1-\alpha} K^{\lambda+\alpha} .................(5)$$

As the evolution of output in this frame work is assumed from capital stock only and technical change and labor force are assumed to be constant. Hence, output is a function of capital accumulation by firms and in unchanging state of knowledge, the time path of output of an industry entirely depends up on the evolution of capital stock. Following the specification in the lecture note by Peter Thompson[2], the evolution of capital stock of a firm is specified as

$$\dot{K} = I - \delta K .....................(6)$$

Where, as usual in economics and/or Math, the dot over a variable indicates its derivative w.r.t time and I is investment by a firm and $\delta K$ is instantaneous depreciation of capital. Without loss of generality and for technical reasons, we assume Investment is a constant proportion of output produced $\rho Y$. However, we can endogenize this proportion by inculcating financial market in to the picture but, it will not be easily tractable for our purpose and will be left out for the rest of the paper. It is not bad assumption if we treat capital stock as industry wide. Hence, we have (7) which is easy to handle using Bernoulli method.

$$\dot{K} + \delta K = \rho AL^{1-\alpha} K^{\lambda+\alpha} \quad .......................(7)$$

Since the term $\rho AL^{1-\alpha}$ is assumed to be constant, we can safely assume that $\psi = \rho AL^{1-\alpha}$ and $\alpha + \lambda = \eta$ so that the above differential equation is reduced to

$$\dot{K} + \delta K = \psi K^{\eta}$$

After little algebra, one can easily see that the time path of capital stock is given by

$$K_t = \left\{ \left[ K_0^{1-\eta} + \frac{\psi}{\delta} \right] e^{-(1-\eta)\delta t} + \frac{\psi}{\delta} \right\}^{1/1-\eta} \quad ...........(8)$$

Now, (8) is simpler to see what Young has in mind. By taking natural logarithm of (5) and differentiating with respect to time, we get the progress in the industrial output as

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + (1-\alpha)\frac{\dot{L}}{L} + (\lambda+\alpha)\frac{\dot{K}}{K} = \eta \frac{\dot{K}}{K} \quad ...............(9)$$

.To see what happen to the time path of industrial output of the representative firm as time approaches to infinity, it suffices to check the time path of capital stock of the firm, namely $\lim\limits_{t\to\infty} K_t$ ,whose value depends

up on $\eta$ .

If $\eta > 1$, then $\lim\limits_{t\to\infty} K_t = +\infty$ ! The message from Young is then, the economy grows forever even in the absence of change in the basic knowledge! He believes that in partial equilibrium " *...[industries] can increase their output without increasing their costs proportionately, or to the possible advantage of fostering the development of such industries while putting a handicap upon industries whose output can be increased only at the expense of a more than proportionately increase in costs*"

On the other hand, if $\eta < 1$, then $\lim\limits_{t\to\infty} K_t = \left\{ \frac{\psi}{\delta} \right\}^{1/1-\eta}$ reducing $\lim\limits_{t\to\infty} \frac{\dot{Y}}{Y} = 0$ ! Hence this result reduces the

model in to Poverty trap model. However, Young excludes this result by resorting to the discovery of new natural resources, technical change, and population growth.

**III. EVALUATION**
In general, we believe that, had the great depression not diverted the attention, economists would have saved a lot of effort in understanding on increasing returns of the aggregate production function quite earlier. Modern theories of such a kind are remerged in 1986 &1987 by Stanford economist Paul Romer and Chicago economist Robert Lucas Jr. in 1988. In the small section below, we try to give some assessment as to what seems reasonable [of course for us! And you may comment over it.] We have grouped the points in to externalities from capital accumulation, resource endowments, and population growth and the evidence we have from large number of modern theories which at least qualify his argument.

**3.1 On Capital Externalities**
We believe most of the arguments in the whole paper are essential for developing countries except some qualifications. As described earlier, as each firm invest and produce, they create market. Firms benefit from the economies of other firms as a result of which there exist complimentarity between the investment of a firm and the rest of firms in an industry. We have some empirical evidences, though more or less from two authors only, from Delong and Summers (1992),[3] Delong (1992), Delong (1992)[4], and Delong (1999)[5] on

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[3] . Bradford DeLong and Lawrence H. Summers (1992), "Equipment Investment and Economic Growth: How Robust Is the Nexus?" *Brookings Papers on Economic Activity*

externality of capital accumulation. The evidence suggests the existence of industry and economy wide externalities from investments of firms in equipments. However, the evidence is limited to more developed nations and it is not clear as to its extent in developing nations. We strongly believe this externality is essential for developing nations. As the market for most of the output they produce is very limited due to bulkiness and transportation costs, it seems reasonable that LDCs are not benefiting from such an externality.

## 2.2 On Resource Endowment

Young claimed that discovery of new natural resource is a means of relieving natural scarcities that impede the externalities supposed to be realized. However, the importance of resource endowment for poor countries is questionable.  For some countries, such as Democratic Republic of Congo and Angola, by interacting with geographical factors, resource endowment has facilitated the emergence of extractive institutions which persist still today[6]. The importance of resource endowment however is different in countries which are characterized by what Hall and Jones (1999)[7] call social infrastructure. Or instance in Norway, the discovery of oil has served the economic performance very well. There is sufficient empirical evidence that clearly shows the effect on economic progress of resource endowment is dependent up on the quality of institutions. Mehlum, Moene, and Trovik (2002)[8], Easterly and Levine (2003)[9] and Sala-i-martin and Arvind Subramanian(2003)[10],  show using cross country and country specific data set that the effect of resource endowment on economic progress largely depends on the existence of property right institutions or not at large. We feel, although it is predetermined, resource endowment is good for LDCs with good quality of institutions and bad for others without it.

## 2.3 On Population Growth

Young admitted that the effect of population growth is subject to controversy. It can be a source of market and ideas. How ever, it acts also as effective depreciation on accumulation of capital stock and production of output. The evidence on population growth is at best mixed. In poor countries, population growth creates pressure on the existing social and economic services and acts negatively on the participation of women in the economy. Some recent papers have argued that technical change over very long run is dependent up on population growth. However, a number of recent papers suggest that it is negatively related to economic progress. See Durlauf and Quah (1998)[11]. We believe, population growth is not good for developing nations. While they are unable to provide sufficient schooling, food, shelter, and income for the existing population, it is not fair from at least moral ground to bring new children to suffer!

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[4] J. Bradford DeLong (1992), "Machinery Investment as a Key to American Economic Growth," in Mark Bloomfield, Margo Thorning, and Charls Walker, eds., *Tools for American Workers* (Washington, DC: American Council for Capital Formation)

[5] J. Bradford DeLong, (1999) "What Do We Really Know About Economic Growth?" in Michael Boskin., ed., *Economic Growth* (Stanford: Hoover Institution, forthcoming)

[6] See Acemoglu, D., S. Johnson and J.A. Robinson: (2001) *"The Colonial Origins of Comparative Development: an Empirical Investigation"*, American Economic Review,  91 (5)

[7] Hall, R.E. and C.I. Jones: (1999) *"Why Do Some Countries Produce So Much More Output Per Worker Than Others?" Quarterly Journal of Economics*, February 114 (1)

[8] Halvor Mehlum, Kalle Moene, and Ragnar Trovik (2002), Institutions and the Resource Curse. http://folk.uio.no/karlom/natres.pdf

[9] William Easterly and Ross Levine(2003) "Tropics, germs, and crops: the role of endowments in economic development",Journal of Monetary Economics, 50:1

[10] Sala-i-martin Xavier and Arvind Subramanian(2003) "Addressing the Natural Resources Curse: An Illustration from Nigeria" NBER Working No. 9804

[11] Durlauf Steven and Danny T. Quah (1998), The New Empirics of Economic Growth, NBER Working No. 6422.