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DETECTION OF INTER-STATE KUZNETS CYCLE THROUGH NEO-CLASSICAL AND NEO-KEYNESIAN PARADIGMS

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ABSTRACT

Kuznets hypothesis (1955, 1963) has established a link between inequality and average well-being at the level of economy. The hypothesis maintains that given a two-sector economy with not much inequality within sectors but different sectoral mean incomes, a continuous transfer of population from one sector to another will initially raise the aggregate inequality and it will decrease at later stage. Several attempts [Knight (1976), Robinson (1976), Sen (1984), Harriss (1986), Braun (1988), Deaton (1989), Anand and Kanbur (1990), Hadd and Kanbur (1992), Alperovich (1992)] have been made to test this hypothesis empirically but this hypothesis was not tested in relation to inter-state income inequality which is imperative for identification of the poorer states / regions during the process of economic development as well as change in the degree of inter-state income inequality. The policy significance of the present analysis is that in view of existence of "inverse U" pattern / Kuznets cycle in inter-state income inequality, it helps in designing the appropriate resource transfer scheme for the states by the federal government in order to establish the horizontal equity among the states.

KEYWORDS

Kuznets Curve, Kaldor-Pasintti model, Concavity of Inequality function, Multi-Sector etc.

1. INTRODUCTION

It is about forty seven years ago, Prof. Simon Kuznets (1955,1963) formulated a hypothesis which maintains that given a two-sector economy with not too distinct degrees of sectoral mean incomes, a perennial shift of population from one sector to another will initially raise aggregate inequality and it will decrease at later stage. This formulation has been labelled as the "Inverted U" (I-U) hypothesis or kuznets cycle (Branlke1983).

There exists difference of opinion as to what the I-U hypothesis actually stands for. Sometimes, it is argued that inverted shape is merely a technical property of some inequality measures (Knight 1976) while Robinson (1976) showed the same to hold true if the varience is taken as measure of inequality. The other group of experts [Oshima (1962), Adelman and Morris (1973), Paukert (1973), Della Valle and Oguchi (1976)] have interpreted the I-U hypothesis as a theory about the nexus between economic development and inequality. There have been several attempts [Ahulwalia (1976), Sen (1984), Harris (1986), Braun (1988), Deaton (1989), Anand and Kanbur (1990), Hadd and Kanbur (1992), Alperovich (1992), Braulke (1983), and Shreman Robinson (1976)] to test this hypothesis empirically, in case of only two sector. The more realistic assumption would be to explore the possibility of existence I-U hypothesis in case of multi-sectoral/region economy. The existence of "I-U" hypothesis, for a multi-sectoral economy has its far-reaching consequences over the policy decisions of the modern welfarestic governments. For instance, in the light of this hypothesis, the poorer states/regions of the economy may be well identified during the process of change in the degree of inter-sectoral economic inequality. Accordingly, the government may introduce corrective measures to check the unwarranted degree of inter-sectoral/inter-regional economic inequality.

In the present paper, an attempt has been made to test the existence of "I-U" hypothesis/Kuznets cycle for a multi-sectotal / multi regional economy under the framework of basic assumption of Neo-classical and Neo-Keynesian growth models. The scheme of the present paper is as follow.

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Section II provides major assumption of the Neo-classical and Neo-Keynesian growth models. In section III, a theoretical model has been developed that provide support for existence of "I-U" hypothesis for a multi-sectoral economy. Section IV deals with a brief discussion pertaining to various inequality indices that are used in the present paper. Concluding observations are contained in section V.

2. NEO-CLASSICAL AND NEO-KEYNESIAN GROWTH MODELS: MAJOR ASSUMPTIONS

The Neo-Classical economist [Solow (1956. 57, 85), Swan (1960)] have derived the conditions of steady state economic growth under certain assumptions. Prof. Solow has taken the assumption of aggregate homogeneous production function, continuously substitutable inputs of labour and capital, fixed technology and constant growth in the labour force. Under these assumptions, Prof. Solow has established a unique growth path that displayed full employment of all resources where the rate of growth of total income equal to the rate of growth of labour force. This growth path is one where total output grows, but output per head remains constant.

In the Neo-keynesian approach to economic growth, Kalechi (1954, 71), Steindl (1952), Kaldor (1955-6, 60) and Pasinetti (1962, 77,81) have explained the inter-relationship between income distribution and economic growth in a lucid manner. The Kalechi-Steindl (K-S) model assumes that the firms set the price level as a mark up on the prime costs; the mark up rate is given[1]. Next, the firms have a higher desired rate of accumulation if the profit rate is higher or the rate of capacity utilization is higher. On the basis of these assumptions, the K-S models concludes that reduction in the industrial concentration raises the real wage and provides a re-distribution of income towards workers and it ultimately results in a higher degree of capacity utilization. In other words, a better distribution of income is associated with a higher rate of economic growth.

The effect of skewed income distribution on economic growth is also explained by the growth models of Kaldor and Pasinetti (K-P). The K-P model assumes that income (Y) is divided into two broad categories, wages (W) and profit (P). Next, the model assumes that the marginal propensity to save for wage earners are less than those of capitalists is. Further, assuming the identity between the saving and the investment i.e. $I \equiv S$, the K-P model concludes that the share of profit in income is direct positive function of ratio of investment to profit[2]. In other words, the skewed income distribution in favour of profit earner class is an essential condition for steady state economic growth.

3. GENERALIZED INVERSE-U HYPOTHESIS: THEORETICAL JUSTIFICATION

At it is obvious from the narrations contained in section II that the economic growth is closely associated with the distribution of income, we shall consider here the "I-U" hypothesis as a theory about the nexus between economic growth and inequality. The basic assumptions of Neo-classical and Neo-Keynesian growth models will be taken here to test the existence of "I-U" hypothesis for a multi-sectoral economy. Since there is a very close positive correlation between per capita Gross Domestic product (GDP) and economic growth, the per capita GDP is considered as good indicator of country's economic growth.

Let us assume n sectors/states in an economy whose respective GDP are.

$$Y_1, Y_2, Y_3 \ldots\ldots, Y_n \qquad (3.1)$$

In a developing economy, sectoral income (Y_i) may be taken as direct positive function of time (t). There would be various functional forms[3] explaining the relationship between Y_i and t. Let us assume linear relationship between Y_i and t which is given by eq. (3.2) as.

$$Y_i = \alpha_0 + I_Y.t + u_i \qquad (3.2)$$

Where α_0 is constant, I_Y is a constant which reveals some form of inter-sectoral economic inequality[4] in the sectoral domestic produicts and U_i is the random disturbance term. Differentiating Eq. (3.2) w.r.t. time (t), we get,

$$\frac{dYi}{dt} = I_y \quad (3.3)$$

Obviously, Eq. (3.3) corroborates the basic sprit of Neo-Keynesian model of economic growth. Economic disparity among various sectors is governed by several socio-economic factors but for simplicity, only two factors i.e. GDP (Y_i) and population of respective sectors (P_i) have been taken in the present model. In other words,

$$I_Y = \phi\,(Y_i, P_i) \qquad i = 1,2\ldots\ldots n \quad (3.4)$$

from (3.3) and (3.4)

$$\frac{dY_i}{\;} = \phi(Y_i, P_i) \quad (3.5)$$

Let us assume that population of the various sectors are growing at a constant rate m. Thus, growth in populations of the sectors will be function of time (t), and we may write.

$$P_i\,(t) = P_i\,(o)\,.\,e^{mt} \quad (3.6)$$

where $P_i(t)$ is population of the ith sector at time t, P_i (o) is the initial population of ith sector at time t and m is its growth rate.

Substituting population growth rate as specified by Eq. (3.6) in the inequality function (Eq. 3.5), we get,

$$\frac{dY_i}{dt} = \phi\left[Y_i, P_i(O).e^{mt}\right] \quad (3.7)$$

Equation (3.7) reveals the time path that change in GDP of the various sectors must follow when respective population of the sectors grow at the constant rate (m). It now helps us to investigate the behavior of ratio of GDP of the sectors, and their respective population. To do this, let us introduce a new variable q (per capita GDP of the sectors) where $q_i= Y_i/P_i$ or $Y_i=qi\,.\,P_i$ and substituting this relationship into (3.6), we get,

$$Y_i = q_i.P_i(o).e^{mt} \quad (3.8)$$

Differentiating Eq. (3.8) with respect to time, we get,

$$\frac{dY_i}{dt} = q_i.m.P_i(0).e^{mt} + \frac{dq_i}{dt}.p_{i(0)}.e^{mt}$$

$$\Rightarrow \frac{dy_i}{dt} = \left[q_i m + \frac{dq_i}{dt}\right].P_i(0).e^{mt} \quad (3.9)$$

From Eq. (3.8) and Eq (3.9), we get

$$\left[\frac{dq_i}{dt} + q_i m\right].P_{i(o)}.e^{mt} = \phi\left[Y_i.P_i(0).e^{mt}\right] \quad (3.10)$$

In order to express Eq. (3.10) into more meaningful way, let us make use of the assumption that the inequality function follows constant returns to scale. This shows that the inequality function is homogeneous of degree 1. Applying the properties of homogeneous function, Eq (3.10) can be written as:

$$\left[\frac{dq_i}{dt} + q_i m\right].P_{i(o)}.e^{mt} = P_{i(0)}.e^{mt}.\phi\left[\frac{Y_i}{P_i(0).e^{mt}},1\right] \quad (3.11)$$

or

$$\frac{dq_i}{dt} + q_i m = \phi\left[\frac{Y_i}{P_i(0).e^{mt}},1\right] \quad (3.12)$$

or

$$\frac{dq_i}{dt} = \phi\left[\frac{Y_i}{P_i(0).e^{mt}},1\right] - q_i m \quad (3.13)$$

Substituting $q_i = Y_i/P_{i(0)}.\ e^{mt}$ in Eq. (3.13), we get,

$$\frac{dq_i}{dt} = \phi(q_i,1) - q_i m \quad (3.14)$$

Equation (3.14) is a differential equation with per capita GDP (q_i) as its variable and it yields several interesting results.

For instance, if per capita GDP is constant over time then $\frac{dqi}{dt} = 0$ and therefore the GDP of various sectors must be growing at the same rate m, as the population of the sectors. In this case, from Eq (3.14), we get

$$q_i m = \phi(q_i m) \quad (3.15)$$

In the next situation, consider the behavior of the inequality function when per capita GDP is changing i.e. $q_i m \neq \phi(q_i,1)$. Here, we will consider two limiting cases. First, there is no inter-sectoral income inequality i.e. inequality function is zero and Eq. (3.14) reduces to

$$\frac{dqi}{dt} = -q_i m$$

$$\Rightarrow \quad \frac{dq_i}{dt} / q_i = -m \quad (3.16)$$

It is obvious from Eq. (3.16) that proportionate change in per capita GDP is minus the proportionate rate of change in population of the sectors. In order to derive the second limiting case, assume that m=0 i.e. population of the various sectors is constant over time. Now Eq. (3.14) reduces to:

$$\frac{dq_i}{dt} = \phi(q_i,1)$$

$$\Rightarrow \quad \frac{dq_i}{dt} / q_i = \frac{1}{q_i}\phi(q_i,1) \quad (3.17)$$

$$\Rightarrow \quad \frac{dq_i}{dt}/q_i = \frac{P_i}{Y_i}.\phi\left(\frac{Y_i}{P_i},1\right) \tag{3.18}$$

$$\Rightarrow \quad \frac{dq_i}{dt}/q_i = \phi\frac{(Y_i,P_i)}{Y_i} \tag{3.19}$$

It is obvious from Eq. (3.19) that proportionate change in per capita GDP of the various sectors is equal (when m=0) to ratio of inequality function to GDP of the sectors.

Eqs. (3.16) and (3.19) reveal that $\frac{dq_i}{dt}$ in Eq. (3.14) is sum of two components as explained by equations (3.16) and (3.19)

In order to plot $q_i m$ and ϕ (q_i,1),let us assume that q_i is plotted on the X-axis and $\frac{dq_i}{dt}$ on the Y-axis. To get the line $q_i m$, we set ϕ (q_i,1)=0 and plot the relationship between qi and $\frac{dq_i}{dt}$, ignoring the negative sign. This line which has a slope of m, reveals how fast per capita GDP would be declining for a given rate of growth of population for various sectors.

To obtain ϕ (q_i,1), let us assume that q_i m is zero and plot the relationship between qi and $\frac{dq_i}{dt}$ which is given by $\frac{dq_i}{dt} = \phi(q_i,1)$. Here it is important to consider the shape of curve ϕ (q_i, 1). The expression ϕ (q_i,1) may be interpreted as inter-sectoral economic inequality curve with sectoral population input held constant at one unit and per capita GDP of the sectors as the variable factor. The assumption of diminishing returns to one factor is enough to assume that the slope of ϕ (q_i,1) must declining as q_i is increased.

Is obvious from fig.1 that the inequality function ϕ (q_i,1) is strictly concave[5] everywhere for all the possible values in the range (0, q_i*). The economic inequality function (inter-sectoral economic inequality in per capita GDP) increases, reaches to maximum and then declines as per capita GDP of the sectors increases. More specifically, the inter-sectoral economic inequality in per capita GDP takes the shape of "inverse-U" with respect to time. Next, the relationship between ϕ (q_i,1) determines optimal size of per capita GDP of the n sectors of the economy given the "inverse –U" shape in inequality in per capita GDP.

4. MEASURES OF INCOME INEQUALITY

There exists plethora of literature on measures of income and wealth inequality. The conventional inequality measures (Atkinson 1970, 83) that are most frequently used in empirical research are (a) the coefficient of variation i.e.

$$\sigma/\mu \tag{4.1}$$

and (b) the standard deviation of logarithms i.e.

$$\int_0^{\bar{Y}} \{\log(y/\mu)\}^2 f(y).dy \tag{4.2}$$

where Y, σ and μ are in usual notations.

Dalton's Principle of transfer (1920) has established that measure of inequality should increase when income is transferred from a poor person to a richer person. Chapernownq (1974) argues that coefficient of variation is most sensitive to inequality of extreme income that procedures a flat response to the transfers. The variance of logarithms of income may be interpreted as a measure of concentration of incomes since it can be estimated through the framework of Lorenz's measures of concentration (Aitchinson, J and Brown, J.A.C., 1957).

An attractive way to measure income inequality without imposing a functional form of statistical distribution on income graduation is to use Lorenz-based inequality measures. In the Lorenz diagram (Fig.2), the proportion of income receivers having income less than x is measured along x axis and the proportion of total income accruing to the same income receivers along the y-axis. The points plotted for the various values of x trace out a curve below the line sloping 45^0 from the curve explains the relation between the distribution function F(x) and the first-moment distribution function F_1 (x), given by

$$F_1(X) = \int_0^X tdF(t) / \int_0^\infty tdF(t) \qquad (4.3)$$

It is obvious form the Lorenz diagram that the measure of income concentration is the ratio of the shaded area between the Lorenz curve and the 45^0 line. The income concentration (L) for the log normal hypothesis is defined as.

$$L = 1 - 2\int_0^\infty F_1(x)dF(x) \qquad (4.4)$$

substituting the value of F_1 (X)[6] in Eq (4.4) we get

$$L = \left[2N\left\{ \frac{\sigma}{\sqrt{2}} | 0,1 \right\} - 1 \right] \qquad (4.5)$$

Obviously, the measure of concentration (L) is monotonically related to value of σ^2 and thus the parameter σ^2 (variance of logarithms of the income) may well be interpreted as a measure of income inequality.

The Lorenz curve may again be generated by defining the income earner units, say, quintile shares where q_i, i= 1,2,.. n reveals the share of ith income earner. Let, incomes are arranged in ascending order i.e.

$$o \le q_1 \le q_2 .... \le q_i ..... \le q_n \le 1 \qquad (4.6)$$

From the order of the incomes as shown by Eq. (4.6), several well known income inequality measures may be derived (Slottje, D.J., Basmann, R.L. and Nieswiadomy, M., 1989).

For example, the Gini (1912) measure of income inequality is given by

$$G = 1 - \frac{1}{n} - \frac{2}{n} . \sum_{i=1}^{n-1} (n-i) q_i ... \qquad (4.7)$$

and the relative mean deviation (Cowell, 1980)

$$R = \frac{1}{2} . \frac{n}{n-1} \left[\sum_{i=1}^{n} \left| q_i - \frac{1}{n} \right| \right] \qquad (4.8)$$

Theil's (1967) entropy measure (normalised) is given by

$$T = 1 + \frac{1}{\ln(n)}\left[\sum_{i=1}^{n} q_i . \ln(q_i)\right] \quad (4.9)$$

Kakwani's (1980a, 80b) measure is defined by

$$K = \frac{\left\{\sum_{i=1}^{n}\left[\sqrt{q_i^2 + 1/n^2}\right] - \sqrt{2}\right\}}{2 - \sqrt{2}} \quad (4.10)$$

The survey of literature on income inequality reveals that Gini coefficient suffers with serious drawbacks. For instance, the simple aging of populations will raise income inequality (Morgan, 1962). The Gini Coefficient is also insensitivity to non-money components and differential price indices between states, which exaggerate income inequality in rural areas (Jonish and Kau, 1973). It is found that Gini ratio is more responsive to changes in income of the middle class rather than among the rich or poor (Allison, 1978 and Osberg, 1984). Reynolds and Smolensky (1977) have concluded that despite of major changes in taxation and welfare during 1950-70 in United States, inequality as measured by Gini Coefficient remained unchanged. It is obvious that the Kakwani measure and the Gini ratio measure every different properties of the Lorenz Curve (Basmann, R.L. Slottje, D.J., 1987). The Gini ratio measures a property of distribution inequality that varies in direct proportion to the area of the closed geometric representation (Fig.2) and bounded below by the horizontal axis on the right by the Lorenz Curve itself while the Kakwani measure correlates a property of distributional inequality that varies directly with the perimeter if the closed geometric area (Fig.2).

The relative mean deviation violates the principle of transfer since it is insensitive to transfer between income units on the same side of the mean. Theil (1967) proposed decomposable measures based upon the Lovenz Curve that satisfy dalton's Principle of Transfer (Allison, 1978). Theil index is similar to the Gini index since it is too sensitive to movements in the middle part of the income distribution (Osberg 1984).

Atkinson (1970) developed a new measure of income inequality and argued that there should be social welfare function with each measured of income inequality. The index is defined as.

$$\text{Atkin } (I) = 1 - \left[\sum_{i}\left[\frac{y_i}{\mu}\right]^{1-\epsilon} .f(Y_i)\right]^{\frac{1}{1-\epsilon}} \quad \epsilon \geq 0 \quad (4.11)$$

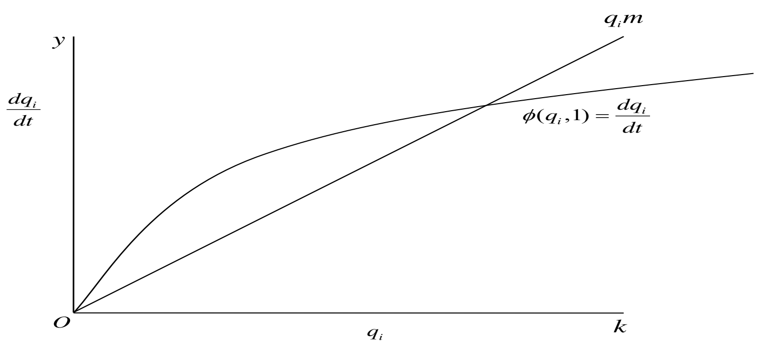
The value of ϵ, which is clearly a measure of the degree of inequality-aversion reveals the relative sensitivity to transfers at various income levels. As ϵ increases, inequality is emphasized much among the poors. Atkinson observed that if we take ϵ=1.0 which implies a lower degree of inequality aversion then the ranking is closer to that of the Gini ratio. A wide range of values of inequality aversion emphasized the inequality at the top of the distribution (ϵ=0.5) and at the bottom (ϵ=1.0).

5. CONCLUDING OBSERVATIONS

The relationship between inequality and average well-being at the level of an economy was first established by Prof. Kuznets. In the present paper, a theoretical model is developed which supports the existence of an inter-state Kuznets curve. More specifically, the inter-state income inequality first increase attains the maximum and them declines as the states become better-off.

The policy significance of the present analysis is that in view of existence of "inverse U" pattern/Kuznets cycle in inter-state income inequality, it helps in designing the appropriate resource transfer scheme for the states by the federal government in order to establish the horizontal equity among the states..

Figure-1: Kuznets's Hypothesis and Shape of Inequality Function



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Notes

1. The Kalechi-Steindl model of economic growth assumes that the firms are not price takers in a perfectly competitive economy. Under the assumption of fixed coefficients and constant returns to scale, the firms set prices when wage i.e. W is given. Thus, the price becomes independent of demand and is determined by the firms as a markup on the prime costs i.e. $W.a_0$ was such that

   $$P= Wa_0 (1+z) \quad (N.1)$$

   Where Z signifies the degree of monopoly power which depends, among other things, on the extent of industrial concentration. For details, see Dutt, Amitava (1990); Ch.2.

2. The Kaldor-Pasinetti model of economic growth assumes following income indentities:

   $$Y \equiv W+P \quad (N.2)$$
   $$I \equiv S \quad (N.3)$$
   $$S \equiv S_w + SP \quad (N.4)$$

   Where Y,W, P, I and S stand in usual notation and S_w and S_p denote savings of workers and profit class respectively. Taking investment as given, and assuming simple proportion saving function i.e.

   S_w = sw. W
   And SP= sp.P (N.5)
   We get,
   I = sp.P + sw.W (N.6)
   $\Rightarrow$ I= sp.P + sw (Y-P)
   = (sp-sw) P + sw.Y (N.7)
   $\Rightarrow$ I/Y = sw+ (sp-sw) P/Y (N.8)
   and

   $$\frac{P}{Y} = -\frac{SW}{(sp-sw)} + \frac{1}{(sp-sw}.\frac{I}{Y} \quad (N.9)$$

Equations (N.8) and (N.9) reveal interdenedence of income distribution and economic growth. For instance, N.8 reveals that increasing proportion of profit in the income is essential for steady economic growth. Similarly, N.9 explains that proportion of profit in the income would be negative when there is no investment in the economy.

3. In additions to linear functional form between two variables, there would be several other functional form i.e. quadratic, hyperbolic, semi-logarithmic, log-quadratic, log-hyperbolic and double logarithmic. For details, see Johnston, J. (1988), Econometric methods, Singapore; Mcgraw-Hill Book Company.

4. Inter-sectoral structure of income as well as it change over time (dyi/dt) may be explained through various measures of inequality in income and wealth. A brief discussion about inequality increases is contained in section IV of this paper.

5. The function ϕ (qi,1) is strictly concave since d2 ϕ (qi,1) is negative definite. It is easy to verify that in the inequality function IY = ϕ (Y,P),

   Equation $$\frac{\partial^2 I_y}{\partial Y^2} \langle 0$$

   And
   $$\begin{bmatrix} \frac{\partial^2 I_Y}{\partial Y^2} & \frac{\partial^2 I_Y}{\partial Y.\partial P} \\ \frac{\partial^2 I_Y}{\partial Y.\partial P} & \frac{\partial^2 I_Y}{\partial P^2} \end{bmatrix} \rangle 0$$

6. Let, consider a positive variate X (0<x<∝) such that Y= Log X is normally distributed with mean μ and variance σ2 then we say that X is log normally distributed or that X is a Λ-variate and write : X is Λ(μ, α2) and correspondingly Y is N (μ, α2). Since we know that Y log X, the distribution function of X and Y are related by

   Λ (X) = N(log x) (X>0) (N.10)

   And

$$d\Lambda(x) = \frac{1}{X\sigma\sqrt{2\pi}} e^{\left\{-\frac{1}{2\sigma^2}(\log X - \mu)^2\right\}} dx(X > 0) \quad \text{(N.11)}$$

It is also true that j-th moment distribution of a Λ-distribution with parameters μ and α^2 is also a Λ-distribution with parameters $\mu+J\alpha^2$ and α^2. Applying this theorem, Ef\q. (4.4) can be written as:

$$L = 1 - 2\int_0^\infty \Lambda\left(X \middle| \mu + \sigma^2, \sigma^2\right) d\Lambda\left(X \middle| \mu, \sigma^2\right) \quad \text{(N.12)}$$

$$= 1 - 2\Lambda\left(1 \middle| \sigma^2, 2\sigma^2\right)$$

$$= 1 - 2N\left[\frac{-\sigma}{\sqrt{2}} \middle| 0,1\right]$$

$$= 2N\left[\frac{\sigma}{\sqrt{2}} \middle| 0,1\right] - 1 \quad \text{(N.13)}$$

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