Pro poor growth : A partial ordering approach

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Abstract

The paper examines the partial pro poor orderings for different growth curves and sets of Equally Distributed Equivalent growth rate dominance. A new pro poor growth curve as the of change of Gini social welfare function, based on the quantiles of logarithmic income, has been proposed. It has been established that the newly proposed growth curve including its relative version i.e its deviation from the growth rate of mean, is robust to other growth curves that has been proposed in the literature, in terms of conclusiveness. Empirical illustrations are provided using Monthly per capita expenditure data, for different states of India, officially collected by National Sample Survey Office. It has been observed that the absolute and relative versions provides conclusive result in many cases where other pro poor growth curves fails to do so. Growth in rural and urban India is pro poor in an absolute sense, since from the early 1990s. Although, relative pro poor growth has been achieved for some spells in rural India, but, in Urban India, it is in general biased to the non-poor in most of the spells.

Key words: Pro Poor Growth; Stochastic dominance; Inequality; India

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1 Introduction

Most of the developing economies show evidence of increment of growth rate over the last few decades. Questions have been raised by academicians and policy makers, whether poorer section of the society enjoys the benefit from it. Thus the concept of pro poor growth evolved, mainly, to analyze the fact, whether growth is favorable to the poor or not.

The notion "*pro poor growth*" might be analyzed by two different senses. In general growth is said to be pro poor in an absolute sense, if it raises income of the poor, or poverty declines See Kraay (2006) . Following Kakwani and Pernia (2000), growth is labelled as "pro-poor" in a relative sense, only if it raises the incomes of poor proportionately more than that of the non poor. Osmani (2005), criticized, both these approaches.[1] He proposed a stronger absolute definition of pro-poor growth, that growth is pro poor if the poverty reduction is higher than the benchmark level. However, establishing such a benchmark is not easy and is always debatable. On the other hand, this is also a relative approach, which can be traced back to Kakwani and Pernia (2000).

Both, absolute and relative pro poor growth might also be evaluated with two alternative ordering approaches, viz complete and partial ordering approach. Any ordering satisfying reflexivity, transitivity, and completeness property is a complete ordering approach.[2] For example, as a result of increment of average income, if head count ratio declines, growth is said to be pro poor in an absolute sense. The main problem of this approach is it ignores

[1]According to Osmani, '*'simply reducing poverty cannot, in general, be a sufficient condition for pro-poorness....In that sense, Kakwani's definition is a move in the right direction. He calls a growth process pro-poor only when the poor benefit proportionately more than the rich. But he takes the bias to an extreme, leading to potentially counterintuitive implications.*" (Osmani, 2005).

[2]For details on these properties see Chakravarty (1990).

the fact that choice of a different poverty index, or a different poverty line might alter the result. Partial ordering pro poor growth on the other hand relaxes the completeness axiom. Although situations might end inconclusively, but conclusions if provided is robust to the choice of different class of index and/or parameter used to compute those index.

Partial pro-poor ordering begins with the contribution of Ravallion and Chen (2003). They proposed Growth Incidence Curve (GIC), which measures the rate of change of income quantile. A conclusive result is obtained following GIC, if it lies strictly above zero for at least one quantile and not below zero for any of the quantiles. Son (2004) developed a new approach on the basis of Atkinson (1987) theorem linking the generalized Lorenz curve and changes in poverty, and proposed a new growth rate curve namely poverty growth curve (PGC). GIC and PGC provides conclusive result if there is evidence of first and second order stochastic dominance of one distribution over the other respectively. Since, Stochastic dominance conditions are nested, PGC provides better results than GIC, in terms of conclusiveness. A relative version of GIC and PGC are derived considering their deviations from the average growth rate of the society. Recently, Duclos (2009) suggested a relative pro poor orderings approach, based on normalizing income of all individuals by any pro poor standard.

Adopting a complete ordering approach, Nssah (2005) introduced a concept called Equally distributed Equivalent Growth rate(EDEGR). EDEGR is almost similar to equally distributed equivalent income introduced by Atkinson (1970), as the growth rate socially equivalent to observed one, for some choice of a focal parameter, which measures the degree of inequality aversion. EDEGR might also be represented as weighted average of the points of the GIC, where the weights has been restricted to Relative Extended Gini Index type. Nassah also defined Distributive Adjusted Factor (DAF), considering the deviation of EDEGR from the growth rate of mean. She declared that absolute and relative pro poor growth occurs in the society, when EDEGR and DAF respectively are strictly positive.

Our first objective in this article is to relax the restrictions on the weights adopted by Nssah. We begin by introducing a concept called EDEGR dominance. EDEGR dominance is obtained, if EDEGR is non negative for a class of the weights attached, and strictly positive for at least one of those weights. The choice of the class of the weights is based on some ethical restrictions on EDEGR, which we believe a pro poor growth index must satisfy. The restrictions are based on weak monotonicity, Transfer principle(PT) and positional version of transfer principle (PPTS) , discussed in details by Zoli (1999). Accordingly, we have first, second and third order EDEGR dominance. Further, third order EDEGR dominance of one distribution over the other, implies growth is pro poor following the class of EDEGR following Nssah. Since, EDEGR is weighted average of all income quantile, our domain of interest will be logarithmic income. We have shown that the EDEGR dominance and inverse stochastic dominance (ISD) based on logarithmic income domain are equivalent. The nested property of ISD implies dominance conditions derived in this article are also nested. Hence, the third order EDEGR dominance is the most general one, and theoretically it is possible to construct situations where it provides conclusive results, unlike others. In order to apply the third order EDEGR dominance empirically, we have further introduced a new growth curve based on gini social welfare function. In spite of the fact that, the newly proposed growth curve is based on logarithmic income domain, we have shown that conclusive GIC and/or PGC ordering, appears to be a sufficient condition for the conclusive ordering of the newly proposed growth curve. We have also characterized the relative version of EDEGR i.e DAF, using the normalization approach suggested by Duclos (2009). Thus if we consider a domain with income of all individuals being normalized by their mean, we obtain DAF dominance almost similar to EDEGR dominance. Further, we have shown that DAF dominance implies (implied by) EDEGR dominance when the avearge growth rate of the society is positive (negative).

The paper has been organized in the following fashion. The next section consists of discussion on some preliminary topics, related to this article. In section 3 we have introduced the new dominance result. An empirical analysis has been done in section 4. The first part of the empirical analysis deals with the performance of new growth curve in terms of conclusiveness. The second part is mainly to evaluate the pro poor scenarios of India for the last two decades. The paper is concluded in section 5.

2 Preliminaries

In a society, let at time point t and t-1, $y_t = (y^t_1, y^t_2 ... y^t_n) \in \mathbb{R}^n_{++}$, and $y_{t-1} = (y^{t-1}_1, y^{t-1}_2 ... y^{t-1}_m) \in \mathbb{R}^m_{++}$, be the vector of incomes arranged in ascending order. Through out this paper our aim is to evaluate whether movement of income profile y_{t-1} to y_t is pro poor or not. Let $F_t(y)$ be the empirical distribution function, representing percentage of individuals with income $\leq y$. In some cases we will also represent the distribution function as $F(y_t)$, where y_t denotes the underlying domain of the distribution function. Consider $y^p_t = F^{-1}_t(p) = inf\{y : F_t(y) \geq \ p\}$ as the p^{th} income quantile of the income distribution at time point t. Let, $\mu_t = \int_0^1 y^p_t dp$, be the mean income of the society at time t, and $g = log(\mu_t) - \log(\mu_{t-1}) = \Delta log(\mu_t)$ as the growth rate.[3]

2.1 Stochastic and inverse stochastic dominance

If y_t is defined on a continuum, the recursive integral for the distribution function may be written as $F_t^{r+1}(y) = \int_0^y F_t^r(s)\, ds \; \forall s \; \in [0, \infty)$ where $r \geq 0$ is an integer. Stochastic Dominance (SD) and Inverse Stochastic Dominance (ISD) has remained one of the major tolls of partial ordering approaches, including partial pro poor ordering analysis. We will discuss these issues very briefly. Our main analytical results also depends on these techniques.

Definition 1. ***Stochastic dominance :*** *$F(y_t)$ stochastically dominates $F(y_{t-1})$ by r+1 th order/degree i.e $F(y_t) \succ_{r+1} F(y_{t-1})$ if $F_t^{r+1}(s) \leq F_{t-1}^{r+1}(s)$ $\forall \; s \; \in [0, \infty)$ & $<$ for at least one s.*

Instead of considering a distribution function, the same purpose might be solved using the inverse distribution function. Let $F_t^{-(r+1)}(p) = \int_0^p F_t^{-(r)}(p)\, dp$ where $r \geq 0$ is an integer.[4]

Definition 2. ***Inverse Stochastic dominance :*** *$F(y_t)$ dominates $F(y_{t-1})$ by (r+1)th order/degree Inverse Stochastic Dominance i.e $F(y_t) \succ_{-(r+1)}$ $F(y_{t-1})$ if $F_t^{-(r+1)}(p) \geq F_{t-1}^{-(r+1)}(p)$ $\forall p \in [0, 1]$ & $>$ for at least one p.*

SD and ISD are nested, i.e lower order implies higher order dominance. However, the reverse is not necessarily true. SD implies ISD and vice versa for $r \leq 2$. However, for $r > 2$ the relationship is no longer valid. SD of one distribution over the other implies a decline of poverty for a class of poverty index discussed in Atkinson (1987). SD also implies an increment of

[3]The operator Δ will denote the the difference of the function between time point t and t-1; e.g $\Delta x_t = (x_t - x_{t-1})$

[4]For expressions of $F_t^{r+1}(y)$ and $F_t^{-(r+1)}(p)$ on discrete domain, See Chakravarty (2009)

welfare for different class of social welfare functions also known as "*Welfare Dominance*", See Foster and Shorrocks (1988a,b).

2.2 Absolute and Relative Pro poor growth

We will now formally introduce the concepts of absolute and relative pro poor growth. In a nutshell a growth is said to pro poor in an absolute sense if it raises the income of the poor Kraay (2006). It may also be defined as follows

Definition 3. ***Absolute Pro Poor growth :*** *A change from y_t to y_{t-1} is said to be pro-poor in an absolute sense whenever, as a result of growth, poverty declines.*

Consider $g > 0$, and for a given poverty index and poverty line, if poverty declines we would say growth is pro poor in an absolute sense, following a complete pro poor ordering approach. The absolute pro poor growth might be accessed by considering the growth elasticity of poverty, which measures the % change in poverty as a result of increment of 1% growth. Thus following the above definition if the elasticity is negative, growth might be considered as pro poor.

It is possible that pro poor growth ordering might depend on choice of poverty indexes and/or ordering. In order to rule out these inconsistencies, Ravallion and Chen (2003), considered a partial ordering approach based on first order SD and proposed Growth Incidence Curve (GIC). GIC is the rate of change of y_t^p, which can be represented as $GIC(p) = \Delta log(y_t^p)$. If $GIC(p) \geq 0 \; \forall \; p$ & > 0 for at least one p we refer the situation as pro poor growth or $GIC(p) \succ 0$. Whereas $GIC(p) \leq 0 \; \forall \; p$ & < 0 for at least one p the situation is defined as Anti poor growth or $GIC(p) \prec 0$.

Son (2004) considered poverty growth curve (PGC) on the basis of second order stochastic dominance. The proposed growth curve is the rate of change of generalized lorenz curve of two distributions, $PGC = \Delta log(\mu_t^p)$, where μ_t^p might also be interpreted as the mean of poorest $100p\%$ of population. Since, GIC and PGC are respectively based on first and second order stochastic dominance, conclusive ordering of these curves would also imply decline of poverty for a wide range of poverty index. The ordering is also robust to the choice poverty line.

Kakwani and Pernia (2000) introduced the concept of relative pro poor growth, where the focus is mainly based on the income growth rate of the poor. The formal definition may be written as follows

Definition 4. ***Relative Pro poor growth :*** *A movement from y_t to y_{t-1} is said to be pro poor in a relative sense, if the growth rate of income of poor is greater than that of the non poor.*

It should be noted that the above definition remains unchanged, even if we simply replace "*growth rate of the non poor*", by the average growth rate of the society. A relative version of GIC and PGC might be related to Lorenz curves. The relative versions of GIC and PGC might be written as follows

$$\begin{aligned} g_1 &= GIC - g = \Delta L_t'(p) \\ g_2 &= PGC - g = \Delta L_t^p \end{aligned} \tag{1}$$

where L_t^p and $L_t'(p)$ stands for lorenz curve and slope of lorenz curve respectively. Thus growth is pro poor following GIC and PGC in a relative sense, if and only if the slope of the lorenz curve and lorenz curve does not cross respectively. The ordering g_1 and g_2 might also be obtained following a normalization approach suggested by Duclos (2009). If we normalize income of all individuals at time point t and $t-1$ by their respective means and denote the domains $\bar{y}_t$ and $\bar{y}_{t-1}$ respectively, it can be shown that GIC and PGC ordering, will essentially lead to g_1 and g_2 ordering, where

$$\begin{aligned} \bar{y}_t &= \{y_t^1/\mu_t, y_t^2/\mu_t, ..y_t^n/\mu_t\} \\ \bar{y}_{t-1} &= \{y_{t-1}^1/\mu_{t-1}, y_{t-1}^2/\mu_{t-1}, ..y_{t-1}^n/\mu_{t-1}\} \end{aligned} \tag{2}$$

It should be noted that the approach suggested by Duclos (2009) is more general in the sense that the normalization is not necessary to be by the mean. It may be any summary statistics, which the policy maker is actually interested in, e.g Median, Percentiles e.t.c. However, for the sake of simplicity, we consider the normalization by mean, mainly to track Kakwani and Pernia (2000) definition. We will discuss more on this issue when we introduce our dominance results.

2.3 Equally Distributed Equivalent Growth Rate

Nssah (2005) considered a complete ordering approach and defined Equally Distributed Equivalent Growth Rate(EDEGR) as growth rate socially equivalent to the observed growth for some choice of the focal parameter which captures the degree of inequality. EDEGR might be considered as the weighted average of the points of GIC

$$\zeta = \int_0^1 v(p)\Delta log(y_t^p)dp = \lambda\bar{v}\left(1 - \frac{cov\left(\Delta\tilde{y}_t^p, v(p)\right)}{-\lambda\bar{v}}\right) \tag{3}$$

where $v(p)$ is the weight attached to p^{th} quantiles and $\bar{v} = \int_0^1 v(p)dp$.

Nssah considered weights as $v(p) = v(1-p)^{v-1}$, where v is an indicator of aversion of inequality. The choice of specific weight function leads to $\bar{v} = 1$, thus from equation 3, ζ takes the form of EDEGR, almost similar to Equally distributed as proposed by Atkinson (1970). However, for any choice of weight function $w(p) = v(p)/\bar{v}$, EDEGR might be obtained from 1 provided $\bar{v} \neq 0$, and finite.

Thus from 3 we can write

$$\zeta^* = \lambda\left(1 - \frac{cov\big(\Delta\tilde{y}_t^p, w(p)\big)}{-\lambda}\right) \tag{4}$$

A relative version of EDEGR might also be obtained following its deviation from the average growth rate. Nassah termed it as distributed adjusted factor (DAF).

$$\begin{aligned} DAF &= \zeta^* - g \\ &= \int_0^1 w(p)\Delta log(y_t^p/\mu_t)dp \end{aligned} \tag{5}$$

It is possible to obtain the DAF dominance, similar to g_1 and g_2 ordering, by considering the normalization approach suggested by Duclos (2009). However, we have to consider a logarithmic transformation of all the points of domain $\bar{y}_t$ and $\bar{y}_{t-1}$. Let the new domain is defined as $\bar{l}_t$ and $\bar{l}_{t-1}$, where

$$\begin{aligned} \bar{l}_t &= \{log(y_t^1/\mu_t), log(y_t^2/\mu_t), ..log(y_t^n/\mu_t)\} \\ \bar{l}_{t-1} &= \{log(y_{t-1}^1/\mu_{t-1}), log(y_{t-1}^2/\mu_{t-1}), ..log(y_{t-1}^n/\mu_{t-1})\} \end{aligned} \tag{6}$$

It should also be noted here that in order to obtain the DAF, the normalization should necessarily be mean income of the society. This also leads DAF as the weighted average of the rate of change of slopes of the Lorenz curve.

3 A new dominance result

In this section we will introduce a new dominance result, based on the restrictions of the weight function on an ethical point of view. Since, EDEGR is weighted average of all income quantile, our domain of interest will be logarithmic income denoted by $\tilde{y}_t = \{log(y_1^t), log(y_2^t)...log(y_n^t)\}$. Essentially we establish relationship between EDEGR dominance and inverse stochastic dominance based on this domain.[5] Before introducing the dominance results and discussing on the restrictions necessary on the weight function, we formally introduce the concept of EDEGR dominance as follows.

Definition 5. ***EDEGR Dominance :*** *For a class of weights $W_R \in W$ that satisfies properties* R*, EDEGR dominance occurs when $\zeta^*(w) \geq 0 \ \forall w \ \in W_R$ and $\zeta^*(w) > 0$ for at least one $w \in W_R$ or $\zeta^*(w) \succ 0$.*

3.1 Restrictions on EDEGR

For the sake of simplicity, we will consider only the class of weight function which is differentiable. The first restriction we would like to impose is similar to the monotonicity property of a poverty index. We will consider the case, such that, if there is positive growth for at least one quantile given other quantiles remains unchanged, growth rate must not be anti pro poor. Let x be the growth profile consisting of all the points of GIC, and x_i denotes the

[5] The results are motivated from Zoli's work on inverse stochastic dominance and welfare dominance. As we have mentioned earlier.

GIC for the i^{th} quantile. Let D^n denotes the set of all growth profiles and $N = \{1, 2..n\}$ denotes the set of integers of order n, where n is the number of quantiles.

Axiom 1. ***Week monotonicity (WM) :*** $\forall x \in D^n,\ \forall\ i, j \in N,\ \ x_j > 0,\ \ \&\ x_i \geq 0,\ \forall j\ \neq i \implies EDEGR(x) \geq 0.$

The second restriction is essentially on the line of transfer axiom as proposed in the inequality literature. It is likely that in a society, a rank preserving progressive (regressive) transfer of income from the richer to poorer quantile, would lead to an increase (decrease) of EDEGR.[6] The definition of rank preserving transfer might be formally written as follows[7]

Definition 6. ***Rank preserving Transfer(RPT) :*** *Let* $x, z \in D^n$ *be the growth profiles,* x *is obtained from* z *by a rank preserving Transfer, if for some* i, j $(i < j)$ $\&$ $x_l = z_l,\ \forall l \neq \{i, j\},\ x_i - z_i = z_j - x_j = \delta,$ *where* $\delta \leq \frac{z_j - z_i}{2}$ *if* $j = i + 1$ *and* $\delta \leq min\{(z_{i+1} - z_i), (z_j - z_{j-1})\}$ *if* $j > i + 1$.

The transfer is progressive and regressive if $\delta > 0$ and $\delta < 0$ respectively. Let $x(i, j)$ denotes that in a growth profile x, a RPT takes place from j to i. The transfer is progressive and regressive if $j > i$ and $j < i$, respectively.

Axiom 2. ***Week Transfer principle (PT) :*** $\forall x \in D^n,\ \rho \in N$ *and* $1 < \rho < n,\ EDEGR(x, x+\rho) \geq EDEGR(x)$ *and* $EDEGR(x+\rho, x) \leq EDEGR(x)$

Our next axiom will be introduced mainly to consider the fact that transfer will be valued more if it takes place at the bottom of the distribution.

Axiom 3. ***Week Principle of positional version of Transfer sensitivity(PPTS) :*** $\forall x \in D^n,\ \rho, i, l \in N$ *and* $1 \leq \rho \leq n - l,\ i < l,$ *then*

[6] It is difficult to imagine the transfers between the quantiles. However, using this axiom, comparison of pro poor growth performances between different societies is possible.

[7] See Chakravarty (2009) page 3 for details.

$EDEGR\big(x(i,i+\rho)\big) \geq EDEGR\big(x(l,l+\rho)\big)$ and $EDEGR\big(x(i+\rho,i)\big) \leq EDEGR\big(x(l+\rho,l)\big)$.

We will use the following lemma that essentially establish the relationship between the weights function of EDEGR and the axioms discussed above.

Lemma 1. *Any twice differentiable EDEGR satisfies WM if $w(p) > 0$, satisfies PT if $w'(p) \leq 0$ and satisfies PPTS if $w''(p) \geq 0$.*

Consider the following class of weight functions for which EDEGR satisfies different axioms.

$$w_1(p) = \{w(p) \in W : w(p) \geq 0\} \tag{7}$$

$$w_2(p) = \{w(p) \in W : w(p) \geq 0 \ \& \ w'(p) \leq 0\} \tag{8}$$

$$w_3(p) = \{w(p) \in W : w(p) \geq 0, \ w'(p) \leq 0 \ \& \ w''(p) \geq 0\} \tag{9}$$

For w_1 EDEGR satisfies WM, for w_2 WM and PT and lastly for w_3 WM, PT an PPTS. Using the above set of weight functions, we will now introduce our first main result of the article, that essentially establish a partial ordering of EDEGR dominance.

Theorem 1. *$\zeta^*(w_i) \succ 0$ iff $F(\tilde{y}_t) \succ_{-i} F(\tilde{y}_{t-1})$ $\forall i \in \{1,2,3\}$ and additionally $\lambda \geq 0$ for i=3.*

Where λ is the growth rate of geometric mean. Even if $\lambda < 0$, but $\hat{g} \succ 0$, EDEGR dominance is obtained. For example, if one sets weights for the richest quantile as 0 i.e $w_4 = \{w(p) \in W : w(p) \geq 0, \ w'(p) \leq 0, \ w''(p) \geq 0 \ \textit{and} \ w(1) = 0\}$ then $\hat{g} \succ 0 \Rightarrow \zeta^*(w_4) \succ 0$. Weights adopted by Nssah is a subset of w_4. It should be further noted that since ISD are nested, would imply EDEGR dominance derived in this article are also nested. Thus our next corollary as a by product of Theorem 1 is

Corollary 1. *Higher order EGEDR dominance implies lower order dominance, however, the reverse is essentially not true.*

It is important to emphasize that, the 3rd order EGEDR dominance, will be most robust in terms of conclusiveness. For the empirical application of the third order EDEGR dominance, we will introduce a new pro poor growth curve.

3.2 A new pro poor growth curve

The dominance result derived in the previous section, essentially are based on ISD on log transformed incomes. The empirical applications of the first and second order EDEGR dominance might be easily obtained constructing GIC and PGC on this domain. For application of the third order EDEGR dominance, we propose a new growth curve as the change of gini social welfare functions of logarithmic income for the poorest 100p% of population. The gini social welfare function also known as Sen's welfare function, is the product of mean and one minus gini coefficient thus captures notions of both equity and efficiency. Thus the new growth curve is written as $\hat{g} = \Delta w_t^p = \Delta \tilde{\mu}_t^p (1 - \tilde{g}_t^p)$, where w_t^p, $\tilde{\mu}_t^p$ and $\tilde{g}_t^p$ are the gini social welfare function, mean and gini coefficient respectively of logarithmic incomes for the poorest 100p% of population. We will use a result of Zoli (1999) in order to establish relationship between ISD and $\hat{g}$.

Lemma 2. *If* $\hat{g} \succ 0 \iff F(\tilde{y}_t) \succ_{-3} F(\tilde{y}_{t-1})$

Our next target is to relate GIC, PGC and $\hat{g}$ ordering. Since, the domain of the first two curves are different from that of $\hat{g}$, we will consider our next Lemma in order to relate them. We have derived this result partially using the relationship between SD and Welfare dominance by Foster and Shorrocks (1988a,b), which we consider as our next Lemma.

Lemma 3. *$F(y_t) \succ_{-2} F(y_{t-1}) \implies \int_0^1 u(y_t)dF > \int_0^1 u(y_{t-1})dF$ where u is differentiable and $u' > 0$ and $u'' < 0$ (Foster and Shorrocks, 1988a,b)*

Using the above Lemma[8], we derive a new lemma, which basically relates the EDEGR dominance on log transform domain and income domains.

Lemma 4. *$GIC \succ 0 \iff F_t(\tilde{y}_t) \succ_{-1} F_{t-1}(\tilde{y}_{t-1})$ and $PGC \succ 0 \Rightarrow F_t(\tilde{y}_t) \succ_{-2} F_{t-1}(\tilde{y}_{t-1})$*

Using Lemma 4 and nested property of ISD, it can be shown that PGC ordering might be considered as a sufficient case for $\hat{g} \succ 0$. However, the reverse is not true, thus the new growth curve provides conclusive results in many cases where both GIC and PGC fails to do so. Hence,

Proposition 1. *If $PGC \succ 0 \Rightarrow \hat{g} \succ 0$*

Although, the new growth curve provides conclusive results in cases the PGC fails to do so. However, it should be noted that unlike PGC where pro poor growth and poverty indexes might be related, it is not possible for the new growth curve. The rationale, for the choice of this curve, is that the third order EDEGR dominance is obtainable using the new growth curve. A conclusive $\hat{g}$ ordering is sufficient to say that growth is pro poor at least for the class of EDEGR as suggested by Nssah.

[8] For income domain being continuous the result was derived in Foster and Shorrocks (1988a), while for discrete domain Foster and Shorrocks (1988b).

3.3 Relative Pro-poor growth

So far our discussion was based on the absolute notion of pro poor growth. It is possible to extend the dominance condition also in the context of relative pro poor ordering. Similar to EDEGR dominance, DAF dominance might also be considered provided domain is considered as $\bar{l}_t$ (See equation 6).

Let $\bar{l}_t^p$, denotes the p^{th} quantile based on $\bar{l}_t$. Thus the next theorem essentially establish relationship between DAF dominance and inverse stochastic dominance on the domain $\bar{l}_t$. Like third order EDEGR dominance an extra condition is also required for DAF dominance $\beta = \int_0^1 \Delta\bar{l}_t^p dp \quad \geq 0$, which again can be relaxed for choice of w_4.

Theorem 2. *For any EDEGR with weights being* w_j*,* $DAF(w_j) \succ 0$ *iff* $F_t(\bar{l}_t) \succ_{-j} F_{t-1}(\bar{l}_{t-1}) \forall j \in 1,2$ *and* $DAF(w_3) \succ 0$ *iff* $F_t(\bar{l}_t) \succ_{-3} F_{t-1}(\bar{l}_{t-1})$ *and* $\beta \geq 0$*.*

Like the EDEGR dominance results our next corollary will essentially imply DAF dominance is also nested.

Corollary 2. $DAF(W_1) \succ \ 0 \Rightarrow DAF(w_2) \succ \ 0 \Rightarrow DAF(w_3) \succ \ 0.$

The third order DAF dominance is the most general in terms of conclusiveness. It might be obtained by computing $\hat{g}$ on $\bar{l}_t$, or might also be accessed by considering the curve $g_3 = \hat{g} - g$. The g_3 curve might also be related to g_1 and g_2 defined in 1.

Proposition 2. $g_1 \succ 0 \implies g_2 \succ \implies g_3 \succ 0.$

Essentially the proposition shows that g_3 might conclude in many situations where g_1 and g_2 fails to do so. A conclusive ordering of the g_i curve would imply conclusive ordering of $g_j \forall \{i,j\} \in 1,2,3$ and $i < j$.

We will now investigate on the relationship between DAF dominance and EDEGR dominance. Our next proposition essentially says that DAF dominance is a sufficient condition for EDEGR dominance if the growth rate of mean $g > 0$. On the other hand, DAF dominance will always hold if EDEGR dominance occurs provided $g < 0$. Hence our next proposition

Proposition 3. *If $g > 0$, $DAF \succ 0 \implies EDEGR \succ 0$ and if $g < 0$ $EDEGR \succ 0 \implies DAF \succ 0$.*

In the next section we will consider the performances absolute and relative versions of GIC, PGC and the newly proposed growth curves empirically.

4 Empirical analysis

Our aim in this section is twofold. Firstly, using major states of rural and urban India, we will analyze the performances of GIC, PGC and $\hat{g}$ along with their relative versions $g_1,\ g_2\ and\ g_3$. Secondly, we will discuss on pro poor scenarios of rural and urban India, mainly for the last two decades. We will use National Sample survey Office (NSSO) data on consumer expenditure. Under the program, the survey on consumer expenditure provides a time series of household consumer expenditure data, which is the prime source of statistical indicators of level of living, social consumption and well-being, poverty estimation e.t.c. NSSO does not collect data on income, thus expenditure is considered to be a proxy. We shall use monthly per-capita expenditure(MPCE), based on mixed recall period method. In a mixed recall period method in India, data for educational, medical (institutional), clothing, bedding, footwear and durable goods are collected on a recall period of 365 days. The other items are collected on the basis of a recall period of

30 days.[9] In this article we will use consecutive rounds data on consumer expenditure vij 43rd, 50th, 55th, 61st and 66th, which provides information's respectively for the period of July 1987 - June 1988, July 1993 - June 1994, July 1993 - June 1994, July 1999- June 2000, July 2004-June 2005, and July 2009-June 2010. In order to account for the price adjustments, we have adjusted MPCE of rural India using consumer index for agricultural labourer (CPIAL), whereas consumer price index for Industrial workers(CPIIW) for urban India.[10] For both the state and all India level of rural and urban India the number of quantile is 20.

4.1 Pro poor evaluation in states of India

We will evaluate the performance of both absolute and relative versions of GIC, PGC and the newly proposed growth curves, using 20 states for rural India and 17 for Urban states of India. The number of years considered in this study is 5. We consider all possible combinations of state and year, thus we have altogether 4950 and 3570 pairs of distribution respectively for rural and urban India.

For each states, we compute GIC, PGC and $\hat{g}$ following the five consecutive NSSO rounds. In Table 1, we have reported the number of pro poor, anti poor, inconclusive and inconsistent conclusive (IC) cases along with the percentage of conclusive cases (CC). IC refers to the number of cases where

[9] Comparison in terms of survey design is same for all the rounds. However, 55th rounds contains information of both 7 days and 30 days recall period and is likely to create problems in comparability issues. See Deaton et al Deaton and Kozel (2005). Although there are several methodologies available for the adjustments of this recall error, we will not consider these issues for the sake of simplicity.

[10] The same procedure was also used in adjustments of poverty line estimation in India. The poverty lines, which were found in 1973, are projected using CPIAL and CPIIW in rural & urban sectors. However, there has been a change in the methodology, since after 2004 on publication of Tendulkar committee report.

lower order dominance provides conclusive result but the higher order fails to do so. Theoretically this is not possible, it arises due to choice of small number of income quantiles.[11] If the number of quantiles is increased substantially, the conclusive results as shown by GIC and/or PGC in these cases eventually turns out to be inconclusive.

The last column of Table 1 refers to the percentage of conclusive cases, excluding IC. GIC provides conclusive statements nearly about 40% cases in both rural and urban India. However, the performance of its relative version g_1 is very poor and provides less than 1% cases in both rural and urban India. PGC on the other hand provides conclusive statements on 80% cases, but its relative version performs poorly and more than 40% cases remains as inconclusive. The performance of the newly proposed growth curve is not only better in terms of the absolute sense but also in a relative sense. For both the cases more than 80% cases are concluded.

Insert Table 1 here.

4.2 Pro poor evaluation in Rural and Urban India

Our target in this part is to see whether the evidence of sustained GDP growth in India is favorable to the poor or not. Growth process started mainly on the 1990s when liberalization took place in India, and policies changed substantially at that point.[12] Using NSSO data for the last five

[11] It has been observed that for all these cases the inconsistency arises at the lowest quantiles.

[12] In the 1980's India lacked the confidence of international community on her economic viability, and the country found it increasingly difficult to borrow internationally. Since, after early 1990s, a structural change took place in policies, like loosening government regulations, especially in the area of foreign trade. Many restrictions on private companies were also lifted, and new areas were opened to private capital. There had been a strong opposition of these policies, especially among the trade unions belonging in the left wing. However, Indian GDP has been steadily increasing after these changes.

quinquennial rounds, we will evaluate the pro-poor scenarios of India for all possible spells of comparison of rural and urban India. Since, one of our data point is before 1990 (43rd round), we thus also have the opportunity to evaluate pro poor scenarios before and after liberalization.

All comparison results has been provided in Table 2. It is readily observable that, for both rural and urban India, growth is pro poor in an absolute sense, following PGC and $\hat{g}$. GIC fails to provide conclusive results in almost all cases. However, it has been observed that in almost all the cases inconsistency arises due to a negative value in the last quantile. Since, the last quantile in GIC is the growth rate of the maximum values, there is every possibility that the inconsistency arises due to presence of outliers in the data.[13]

Following g_3, it has been observed for any comparison of other rounds with the pre liberalization period, growth is pro poor in relative sense in the rural India. The conclusion remains same even if we simply replace the data point by just after the period of liberalization i.e 1993-94. However, for the remaining spells of comparisons, growth is favorable to the rich.

Pro poor scenario in urban regions of India, are almost opposite to that of her rural regions. Here, we get six out of the ten cases as anti pro poor in a relative sense. Only in one case i.e. for 55 th vs 43 rd round, following g_3 we found growth is pro poor in a relative sense. However, since there are comparability problems of the 55th round data, this result should be reported with caution. An example of inconsistent conclusive case might be observed in the comparison of 55 vs 43 round. In this case although the relative PGC provides conclusive result, but the newly proposed fails to do so. Perhaps a

[13]The inconclusive situations of GIC, might be concluded using a technique called restricted stochastic dominance. Income of the richer individuals thus have to be censored by a constant usually by poverty line. It is possible to obtain conclusive results by GIC, using such restricted analysis.

better way to deal this situations is to consider different statistical tests for Stochastic dominance that has been proposed in the literature. We consider this as our future research plan.

Insert Table 2 here.

5 Conclusion

Nssah (2005) introduced the concept of equally distributed equivalent growth rate (EDEGR) as the growth rate socially equivalent to the observed one for some choice of focal parameter capturing the degree of inequality. EDEGR appeared to be the weighted average of points og the growth incidence curve (Ravallion and Chen, 2003). However, the weights were restricted to the relative extended Gini type class of functions. A relative version of it, also known as distributed adjusted factor(DAF), was also proposed in the same article as the deviation from growth rate of mean.

Our main contribution in this article is to introduce a partial ordering condition for EDEGR and DAF, which we have termed as EDEGR and DAF dominance. The dominance results derived in this article, are based on ethical restrictions, which we assume a pro poor growth index must satisfy. The first order EDEGR (DAF) dominance corresponds to the satisfaction of week monotonicity property of pro poor index, i.e if growth is positive in at least on quantile, growth must not be anti poor. For the second order EDEGR(DAF) dominance an additional transfer principle has been incorporated, which implies is transfer of income from richer to poorer quantile growth rate will be pro poor. Additionally we need principle of positional version of transfer sensitivity for third order EDEGR dominance. It states that transfer is valued more if it takes place at the bottom. The derived dominance conditions are based on inverse stochastic dominance on log transformed income distribution. Thus the conditions are nested i.e lower order EDEGR(DAF) dominance will always imply higher order, but the reverse is not necessarily true. The EDEGR chosen by Nssah, satisfies all these properties and we have shown that if there is evidence of third order dominance of one distribution over the other, EDEGR will be pro poor.

Since, the third order dominance curve is most general in terms of conclusiveness, we have introduced a new growth curve for its empirical application. The growth curve corresponds to the change of gini social welfare function based on the quantiles of logarithmic income. It provides conclusive result if and only if there is evidence of third order inverse stochastic dominance of one distribution over the other (Zoli, 1999). However, the domain has to be modified by considering a log transformation of income of all the individuals. Previously there has been evidence of two growth curves Growth incidence curve (GIC) and Poverty growth curve (PGC) based on first and second order stochastic dominance. It has been established in spite of the fact that the domain of the growth curves being different, a conclusive statement of GIC and/or PGC would always imply the same for the new growth curve. However, it is possible to construct situations where unlike the previous curves, the newly proposed curve provides conclusive statements.

The same analysis might also be extended for the context of relative pro poor comparison. However, it is necessary to change the domain by considering normalization of incomes by any pro poor standard (Duclos, 2009). For the sake of simplicity and for DAF dominance we consider the pro poor standard as the mean income of the society.

The performance of the newly proposed growth curve and its relative version has been analyzed empirically using Monthly per capita expenditure

(MPCE) data for rural and urban regions of Indian states. We have used data for five consecutive NSSO quinquennial rounds, for the period of 1987-88, 1993-94, 1999-00, 2004-05 and 2009-10. For each data points we have further divided into 20 and 17 major states of rural and urban India respectively. Our results shows that the absolute and relative version of the newly proposed growth curve provides conclusive results nearly in 80% of the cases. The absolute and in particular the relative version performs much better than the same for PGC and eventually for GIC.

Another empirical exercise has also been considered mainly to analyze whether the growth process started in the early 1990s is pro poor or not. Instead of considering subgroups of Rural and Urban Indian states, this exercise is based on the full sample of rural and urban India. Thus for the five data points we have 10 spells of comparisons separately for each sectors. It has been observed that, growth is in general pro poor in an absolute sense in both rural and urban India, for all the spells of NSSO rounds. Although we have found some evidence of relative pro poor growth in the spells of rural India, but mostly anti poor in urban India.

In the empirical analysis, we found that in a very few cases, lower order dominance provides conclusive results, but higher order fails to do so. This arises due to choice of low number of income quantiles, and the inconsistency disappears once we increase the number of quantiles. We refer these cases as inconsistent conclusive results. A future research program in this direction will be to derive the asymptotic properties of the newly proposed curves, and on the construction of the confidence intervals.

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6 Appendix

Proof of Theorem 1

Proof : For $i = 3$ the proof is similar to Zoli (Zoli, 1999) on Yaris social welfare function and ISD. We will prove for $i = \{1, 2\}$

Case 1 : i=1

(Sufficiency) If $F(y_t) \succ F(y_{t-1}) \iff GIC \succ 0 \iff \Delta log(y_t^p) \succ 0$, since $w(p) \geq 0$, thus $\zeta^*(w_1) = \int_0^1 w(p)\Delta log(y_t^p)dp \geq 0$. Clearly if $w(p) > 0 \; \forall p \in [0, 1] \Rightarrow \zeta^* > 0$.

Necessary : We begin with the assumption, that, GIC fails to provide conclusive results. Thus in interval $u_1 = (\bar{p}, \bar{\bar{p}}) \subset (0, 1)$, $GIC(p) < 0 \forall p \in u_1$ and $> 0 \forall p \in [0, 1] - u_1$. Consider the following weight function

$$
\begin{aligned}
w(p) &= a > 0 && \forall p \in (0, \bar{p}) \\
&= b > 0 && \forall p \in (\bar{p}, \bar{\bar{p}}) \\
&= c > 0 && \forall p \in (\bar{\bar{p}}, 1)
\end{aligned}
$$

Considering the weight structure mentioned above we get the following expression for $\zeta^* = a \int_0^{\bar{p}} \Delta log(y_t^p)dp + b \int_{\bar{p}}^{\bar{\bar{p}}} \Delta log(y_t^p)dp + c \int_{\bar{\bar{p}}}^1 \Delta log(y_t^p)dp$. Clearly for b chosen very high and low compared to a and c, would lead to $\zeta^* < 0$ and $\zeta^* > 0$ respectively. The last part $F_t(\tilde{y}_t) \succ_{-1} F_{t-1}(\tilde{y}_{t-1})$ iff $F_t(y_t) \succ_{-1} F_{t-1}(y_{t-1})$ is trivial and is left to the reader.

Case 2 : i=2

(Sufficiency) Integrating by parts ζ^* we get

$$
\zeta^* = \int_0^1 \Delta log(y_t^p)dp - \int_0^1 w'(p)\left(\int_0^s \Delta log(y_t^s)ds\right)dp \tag{10}
$$

$F_t(y_t) \succ_{-2} F_{t-1}(y_{t-1}) \Rightarrow \int_0^s \Delta log(y_t^s)ds \geq 0 \forall s$ and > 0 for some s. Thus the second term is always > 0 given $w'(p) \leq 0$. Since the first term is always positive whenever $F_t(y_t) \succ_{-2} F_{t-1}(y_{t-1})$ holds. Hence $\zeta^* \geq 0$. Choosing weights such that $w'(p) < 0 \ \forall p \in [0, 1]$, would always lead to $\zeta^* > 0$.

Sufficient : Let $F_t(y_t) \not\succ_{-2} F_{t-1}(y_{t-1})$, consider the following weight functions

$$\begin{aligned} w(p) &= a - L_1 p > 0 && \forall p \in (0, \bar{p}) \\ &= b - L_2 p > 0 && \forall p \in (\bar{p}, \bar{\bar{p}}) \\ &= c - L_3 p > 0 && \forall p \in (\bar{\bar{p}}, 1) \end{aligned} \tag{11}$$

where all the parameters a, b, c, L_1, L_2 and L_3 are positive. From 10 we can always get $\zeta^* < 0$ and $\zeta^* > 0$ for choice of high and low values of L_2, provided a, b, c L_1 and L_3 has been restricted accordingly. Hence EDEGR dominance breaks.

Proof of Theorem 2

Proof : Similar to Theorem 1.

Proof of Lemma 3 : FOr domain being continuous see Foster and Shorrocks (1988a), while domain being discrete see Foster and Shorrocks (1988b).

Proof of Lemma 4

Proof : The first part i.e $GIC \succ 0 \iff \hat{g} \succ 0$ is trivial and is left to the author.

For the second part essentially, have to show $F(y_t) \succ F(y_{t-1}) \Rightarrow F(\tilde{y}_t) \succ F(\tilde{y}_{t-1})$. Consider, income profiles are discrete (for the sake of simplicity) and population size being fixed.

$$F(y_t) \succ F(y_{t-1}) \Rightarrow \sum_{i=1}^{i} y_t^i \succ \sum_{i=1}^{i} y_{t-1}^i \tag{12}$$

Similarly, considering logarithmic income domain

$$F(\tilde{y}_t) \succ F(\tilde{y}_{t-1}) \Rightarrow \sum_{i=1}^{i} \tilde{y}_t^i \succ \sum_{i=1}^{i} \tilde{y}_{t-1}^i \Rightarrow \prod_{i=1}^{i} y_t^i \succ \prod_{i=1}^{i} y_{t-1}^i \tag{13}$$

We shall show 12 $\Rightarrow$ 13, by method of induction. For $n = 1$, it would be a trivial exercise. For $n = 2$, if 12 holds we can write

$$y_t^1 \geq y_{t-1}^1 \tag{14}$$

$$y_t^1 + y_t^2 \geq y_{t-1}^1 + y_{t-1}^2 \tag{15}$$

with strict inequality for at least one case.

If $y_{t-1}^2 \leq y_t^2$ it would be once again a trivial exercise to show that $y_t^1 y_t^2 \geq y_{t-1}^1 y_{t-1}^2$. The maximum value of y_{t-1}^2, following 15 can written as $z_{t-1}^2 = y_t^1 + y_t^2 - y_{t-1}^1$. It can be shown

$$y_t^1 y_t^2 \geq y_{t-1}^1 z_{t-1}^2 \tag{16}$$

whenever 14 holds. Clearly, if we consider any smaller value than z_{t-1} the inequality would always hold. For $n = 3$ the same results can also be proved easily.

Without loss of generality assuming the equivalence is established for $n = k$, where k is any integer and $k > 3$. We will establish the relationship for $n = k + 1$.

Clearly, the conditions implies a generalized Lorenz dominance of income distribution t over t-1. Following Lemma 3 $\sum_1^{k+1}(u(x_t) - u(x_{t-1})) > 0$, for any $x > 0, u'(x) > 0$ & $u''(x) < 0$. Putting $u(x) = log(x)$ satisfies both the conditions. Hence we can write $\sum_{i=1}^{k+1}(y_t^i - y_{t-1}^i) > 0 \Rightarrow \prod_{i=1}^{k+1} y_t^i > \prod_{i=1}^{k+1} y_{t-1}^i$. Hence proved.

If population size is not fixed, let y_t^m and y_{t-1}^n be m times replication of all individuals of the first distribution and n times replication of all individuals in the second distribution. It is well known that stochastic dominance relationship are replication invariant, thus $F_t(y_t) \succ_{-r} F_{t-1}(y_{t-1}) \iff G_t(y_t^m) \succ_{-r} G_{t-1}(y_{t-1}^n)$, r being an integer. Thus the analysis again might be thought as a comparison exercise on fixed population size.

Proof of Proposition 1

Proof : Following Lemma 4 we can write $PGC \succ 0 \implies F(\tilde{y}_t \succ_{-2} F(\tilde{y}_{t-1})$. Since, ISD is nested $F(\tilde{y}_t \succ_{-2} F(\tilde{y}_{t-1}) \implies F(\tilde{y}_t \succ_{-3} F(\tilde{y}_{t-1}) \implies \hat{g} \succ 0$. *Hence Proved*

Proof of Proposition 2 *Proof :* Using nested property of ISD $g_1 \succ 0 \implies g_2 \succ 0$. The last part is similar to Proposition 1, only domain being different.

Proof of Proposition 3 *Proof :* The proof is easy, and might be constructed computing EDEGR on domain $\bar{l}_t$ defined on 6, which is eventually DAF.

Table 1: Performances for different growth curves

States of Rural India					
Index	Inconclusive	Anti Poor	Pro poor	IC	CC
GIC	2804	724	1422	173	39.86%
PGC	917	1121	2912	122	79.01%
$\hat{g}$	616	1171	3163	NA	87.56%
g_1	4932	11	7	7	0.22%
g_2	2084	946	1920	107	55.74%
g_3	659	1434	2857	NA	86.69%
States of Urban India					
Index	Inconclusive	Anti Poor	Pro poor	IC	CC
GIC	2026	424	1120	85	40.87%
PGC	675	738	2157	77	78.94%
$\hat{g}$	418	915	2237	NA	88.29%
g_1	3556	13	1	5	0.25%
g_2	1532	1361	677	66	55.24%
g_3	572	1886	1112	NA	83.98%

[1] **Notes :** Results are based on spells of 20 major states of Rural India and 17 major states of urban India for the July 1987 - June 1988, July 1993 - June 1994, July 1999-June 2000, July 2004-June 2005, and July 2009-June 2010. The results of pro poor conclusions are based on any two possible combinations of state and round. Thus we have altogether 4950 and 3570 pairs of distributions, for computation of the growth curves.

[2] GIC, PGC, $\hat{g}$, g_1, g_2 and g_3 are computed from MPCE data of NSSO consumer expenditure rounds. GIC, PGC, $\hat{g}$ represents the absolute pro poor growth curves and the rest are their relative versions i.e. their deviations from their mean. The choice of number of quantile is 20.

[3] IC represents inconsistent conclusive cases, due to low number of quantiles, these cases eventually turn inconclusive by sufficient increasing the number of quantiles (not reported here). CC represents the % of conclusive results, excluding the IC cases.

Table 2: Pro poor growth scenarios in India

	GIC	PGC	$\hat{g}$	g_1	g_2	g_3
Rural India						
2009-10 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
2004-05 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
1999-00 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
1993-94 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
2009-10 vs 1993-94	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\nsucc 0$	$\succ 0$
2004-05 vs 1993-94	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
1999-00 vs 1993-94	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\succ 0$
2009-10 vs 1999-00	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2004-05 vs 1999-00	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2009-10 vs 2004-05	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
Urban India						
2009-10 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2004-05 vs **1987-88**	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\nsucc 0$	$\prec 0$
1999-00 vs **1987-88**	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\nsucc 0$	$\succ 0$
1993-94 vs **1987-88**	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\succ 0$	$\nsucc 0$
2009-10 vs 1993-94	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2004-05 vs 1993-94	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\nsucc 0$
1999-00 vs 1993-94	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\nsucc 0$	$\nsucc 0$
2009-10 vs 1999-00	$\nsucc 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2004-05 vs 1999-00	$\nsucc 0$	$\nsucc 0$	$\nsucc 0$	$\nsucc 0$	$\prec 0$	$\prec 0$
2009-10 vs 2004-05	$\succ 0$	$\succ 0$	$\succ 0$	$\nsucc 0$	$\prec 0$	$\prec 0$

[1] **Notes :** GIC, PGC, $\hat{g}$, g_1, g_2 and g_3 are computed from MPCE data of NSSO consumer expenditure rounds. GIC, PGC, $\hat{g}$ represents the absolute pro poor growth curves and the rest are relative based on their deviations from their mean. The choice of number of quantile is 20.

[2] $\succ 0$, $\prec 0$ *and* $\nsucc 0$ implies conclusive pro poor, conclusive anti poor and inconclusive cases respectively.

[3] The data points July 1987 - June 1988, July 1993 - June 1994, July 1993 - June 1994, July 1999- June 2000, July 2004-June 2005, and July 2009-June 2010 corresponds to round 43, 50 ,55, 61 and 66 respectively.