

PROCEDURE TO MEASURE HOUSING DEPRIVATION USING CENSUS DATA

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Abstract: For more accurate assessment of an individual's well-being or deprivation, one may need to identify the various 'real' dimensions of well-being and assess the individual's overall well-being or deprivation on the basis of the individual's achievements in terms of these dimensions. Also, even if one considered income to be an accurate indicator of overall well-being or deprivation, for policy purposes one may still need information about achievements or deprivations of an individual or a community in terms of specific real indicators of well-being. Governments tend to avoid incorporating housing deprivation in poverty estimates probably because they did not have the data on the actual achievement levels of the people in real terms. This paper claims that calculation of housing deprivation is necessary and can be easily estimated by simple procedures using the CENSUS 2011 data which is an extensive study of the real indicators of development and deprivation in contrast to the ornamental data on income levels. This paper also tells how one can compare between various groups like male/female, reserved/general, child/adult, etc. making use of these valuable qualitative data.

Introduction:

Though income is considered to be an important indicator, it is now widely recognized that 'real' dimensions¹ like nutrition, health, shelter, education etc. assess the overall wellbeing of an individual/household. Even if income is considered to be an accurate, sufficient or exhaustive indicator, information about the achievement or deprivations of an individual with respect to real factors may be of interest on policy grounds. Amartya Sen (1987) stated that 'income' is necessarily a useful indicator but is not adequate in judging the overall well-being or the degree of actual deprivation. For more accurate assessment of an individual's well-being or deprivation, one may need to identify the various 'real' dimensions of well-being and assess the individual's overall well-being or deprivation on the basis of the individual's

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achievements in terms of these dimensions. Also, even if one considered income to be an accurate indicator of overall well-being or deprivation, for policy purposes one may still need information about achievements or deprivations of an individual or a community in terms of specific real indicators of well-being.

The objective of this paper is to discuss and formulate a methodology by which one can measure housing deprivation in a locality as a step forward to add on to overall well-being of an individual or household. Though it requires a broader study 'real aspects' of the standard of living, over time, in this village, this paper believes that this may also be of independent interest as a case study insofar as: (i) it seeks to grapple with the problem of multidimensional deprivation in the context where much information is likely to be qualitative rather than quantitative; and (ii) to the best of my knowledge, there are not much detailed case studies of housing deprivation in India.

Though the objective of this paper is similar to that of Sundaram & Tendulkar (1995) and that of Dutta & Pattanayak (1999), there are a few differences too. First, Sundaram & Tendulkar (1995) studied the problem on a large scale mainly on inter-state basis while this paper would like to confine itself to only a single village so that the study is more focused. Second, this paper has a different conceptual structure regarding aggregation of individual indices. Finally, this paper appeals to make use of **CENSUS 2011 data which is of immense help to the researchers and policy makers** regarding the actual status of the people irrespective of the varying income levels.

Basic Structure and Methodology:

Various groups $N = \{1, 2, \dots, n\}$ comprising either of SC, ST, OBC, General or Total villagers are to be considered whose deprivation are to form the principal interest of our study. Let \mathbf{d} denote the degree of housing deprivation for the group \mathbf{N} such that \mathbf{d} is an increasing function of \mathbf{d}_i ($i = 1, 2, \dots, n$) where \mathbf{d}_i denotes the degree of individual i 's housing deprivation. Hence we may write $\mathbf{d} = F(\mathbf{d}_1, \mathbf{d}_2, \mathbf{d}_3, \dots, \mathbf{d}_n)$. We assume that \mathbf{d}_i lies in the interval $[0,1]$ and an individual is said to be deprived if and only if $\mathbf{d}_i > 0$. However, it is to be admitted that this paper does not distinguish between individuals who do not suffer from housing deprivation but who have different levels of achievement in terms of housing. The intuitive conclusion about this formulation is that the degrees of 'overachievements' in terms of housing, of individuals, who are not deprived in terms of housing, are irrelevant for the purpose of measuring the housing deprivation of the group. This is, of course, exactly analogous to the literature on poverty measurement where no distinction is made between the different non-poor individuals.

In the process we assume that all the individuals living in the same housing unit enjoy the same standard of housing by ignoring any intra-household differences that may exist in this respect. It is obvious that in judging the standard of housing available to the individuals in a household, one has to take into account many different attributes like condition of roof, the amount of available floor space, type of toilet facilities, etc. Indeed, this multiplicity of the relevant attributes, together with the quantitative nature of some of these attributes, constitutes a major source of complexity in evaluating the standard of housing. To judge the standard of housing available to the individuals in a household, this paper takes into consideration a set of various different relevant attributes Z (relating to adequacy, environment, sanitation, comfort, etc.). For every individual $i \in N$ and for every attribute x , let $y_i(x)$ denote i 's actual consumption of attribute x . since many of the attributes are qualitative rather than quantitative in nature, we are to assume and assign a relevant real number² to denote its level. Let for every attribute x , let $r(x)$ denote the benchmark level of the consumption of attribute x , i.e. $r(x)$ is the level of consumption which is considered satisfactory. For example, if x_i is 'drinking water facilities', then $r(x)$ is 'piped drinking water' which this paper considers the best possible alternative. But then, as these are qualitative in nature, they are denoted by $b(x)$, which then is converted, to a real number $r(x)$ by a rule to be discussed later. It follows that individual i 's consumption of attribute x is satisfactory if and only if $y_i(x) \geq r(x)$. We assume that, for every $i \in N$, the degree of housing deprivation, d_i , is a function of $y_i(x)_{x \in Z}$ $r(x)_{x \in Z}$. Thus, the function can be written as:

$$d_i = f(y_i(x)_{x \in Z}, r(x)_{x \in Z})$$

The Criteria and the Attributes:

Though there are numerous attributes which are relevant in judging the standard of housing enjoyed by the members of the household, this papers focuses and considers a set of only 20 such attributes. These attributes are partitioned into four groups each of which is called as **criterion**. The partitioning of the attributes are not entirely arbitrary; it has an intuitive basis in so far as the attributes in each criterion relate to a specific intuitive aspect of housing. The four criteria henceforth will be called adequacy (A), sanitation (S), environment (E) and comfort (C). Following are the explanations of each criterion and its elements.

Structural Adequacy (A): The basic purpose of a house is to provide protection against the elements and this is the aspect that is captured by this particular criterion. This paper considers a set $\{a_1, a_2, a_3, a_4, a_5\}$ of following five attributes for this criterion to explain structural adequacy of a house.

Material of the roof (a_1), Material of the walls (a_2), Material of the floor (a_3), Type of structure (a_4), Ownership status (a_5)

However, it is to be admitted that many other attributes could have been included into this criterion for its exhaustiveness, but as field data is generally collected by surveyors, who actually are not dwellers of those houses, one has to totally depend on their value judgments which generally is also a fact that it is difficult for them to judge exactly in cases when such attributes³ cannot be understood just by seeing it externally.

Sanitation (S): Habitat without sanitary facilities may offer protection from the elements but may cause serious health problems and hence sanitary facilities constitute a basic necessity. This paper considers the criterion of sanitation to be a set, $\{s_1, s_2, s_3\}$ of following three attributes:

Quality of drinking water (s_1), Quality of water for bathing and washing (s_2), Toilet facilities (s_3)

It is tempting to assume that in view of the reality of rural India, one can afford to ignore the toilet facilities. However given that toilet facilities are important for hygienic living, this paper seeks to capture that concept of 'absolute deprivation' rather than 'relative deprivation. Given this, the fact that most of the rural population of India does not have proper toilet facilities either in the house itself or in the compound of the house, is not a compelling reason for not including toilet facilities as a relevant attribute.

Environment (E): Health and hygiene outside the floor area is as important as that inside. Taking this into consideration the criterion of environment is considered a set $\{e_1, e_2, e_3\}$ of following three attributes:

Presence or absence of stagnant water near the house (e_1), Presence of garbage in around the house (e_2), Presence of cattle/other animals in proximity (e_3)

It is to be admitted that many other⁴ attributes could have been included into this criterion for its exhaustiveness, but as only such attributes are common to villages in India, this paper considers the aforementioned. However, one can add many other attributes that may be suitable for a particular place or village where the actual survey and the study are to be done.

Comfort (C): Here we gather together several attributes which, individually, may not be essential as any of those included in structural adequacy, sanitary facilities and environment, but which are important for comfortable living. This criterion of comfort encompasses:

Floor space per adult equivalent (c_1), Room per adult equivalent (c_2), Presence of electricity (c_3), Kitchen Facilities (c_4), Distance from the source of drinking water (c_5), Distance from the source of water for washing and bathing (c_6)

For the purpose of calculating the amount of floor space per person and the number of rooms per person, a child⁵ should not have the same status as an adult⁶, since children need less space at home than adults. It can be assumed, though arbitrarily, that a child of no more than 5 years should count as $\frac{1}{4}$ th of an adult and a child of more than 5 years should count as $\frac{1}{2}$ an adult. The number of adult equivalent has to be calculated for each household using these conversion factors. Note that the floor space per adult equivalent is intended to be an indicator of the amount of space that members of the household have while the number of rooms per adult equivalent is intended to capture the amount of privacy that they enjoy.

Numerical Representation of Consumption Levels:

Some of the attributes, like floor area per adult equivalent, come with obvious numerical measures for corresponding consumption levels. In contrast, the condition of walls does not have any such obvious measure and in real life is judged qualitatively by saying whether it is broken or not. But for numerical analysis the issue is how to transform such qualitative data into some numerical value. Note that numerical measures that seek to capture qualitative judgments cannot have a compelling obviousness of the 'natural' numerical measures available in the case of an attribute such as the floor space enjoyed by a person. They must involve judgments, and, to that extent, they must involve an element of arbitrariness. However, so long as the underlying judgments are made clear, they do serve a useful purpose.

Specification of Achievement Levels: For an attribute x , the different possible qualitative levels have to be specified. As for example, for the criterion **A** (Structural Adequacy) and a_1 (material of the roof), one can consider the following levels of achievements listed in ascending order:

Grass/ Thatch/ Bamboo/ Wood/Mud etc ($a_{1.1}$), Plastic/ Polythene ($a_{1.2}$), Hand made Tiles ($a_{1.3}$), Machine made Tiles ($a_{1.4}$), Burnt Brick ($a_{1.5}$), Stone/ Slate ($a_{1.6}$), G.I./Metal/ Asbestos sheets ($a_{1.7}$), Concrete ($a_{1.8}$)

In general, for any given attribute x , one has to distinguish in quantitative terms, $t[x]$ levels of possible achievements ($x.1$), ($x.2$), ..., ($x.t[x]$). In Appendix I, we identify the different qualitative levels of achievements for the other attributes.

Benchmarks for the Different Attributes: For every attribute x , a qualitative 'benchmark' level, $b[x]$ has to be specified, such that any household that falls short of that benchmark is deprived in terms of x . As for the material of the roof a_1 , we

consider the achievement level $a_{1.7}$ to be the benchmark so that any household achieving only $a_{1.1}$, $a_{1.2}$ or up to $a_{1.6}$ will be considered to be deprived in terms of material of the roof. Thus $b[a_1]$ is $a_{1.7}$.

Specification of Numerical Scores: let 'i' be a given individual and x be a given attribute. Suppose the level of i's achievement in terms of x is $x.k$ and $b[x]$ is $x.k$. The achievement score $y_i(x)$ for x is to be specified as $(k-1)$ and the numerical benchmark score $r(x)$ for x to be $(k-1)$. Consider the following example. Suppose, in terms of the material of the roof a_1 , household i's achievement level is 'made of Burnt Brick' ($a_{1.5}$). Then i's achievement score $y_i(a_1)$ is given by $(5-1) = 4$ and noting $b[a_1] = a_{1.7}$, the benchmark score of a_1 is $(7-1) = 6$. At the risk of emphasizing the obvious, it may worth be explaining the intuitive procedure underlying this method for specifying $y_i(x)$ and $r(x)$. The procedure is actually the procedure for assigning rank numbers under the well known **Borda**⁷ rule, supplemented by the rule of normalization. Since there are eight possible achievement levels for the roof a_1 , the rank numbers for them range from 1 to 8, a higher number being assigned to a higher achievement level; like rank number assigned to the benchmark level $b[a_1] = a_{1.7}$ is 7. These numbers are then normalized by deducting 1 from each of them, so that the lowest possible achievement level ($a_{1.1}$) is assigned the number 0 and the benchmark level $b[a_1]$ is represented by the benchmark score 6.

The Function f: Given the scores $y_i(x)$ and $r(x)$ for each attribute x, the overall deprivation d_i of individual i can be obtained by a three-stage technique. First, for every individual i and every attribute x, his or her deprivation in terms of that attribute can be represented as:

$$d_i(x) = \begin{cases} 0 & \text{if } y_i(x) \geq r(x) \\ \frac{r(x) - y_i(x)}{r(x)} & \text{if } y_i(x) < r(x) \end{cases}$$

Where individual i is said to be deprived of the attribute x if $y_i(x) < r(x)$ and thus $d_i(x) > 0$. Intuitively, an individual is deprived in terms of attribute x if and only if i's achievement score falls short of the benchmark score for x. further, the degree of deprivation, if any, is the shortfall from the benchmark score expressed as a percentage of the benchmark score.

Once the level of deprivation of an individual is obtained for each attribute $d_i(x)$, the deprivation of individual i for each criterion $d_i(X)$ can be obtained by the following two alternative measures.

$$d'_i(X) = \frac{\sum d_i(x)}{|X|}$$

$$d''_i(X) = \begin{cases} 0 & \text{if } \sum \frac{r(x)-y_i(x)}{r(x)} \leq 0 \\ \frac{\sum \frac{r(x)-y_i(x)}{r(x)}}{|X|} & \text{if } \sum \frac{r(x)-y_i(x)}{r(x)} > 0 \end{cases}$$

The two alternative ways of computing the degree of deprivation in terms of X differ insofar as $d''_i(X)$ allows deprivation in terms of one attribute in X to be compensated by over-achievement in terms of another attribute in X, where $d'_i(X)$ does not allow for such compensation or trade-off. Therefore if one uses $d'_i(X)$ as a measure of i's deprivation in terms of X and i happens to be deprived in terms of any attribute in X, then I will turn out to be deprived in terms of criterion X, no matter how high i's achievements in terms of the other attributes in X may be. However, for all X in {A,S,E} and all x in X, the benchmark score in terms of x is also the highest of all the possible achievement scores for x, and therefore,

$$\text{for all } x \in \{A, S, E\} \text{ and for all } x \in X \text{ we must have } \frac{r(x) - y_i(x)}{r(x)} > 0$$

$$\text{for all } x \in \{A, S, E\} \text{ we must have } d'_i(X) > d''_i(X)$$

It is only for X=C that $d'_i(X)$ and $d''_i(X)$ may diverge as the benchmark level is not the top-most level. The judgment is that none of the attributes in C is as 'essential' as those in A, S or E. therefore, in thinking of a household's deprivation in terms of comfort, it does not seem unreasonable to allow for the possibility of the shortfall in terms of one attribute in C being partly or fully cancelled out by the over-achievement in terms of another attribute in C. For example, it is not implausible to argue that the shortfall in terms of 'kitchen' arising from the absence of kitchen could be compensated, at least partially, by an over-achievement in terms of 'floor space per adult equivalent'.

The overall deprivation of an individual i is assumed to a weighted average of the deprivations of i in terms of each of the four criteria. However, since for every criterion X, there may be two conceptually different measures of deprivation $d'_i(X)$ and $d''_i(X)$, and since $d'_i(C)$ is actually different from $d''_i(C)$, there must be two different distinct versions of the overall deprivation d_i for individual i.

$$d'_i = w(A). d'_i(A) + w(S). d'_i(S) + w(E). d'_i(E) + w(C). d'_i(C)$$

$$d''_i = w(A). d'_i(A) + w(S). d'_i(S) + w(E). d'_i(E) + w(C). d'_i(C)$$

where w(A), w(S), w(E) and w(C) are non-negative weights adding up to 1. These weights can be considered equal and taken to be each equal to ¼ or in any other fashion as the investigator perceives about the importance of the criterion. Suppose

the investigator opines that 'comfort' is not that much essential, he may consider $w(A) = w(S) = w(E) = 2/7$ and $w(C) = 1/7$.

Aggregation of Individual Deprivation Levels:

Once derived a measure of housing deprivation of every individual in N , the process to measure the housing deprivation of the group N is similar to measuring income poverty of a group, given the percentage shortfall of each individual from the poverty threshold. For this, the three measures can be used, the **Sen Measure**, the **Quadratic Measure** and the **Simple Average** each of which can be based either on $(d'_1, d'_2, \dots, d'_n)$ or on $(d''_1, d''_2, \dots, d''_n)$. Thus there are actually six different measures of housing deprivation on N . Measures based on $(d'_1, d'_2, \dots, d'_n)$ are termed as **Type - I** and those based on $(d''_1, d''_2, \dots, d''_n)$ are termed as **Type - II**.

Let J be the set of all I in N such that $d'_j > 0$. Let p be the cardinality of J . Index the individuals in J as $j(1), j(2), \dots, j(p)$ in such a way that $d'_{j(1)} \leq d'_{j(2)} \leq \dots \leq d'_{j(p)}$. For all I in J , the rank of i , denoted by $q(i)$, is defined to be v where $I = j(v)$. Then,

$$\text{Sen Measure (Type - I)} = \frac{2 \sum_{i \in J} q(i) \cdot d'_i}{n(p+1)}$$

$$\text{Quadratic Measure (Type - I)} = \frac{\sum_{i \in J} (d'_i)^2}{n}$$

$$\text{Simple Average (Type - I)} = \frac{\sum_{i \in J} (d'_i)}{n}$$

Type - II measures can be defined similarly in terms of d''_i . The Sen measure was first introduced in his classic paper Sen (1976). The Quadratic measure is a distinguished element of the class of poverty measures considered by Foster, Green and Thorbecke (1984). The Simple Average is just the aggregate of all deprivations divided by the total number of individuals in the group under consideration but this measure has serious limitations insofar the intuitively compelling 'transfer axiom'.

Indices of overall deprivation for different groups

The indices of overall deprivation for different groups of individuals in the village may be of great use so far as the nature of policy prescriptions are concerned. This may help policy makers to choose the right target group or the right policy for the group. To compare the deprivations of the various groups, this paper considers the following index for the relative gap between the concerned groups. For every measure of deprivation, H , and every ordered pair of groups (N', N'') , the index of deprivation gap (DGI) is the proportion by which the deprivation of N' exceeds the deprivation of N'' . Thus, we have:

$$DGI = \frac{DI_{N'} - DI_{N''}}{DI_{N''}}$$

where $DI_{N''}$ is the deprivation index of N'' under the measure of H (Sen, Quadratic or Simple Average) and $DI_{N'}$ is the deprivation index of N' under the measure of H. The following are the groups that can be considered and their gaps in deprivations.

- i) Male & Female
- ii) Adult Male & Adult Female
- iii) Adult & Children
- iv) SC & ST
- v) SC-ST-OBC & General

Conclusion:

Housing deprivation is one of the real indicators which must be taken into consideration in measuring poverty. Income, the most popular of the indicators, does not only lack in completeness of measurement, but also undergo a limitation that it is the most difficult variable to estimate. Whereas, conversion of qualitative data to numerical ranks is difficult in case of housing deprivation, income deprivation is easy to calculate, but what does such calculation infer when income is never estimated correctly? Governments tend to avoid incorporating housing deprivation in poverty estimates probably because they did not have the data on the actual achievement levels of the people in real terms. This paper claims that calculation of housing deprivation is necessary and can be easily estimated by simple procedures using the CENSUS 2011 data which is an extensive study of the real indicators of development and deprivation in contrast to the ornamental data on income levels.

Notes:

1. See Sen (1987) for some of these reasons in detail.
2. The rule for deciding what real number is to be assigned, a rule is to be used that has been discussed later in this paper.
3. For example, soundness of the foundation of the house or strength and life of the pillars of the house.
4. Features of neighborhood such as the presence of parking lots, presence of high rises, graffiti, the number of housing units in the neighborhood with bars on their windows, the number of boarded up, vandalized or abandoned buildings in the neighborhood, litter and trash, etc. are attributes taken for the western society as has been included by American Housing Survey (AHS) conducted by the U.S. Department of Commerce for the Department of Housing and Urban Development (HUD).
5. Defined to be a person aged less than 15 years.
6. Defined to be a person of age 15 years or more.
7. famous rule for assigning numerical ranks to qualitative data.

References:

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