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## Alternative wealth indices and health estimates in India

### 1. INTRODUCTION

Economic differentials on key population and health parameters are vital in shaping the policies and programs of any country. The two direct economic measures, household income and consumption expenditure, have not yet been integrated into many population-based health surveys in developing countries, including the Demographic and Health Surveys (DHS), for a number of reasons. First, household income suffers from under-reporting and it is drawn from multiple sources whereas consumption expenditure schedules are relatively lengthy, suffers from recall bias and it is sensitive to household size, composition, and price level (Linjouw and Ravallion, 1995; Montgomery *et al.*, 2000; Meenakshi and Ray, 2002). Second, household income and/or consumption expenditure do not capture the multi-dimensionality of well-being. The human development paradigm emphasizes enlarging human choices and promotes the income as well as non-income measures of economic status. For example, the human poverty Index 1 and 2, developed by UNDP, are non-monetary measures of poverty that encompass ill health, illiteracy, lack of access to improved water and long term unemployment (UNDP, 1997). Third, the collection of household income and consumption expenditure involve higher cost and time.

Alternatively, some economic proxies (consumer durables, housing quality, household amenities and land holding size) are collected to measure the economic status of the households in both small and large scale population-based surveys. These economic proxies are combined to form a composite index, often referred to as the wealth index or as the standard of living index and they are used to describe the economic differentials in health outcome, health care utilization and other related variables. It is also easy to obtain information from households on economic proxies through simple questions or direct observation (Sahn and Stifel, 2003) and these indicators have a direct influence on health (Howe *et al.*, 2008). In this paper, the indicators considered refer to individual items and to indices obtained by the combination of two or more items. The wealth index, as a proxy of consumption expenditure, is a subject of intense debate and

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discussion, though its utility in predicting differentials in health outcome and health care utilisation has been established. A number of studies demonstrate that the wealth index is a good proxy of economic status (Filmer and Pritchett, 2001; Wagstaff and Watanabe, 2003; Rutstein and Johnson, 2004). Other studies, however, also describe the wealth index as a weak predictor of consumption expenditure and a poor measure of inequality (Montgomery *et al.*, 2000; Lindleow, 2006; Howe *et al.*, 2008). The Spearman's rank correlation of wealth index and consumption expenditure varies largely across countries; from 0.37 in Mozambique (Sahn and Stifel, 2003) to 0.56 in Indonesia and 0.64 in Nepal (Filmer and Pritchett, 2001).

Besides proxies for a direct economic measure, the wealth index tends to have an urban bias, does not segregate the poor, does not identify the poorest of the poor and it is sensitive to the choice of indicators included in its calculation (Rutstein, 2008; Houweling *et al.*, 2003). It has been recommended that for most policy decisions, a national index is best compared to separate rural and urban indices (Rutstein, 2008). While in the standard practice a single wealth index at national level is constructed (rather than separate by rural and urban areas), the first or, sometimes, the first and the second wealth quintiles are used to identify the poor, as policy makers invariably need such identifications to implement various programmes. The rationale for including certain variables is usually not discussed. Howeling *et al.* (2003), using the DHS data from 10 developing countries, have found that the magnitude of health inequalities is sensitive to the choice of asset items included in the index. Bollen *et al.* (2002) have found that the choice of proxies makes a difference in the economic status of the household.

The aim of this paper is to understand whether the estimates of reproductive and child health services of wealth groups in India significantly differ when two alternative wealth indices are used. The estimates of reproductive and child health services are compared with respect to wealth groups of two different wealth indices: i) a single wealth index for the population at national level and ii) two separate wealth indices for rural and urban areas.

## 2. DATA AND METHOD

### 2.1 Data

Data from the 2005-6 National and Family Health Survey 3 (NFHS 3) in India have been used in the analysis. The NFHS 3 covers a nationally representative sample, including 109,041 households and 124,385 women

(aged 15-49 years) in the country. The NFHS 3 is a survey that canvasses different schedules to collect information on household, women and men separately. The household schedule contains information on economic proxies such as housing quality, household amenities, size of land holding and consumer durables, whereas the women schedule contains detailed information on demographic characteristics, health, nutrition and other related parameters concerning mothers and children. A detailed description of both the survey design of the NFHS and its main findings are available in the national report (IIPS and Macro International 2007). Starting from these information, different data file such as a household file, a women file, a kids file and a member file were prepared.

There were improvements in coverage and in the methodology used to assess the economic status of the households in subsequent rounds of NFHS. The number of variables covered under economic proxies increased from 27 in NFHS 1, to 32 in NFHS 2, and 38 in NFHS 3. Most of the variables collected in NFHS 1 were covered in subsequent rounds, except two, namely, owning a sofa and VCD/VCR. The NFHS 1 did not provide any composite measure of economic status in the report, where as the NFHS 2, provided a composite index, the standard of living index (*SLI*) by assigning an arbitrary score to individual variables. The NFHS 3 was the first to provide a wealth index based on the principal component analysis (PCA) and classified the population into quintiles. This index classified 3 percent of the urban population in the lowest quintile, compared to 28 percent in rural areas. On the other hand, the wealth index classified 77 percent of the urban population in the fourth and fifth wealth quintiles (IIPS and Macro International, 2007). The wealth index constructed in NFHS 3 has been criticised, for not taking into account the rural-urban and inter-state variations in economic differentials in a large and heterogeneous country like India (Misra and Dillip, 2008).

## 2.2 Method

Composite indices are useful in ranking countries, states or districts, measuring multi-dimensional issues, framing policies and implementing various programmes. Notable among these are the human development index (*HDI*), the gender development index (*GDI*), the human poverty index 1 (*HPI* 1), a socio economic status index, and the standard of living index. However, despite their popular uses, there are concerns about various issues, such as the choice of indicators, the weight of individual indicators, the treatment of missing values and the choice of aggregation of indicators in the construction of composite indices (Nardo *et al.* 2005; Saisana and Tarantola,

2002). The choice of indicators primarily reflects the theoretical consideration of the composite index. Multivariate techniques such as principal component analysis (PCA), factor analysis, as well as linear regression approaches and aggregation techniques are used in weighting indicators. The details of the tools for composite indicators building are discussed elsewhere (Nardo *et al.* 2005).

The use of PCA to construct a wealth index or, more in general, to measure socio-economic status has been well established and validated (Houweling *et al.*, 2003; Vyas and Kumaranayake, 2006). The PCA works best when the distribution of variables varies across the household and the variables are correlated and unequally distributed (McKenzie, 2003). It transfers the correlated original variables into a set of uncorrelated variables using the co-variance matrix. The derived factor score works as a weight. The PCA assigns weights to the original variables on the basis of their covariance. Hence, the factor scores may not necessarily reflect the socioeconomic importance of various dimensions. However, variables with a positive weight (factor score) are generally associated with better economic status, and those with a negative weight with a relatively lower economic status.

This study uses the PCA in the construction of two alternative wealth indices:

- i. Index 1: a single wealth index for the national population
- ii. Index 2: a wealth index derived from rural and urban wealth indices (separate wealth indices are constructed for rural and urban areas).

In doing so, two critical issues have been met: the choice of indicators and the inter-correlation of variables. Firstly, a set of alternative wealth indices, by inclusion and exclusion of various indicators based on theoretical reasons, were explored. It was determined that a wealth index with a restricted number of indicators was not significantly different from one with more variables. Therefore, the index used maintained as many variables as possible and theoretically relevant. Then, the alpha values in both cases were 0.9, indicating that the inter-correlation among variables was high and it was therefore suitable to use PCA.

The analysis is specific to India and no analyses at sub-national level were performed. The household, women and children's file are used in the analyses. The wealth indices are derived using the household file while the differentials in health estimates are analysed using the women and kids file. All analyses were carried out using STATA version 10.

The factor scores of two composite wealth indices were generated (Table 1). In Index 1, including all the available variables without further breakdown by rural and urban residence, the first principal component

explains 22.25 percent of the variance. In Index 2, including a measure for urban/rural residence, the first component explains 24.32 percent in urban and 18.57 percent in rural areas. Based on the ascending order of the composite index, a percentile distribution has been obtained for cumulative household population (*de jure*) separately for rural and urban areas under Index 2. The combined estimate of Index 2 was derived from the rural and urban distribution. Further wealth groups are derived from the percentile distribution of each method. In the case of Index 1, the percentile distribution was obtained for the total population. The misclassification between the quintiles of Index 1 and Index 2 are chosen as the measure of agreement. The distributions of indices were examined to assess the extent of skewness and clumping.

A set of six reproductive and child health services, namely, three or more antenatal checkups, medical assistance at delivery, contraceptive use, the unmet need for contraception, basic childhood immunization and underweighted children aged under-5 years have been used to examine the differentials in results under the two different methods (Index 1 and Index 2). Bivariate analyses have been used to check the internal coherence and robustness. The Kappa statistic was used to check the consistency of the estimates derived by the two different methods. The *z* test was used to test for significant differences in the proportions of both the methods and by wealth groups.

### 3. RESULTS

Results are presented in two sections. The first section discusses the derivation of wealth indices, their validity and reliability and the extent of agreement between the two different indices. The second section compares the estimates of reproductive and child health services for wealth groups according to the two different indices.

#### *3.1 Section I: Derivation of wealth indices and their agreement*

##### 3.1.1 Derivation of wealth index

The indicators used in the construction of the wealth index may be grouped into five categories, namely, consumer durables, basic household amenities, housing quality, access to financial institutions and agriculture and related accessories. The mean, the standard deviation and the factor scores of these variables are shown in Table 1.

Table 1 ó Mean, standard deviation and factor score of variables used in construction of wealth index, India, 2005-06

Sr. No.	Variables	Combined			Rural			Urban		
		Mean	Std.Dev.	Factor Score	Mean	Std.Dev.	Factor Score	Mean	Std.Dev.	Factor Score
1	Mattress	0.5743	0.4944	0.1727	0.4873	0.4998	0.1649	0.7541	0.4306	0.2029
2	Pressure cooker	0.3774	0.4847	0.2407	0.2214	0.4152	0.2400	0.6994	0.4585	0.2347
3	Chair	0.5434	0.4981	0.2137	0.4380	0.4961	0.2297	0.7610	0.4265	0.2105
4	Cot	0.8285	0.3769	0.0877	0.8119	0.3908	0.0902	0.8630	0.3439	0.1408
5	Table	0.4340	0.4956	0.2220	0.3295	0.4700	0.2374	0.6498	0.4770	0.2294
6	Radio	0.3089	0.4620	0.1161	0.2701	0.4440	0.1324	0.3888	0.4875	0.1196
7	Black and white television	0.2097	0.4071	0.0541	0.1873	0.3902	0.1119	0.2559	0.4364	-0.0381
8	Colour Television	0.2524	0.4344	0.2281	0.1252	0.3310	0.2159	0.5151	0.4998	0.2351
9	Sewing Machine	0.1860	0.3891	0.1575	0.1264	0.3323	0.1690	0.3090	0.4621	0.1502
10	Mobile	0.1682	0.3740	0.1987	0.0736	0.2612	0.1811	0.3633	0.4810	0.2051
11	Telephone-non mobile	0.1407	0.3477	0.1912	0.0797	0.2708	0.1998	0.2668	0.4423	0.2019
12	Computer	0.0301	0.1709	0.1106	0.0058	0.0760	0.0702	0.0803	0.2718	0.1254
13	Refrigerator	0.1535	0.3605	0.2071	0.0657	0.2477	0.1851	0.3348	0.4719	0.2288
14	Watch	0.7782	0.4154	0.1486	0.7140	0.4519	0.1623	0.9107	0.2851	0.1371
15	Bicycle	0.5114	0.4999	0.0411	0.5164	0.4997	0.0692	0.5012	0.5000	0.0558
16	Motorcycle	0.1724	0.3777	0.1850	0.1080	0.3104	0.1943	0.3053	0.4605	0.1968
17	Car	0.0265	0.1607	0.1031	0.0100	0.0995	0.0907	0.0607	0.2388	0.1151
18	Electric fan	0.5368	0.4986	0.2255	0.3863	0.4869	0.2372	0.8475	0.3595	0.1859
19	Improved drinking water	0.8605	0.3465	0.0575	0.8664	0.3402	0.0376	0.9500	0.2180	0.0294
20	No toilet facility	0.5537	0.4971	-0.2306	0.7403	0.4385	-0.2182	0.1684	0.3742	-0.2041
	Pit toilet	0.0548	0.2275	-0.0055	0.0599	0.2373	0.0223	0.0442	0.2055	-0.0447
	Flush toilet	0.3915	0.4881	0.2375	0.1998	0.3998	0.2260	0.7874	0.4092	0.2092
21	Cooking fuel	0.2555	0.4361	0.2346	0.0879	0.2831	0.1950	0.6014	0.4896	0.2451
22	Electricity	0.6792	0.4668	0.1908	0.5574	0.4967	0.1930	0.9307	0.2539	0.1570

Table 1 ó contóð

Sr. No.	Variables	Combined			Rural			Urban		
		Mean	Std.Dev.	Factor Score	Mean	Std.Dev.	Factor Score	Mean	Std.Dev.	Factor Score
23	<i>Person per room</i>									
	Up to 2	0.3416	0.4742	0.0552	0.3246	0.4682	0.0489	0.3767	0.4845	0.0744
	2.01-4	0.4274	0.4947	0.0096	0.4261	0.4945	0.0200	0.4303	0.4951	0.0017
	More than 4	0.2310	0.4215	-0.0733	0.2493	0.4326	-0.0757	0.1931	0.3947	-0.0935
24	Floor type	0.4688	0.4990	0.2161	0.3051	0.4604	0.2062	0.8069	0.3947	0.1767
25	Wall type	0.6496	0.4771	0.1884	0.5336	0.4989	0.1873	0.8890	0.3141	0.1694
26	Roof type	0.7828	0.4123	0.1374	0.7143	0.4518	0.1304	0.9243	0.2646	0.1391
27	No window	0.3267	0.4690	-0.1818	0.4118	0.4922	-0.1918	0.1511	0.3582	-0.1817
	Window without cover	0.2651	0.4414	-0.0297	0.2893	0.4534	0.0137	0.2152	0.4110	-0.0874
	Window with cover	0.4081	0.4915	0.2002	0.2989	0.4578	0.1927	0.6337	0.4818	0.2097
28	Kitchen	0.5033	0.5000	0.1587	0.4401	0.4964	0.1484	0.6340	0.4817	0.2092
29	Own House	0.8837	0.3206	-0.0374	0.9328	0.2504	***	0.7825	0.4126	0.0410
	Bank/post office account	0.4024	0.4904	0.1724	0.3231	0.4676	0.1747	0.5662	0.4956	0.1935
30	Water Pump	0.1024	0.3032	0.0843	0.0989	0.2985	0.1168	0.1098	0.3127	***
31	Thresher	0.0163	0.1268	0.0171	0.0222	0.1472	0.0600	0.0043	0.0654	***
32	Tractor	0.0172	0.1300	0.0331	0.0233	0.1507	0.0887	0.0047	0.0686	***
33	No land	0.5437	0.4981	0.0631	0.4149	0.4927	-0.0382	0.8095	0.3927	***
	Marginal holding (Up to 2.5 acer)	0.3006	0.4585	-0.0836	0.3925	0.4883	-0.0318	0.1107	0.3138	***
	Small holding (2.51-5 acer)	0.0877	0.2829	-0.0032	0.1102	0.3131	0.0354	0.0414	0.1993	***
	Medium/Large holding (5+ acer)	0.0679	0.2515	0.0311	0.0822	0.2747	0.0849	0.0381	0.1915	***
34	Any Irrigated Land	0.2979	0.4573	-0.0309	0.3814	0.4857	0.0590	0.1255	0.3313	***
35	Animal drawn cart	0.0532	0.2244	-0.0049	0.0741	0.2619	0.0475	0.0100	0.0994	***

Note: \*\*\* Not included in PCA.

*i. Consumer durables (18)*

Among the eighteen consumer durables listed, the largest distribution was found for a watch (78 percent) and the lowest for a car. The standard deviation varied between 0.16 and 0.50, indicating variation in the ownership of consumer durables. The possession of these consumer durables was significantly higher in urban compared to rural areas. All these variables were included in the computation of Index 1 and Index 2. The weights of all variables, except owning a black and white television, were positive in urban areas.

*ii. Household amenities (4)*

Theoretically, the four household amenities, namely, drinking water, toilet facility, cooking fuel and electricity, are crucial in reflecting the economic status of households and for this reason they have been included in the construction of Index 1 and Index 2.

Access to improved water is used as an indicator to measure the human poverty index (UNDP, 2005). Many diseases, particularly those that children in developing countries like India suffer from, are water borne disease. The study retained drinking water in the construction of the wealth index and categorized it into two groups: improved (1) and not improved (0). The improved category included piped water, bottle water, tanker truck, cart with small tank, protected dug well, spring and/or bore-well. Water from ponds, rivers, unprotected springs, wells or others sources were considered as not improved. Similarly, sanitary facility (toilet facility), was divided into three variables; no facility, pit toilet and flush toilet and each of these variable were made dichotomous. Flush toilet had a higher weight and that of no toilet facility was negative, both for rural and urban areas. The type of fuel used for cooking has economic, health and environmental implications. The type of cooking fuel was made dichotomous with electricity, LPG or Biogas coded as 1 and others coded as 0. The weight of cooking fuel was 0.19 for rural and 0.25 for urban India. Electricity, a community variable, had a weight of 0.19 in both the combined index and in rural areas while it was 0.16 in urban India.

*iii. Housing quality (7)*

The type of house is an important economic variable in the Indian context and for this reason seven indicators related to housing were included in the construction of the wealth index. For the first time, NFHS 3 provided information on the type of wall, floor, roof, presence of windows, whether there was a separate room for cooking, and the ownership of a house. On theoretical grounds, the inclusion of the variables related to building



materials to assess the housing quality in the NFHS 3 was an improvement compared to earlier rounds. However, the frequency distribution of those with a rudimentary floor, wall and roof was very low both in urban and rural areas. Therefore, the housing material variables were made dichotomous: 0 for natural or rudimentary materials and 1 for the finished ones in the three categories (floor, wall and roof). The weight of floor, wall and roof was positive for rural and urban areas. From the results, it could be inferred that a household that lived in a house with a finished floor, roof and wall had a higher index value than those that did not. In addition to the materials used in the floor, wall and roof, the types of window reflects the quality of housing. Using this information, a variable was constructed, divided into the following categories: no window, window without any cover (glass or curtain, shutter or screen) and window with cover. The weight of windows, for both rural and urban areas was in the expected direction. For example, in rural areas a house without a window had a weight of -0.19, while a window with a cover had a weight of 0.20. The surveys also collected information on the number of bedrooms in the house. Based on the *dejure* household population and number of bedrooms, person(s) per bedroom was computed and categorized as up to 2, 2-4 and more than four people per room. Households with more than four people per bedroom were defined crowded. Results indicate that rooms with more than four people had a negative weight, both in rural and urban areas. In addition to these variables, a separate room for cooking (kitchen) is a crucial indicator of wealth, for both economic and health reasons. This variable was used in the present analysis but was not included in the computation of the wealth index in NFHS 3. The weight of the kitchen is 0.16 in the national sample, 0.15 in rural areas and 0.21 in urban areas. The ownership of a house was included in Index 1 and only with the urban component in Index 2.

iv. *Access to financial institutions (1)*

An account in a bank or post office is not sensitive to variability in price and quality. The weight for this variable was 0.17 for both the combined and rural areas while it was 0.19 for urban areas.

v. *Agricultural land and related accessories (6)*

Agriculture still forms the backbone of the Indian economy. More than two-thirds of the rural work-force in the country depends on agriculture for their livelihood (Office of the Registrar General and Census Commissioner, 2001). A number of variables such as size of agricultural land, irrigated land, thresher, tractor, water pump and animal drawn cart were collected during the recent round of the NFHS. There is a strong theoretical rationale for the

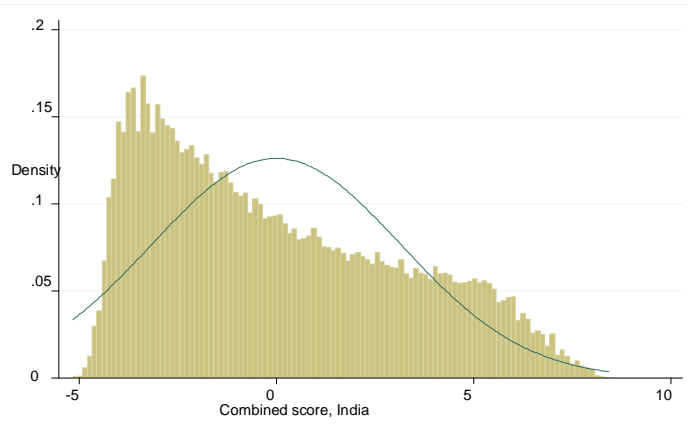
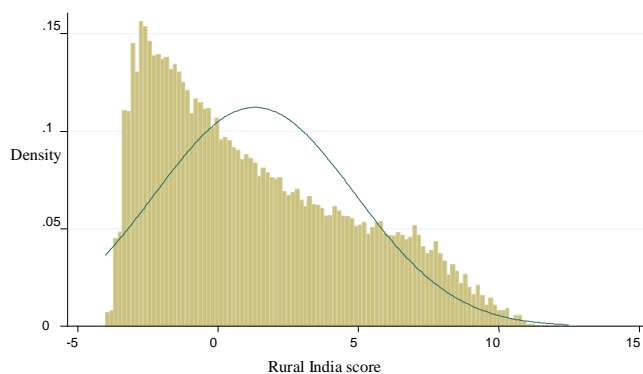
inclusion of these variables in the construction of the wealth index in rural areas. However, in the case of urban areas, the distribution of agriculture and other related variables, including the ownership of a drawn cart animal, is not only low, but also does not warrant inclusion on theoretical grounds.

In the construction of the wealth index in the NFHS 3, agricultural accessories such as threshers, tractor and water pump are included but agricultural land is not included. But among the agriculture related variables, land is the most important economic variable. In this paper, land is included for combined (Index 1) but only the rural component of Index 2. The size of the agricultural land is grouped into four categories, namely, landless (no land), marginal (up to 2.5 acres), small (2.51-5 acres) and medium or large (more than five acres). The weights of marginal land holding were lower if compared to those of small or medium holdings in rural India while no difference in the combined index was reported. The weight for any irrigated agricultural land is negative for the combined index but not in the rural areas. The weights of agricultural accessories were positive for rural India.

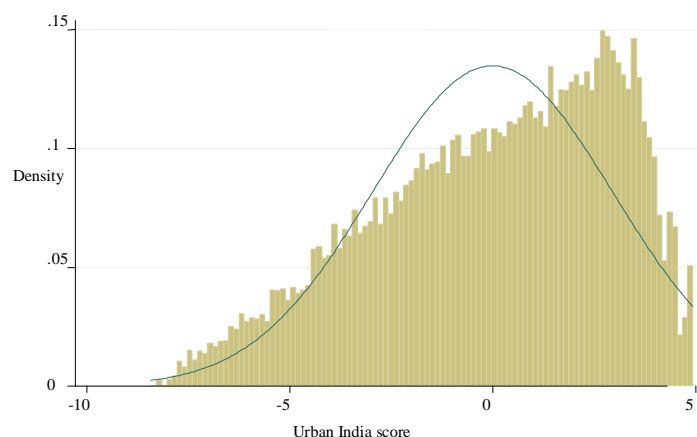
In general, all the factor scores in Index 2 and all those in Index 1 but land show values in the expected direction. The distributions of the factor scores of the composite wealth index (based on first principal component) for the combined areas as well as for the rural and the urban India separately are shown in Figure a, b, c respectively. The distribution of the wealth index is negatively skewed in combined and rural areas while it is positively skewed in urban areas. Clumping, a situation whereby a large proportion of households have the same score, is relatively low both in rural and urban areas. Similarly, truncation, when the score is distributed over a smaller range, appears to be minimal.

### 3.1.2 Internal coherence and validation of wealth indices

The internal coherence, validity and reliability of the wealth indices (Index 1 and Index 2) studies were checked. In doing so, the wealth index was grouped into three broad groups, namely, poorest 40 percent, middle 40 percent and richest 20 percent. The rationale of this choice is rooted in understanding both the broad pattern and the agreement in the wealth indices considered. The internal coherence is checked with respect to three variables, namely, any motorized vehicle, bank or post office account and the mean number of consumer durables (Table 2). These variables are directly or indirectly used in the construction of the wealth index. Any motorized vehicle refers to either a motorcycle, moped, scooter, car or tractor while an account in a bank or post office is a stable indicator. The mean number of consumer durables is computed for a set of 13 variables,

Figure 1(a) *ó* Distribution of the Wealth Index in India, Combined, 2005-06Figure 1(b) *ó* Distribution of the Wealth Index in Rural India, 2005-06

namely, owning one or more of the following facilities: radio, black and white television, color television, sewing machine, telephone (non-mobile), mobile cell phone, computer, refrigerator, watch, bicycle, motorcycle, car and/or electric fan. In general, both the indices showed a greater internal coherence but the differences in Index 1 and Index 2 by wealth group are statistically significant ( $z$  test). For example, in urban India while Index 1 showed a 13 percent of the households in the poorest 40 percent owning a bank or post office account, Index 2 reported a 26 percent. Similarly in rural areas, while Index 1 showed a 16 percent of households in the middle 40 percent of the wealth index owning a motorised vehicle, Index 2 reported only 7 percent.

Figure 1(c) *ó* Distribution of the Wealth Index in Urban India, 2005-06

The validation of the wealth indices was checked with respect to three variables (not used in the computation of the wealth index): caste, religion, and educational level of households. In India, economic status generally varies by caste group; being the lowest among Schedule Tribe (ST), followed next by Schedule Caste (SC), and other backward classes (OBC). Economic status of Muslims is generally lower than that of Hindus (Govt of India 2006). Similarly, the economic status varies directly with the educational level of the head of the household. The caste differentials in economic status suggested that a relatively higher proportion of Scheduled Tribe households are in the poorest 40 percent in Index 1 when compared to Index 2. The distribution of Index 1 by religion showed that, among Muslims, 39 percent are in the poorest category compared to 41 percent of Hindus. This pattern changes in Index 2 (45 percent of Muslims compared to 40 percent of Hindus). The differentials by educational level showed a similar pattern in both indices. One can therefore conclude that the wealth indices predict the prevailing economic inequalities in the country fairly well, though Index 2 seems to be better than Index 1.

### 3.1.3 Agreement between Index 1 and Index 2

Starting from the composite scores, separate wealth quintiles were constructed for Index 1 and Index 2. Only 71 percent of the households classified in the first quintile in Index 1 were classified in the first quintile in Index 2. Similarly, only 59 percent of the households classified in the fifth quintile of Index 1 were classified in the fifth quintile of Index 2 (table not

Table 2 ó Internal coherence. Percentage of households owning a motorized vehicle, bank or post office account and mean number of consumer durables by alternative wealth indices in India, 2005-06

Group based on wealth index	A single wealth index for the national population (Index 1)			Separate wealth index for rural and urban areas (Index 2)		
	% having any motorized vehicle	% owning a bank or post office account	Mean number of consumer durables	% having any motorized vehicle	% owning a bank or post office account	Mean number of consumer durables
<i>Combined</i>						
Poorest 40%	1.43	15.52	1.26	1.74	16.15	1.48
Middle 40%	13.23	42.94	3.32	15.04	45.07	3.42
Richest 20%	63.40	84.02	7.40	59.15	78.49	6.75
All	18.54	40.19	3.31	18.54	40.19	3.31
<i>Urban</i>						
Poorest 40%	0.68	13.27	1.22	4.07	25.84	2.48
Middle 40%	7.91	37.52	3.30	31.99	67.97	5.45
Richest 20%	62.13	84.41	7.45	87.23	95.07	9.09
All	31.86	56.53	4.99	31.86	56.53	4.99
<i>Rural</i>						
Poorest 40%	1.50	15.71	1.26	0.61	11.47	1.00
Middle 40%	16.32	46.09	3.34	6.85	34.00	2.45
Richest 20%	67.03	82.90	7.26	45.58	70.48	5.62
All	12.10	32.29	2.50	12.10	32.29	2.50

Table 3 ó *Validation. Percentage of households classified into wealth groups under alternative wealth indices by religion, caste and educational level of head of household in India, 2005-06*

Group based on wealth index	A single wealth index for the national population (Index 1)			Separate wealth index for rural and urban areas (Index 2)		
	Poorest 40%	Middle 40%	Richest 20%	Poorest 40%	Middle 40%	Richest 20%
<i>Religion</i>						
Hindus	41.36	39.35	19.29	40.20	40.22	19.58
Muslims	38.98	44.16	16.13	45.12	40.07	14.81
Christians	23.65	43.41	32.94	28.84	41.26	29.90
Others	23.09	34.38	42.53	24.06	33.12	42.82
<i>Caste</i>						
Schedule caste	53.86	36.78	9.35	52.92	37.84	9.24
Schedule tribe	64.82	28.10	7.00	72.86	22.00	5.14
Other backward caste	40.35	42.84	16.81	40.80	43.41	15.79
Others	25.08	41.08	33.46	23.00	41.70	35.70
<i>Educational level of head of household</i>						
No education	60.45	33.28	6.27	64.33	31.89	3.78
Up to primary	41.69	44.59	13.71	42.24	47.87	9.88
Incomplete secondary	27.43	46.42	26.15	23.41	49.76	26.84
Secondary and higher	8.59	37.79	53.62	6.03	29.53	64.45
All	40.00	40.00	20.00	40.00	40.00	20.00

shown). Absolute differences between Index 1 and Index 2 were computed, using the following classification system (Table 4):

- i. household classified in the same wealth quintile in both indices (zero difference);
- ii. household moving to adjacent wealth quintiles (the absolute differences between the wealth quintiles of both indices was 1);
- iii. household moving to farthest quintiles (the absolute differences between the wealth quintile of both indices was 2 or more).

Table 4 *Differences in wealth quintile and kappa statistics of two alternate wealth indices in India, 2005-06*

	Total	Rural	Urban
<i>Classification wealth quintile</i>			
% of households remaining in same quintile (Absolute difference of wealth quintiles is zero)	39.85	47.99	23.00
% of households that moved to an adjacent quintile (Absolute difference of wealth quintile is 1)	49.73	51.66	45.74
% of households that moved to the farthest quintile (Absolute difference of wealth quintile is $\geq 2$ )	10.43	0.35	31.26
<i>Kappa</i>			
Statistic	0.1916	0.3328	0.0378
Agreement (%)	36.02	46.04	24.27

Based on this classification, we found that only 39 percent households were in the same quintile of Index 1 and Index 2. Fifty percent moved to an adjacent quintile and 10 percent moved to the farthest quintile, indicating that the majority of the households are misclassified by both indices.

To know the statistical significance of the agreement, the kappa statistics were computed. The kappa statistics, measuring the extent of agreement, was 0.19 for combined; 0.33 for rural and 0.03 for urban areas. There was some, albeit weak, agreement between Index 1 and Index 2.

### 3.2 Section II: Health estimates by wealth groups of Index 1 and Index 2

This section compares the estimates of utilisation of six reproductive and child health services: contraceptive use, unmet need for contraception, antenatal care, medical assistance at delivery, child immunisation and children who were underweight by wealth groups using the two alternate indices.

### 3.2.1 Health care utilisation

The head of household or any adult member of the household were asked a question on general health care utilisation during the survey. The question wording was the following: *“When members of your household get sick, where do they generally go for treatment?”* The responses were classified as public health care providers, private health care providers and others. The public health care providers primarily included the government funded health care centres while the private health centres included private hospitals, doctors, clinical and/or paramedic personnel. The remaining health care providers were classified as *“other”*. The differentials in health care utilisation by wealth groups for both the indices are shown in Table 5. There are significant differences in health care utilisation by sources, in both rural and urban areas. For example, in urban India, among the poorest 40 percent, 51 percent used a private health centre in Index 1 compared to 55 percent in Index 2. Similar differences were found in the other wealth groups.

### 3.2.2 Reproductive and child health services and percent of children who are underweight

The estimates of the percentage of mothers receiving three or more antenatal care (ANC) visits and medical assistance at delivery by wealth groups in Index 1 and Index 2 are shown in Table 6. The estimate of ANC is computed on the last birth occurred in the last five years preceding the survey. The differentials in estimates of ANC were large and follow a particular pattern. In general, in Index 1 the estimates of ANC by wealth groups were underestimated in urban areas and overestimated in rural areas compared to Index 2. For example, the estimates of ANC (Index 1) in urban India were 41 percent for the poorest 40 percent, 71 percent for the middle 40 percent and 89 percent for the richest 20 percent. These estimates are substantially higher than when Index 2 was used; 57 percent in the lowest 40 percent, 85 percent in middle 40 percent and 95 percent in richest 20 percent. In other words, the estimates of ANC in urban India were 20% lower for the poorest 40 percent, 13 percent lower for the middle 40 percent, and 5 percent lower for the richest 20 percent. In the case of rural areas, the estimates were 3 percent higher for the poorest 40 percent, 10 percent higher in middle 40 percent and 9 percent higher in the richest 20 percent. Similar patterns were found for medical assistance at delivery. Medical assistance at delivery, defined as those births assisted by a doctor, auxiliary nurse, midwife, nurse, or lay health advisor, was computed for all live births in the last five years. The absolute difference in the estimates of medical assistance at delivery



Table 5 ó *Wealth Index and Health care utilisation. Percentage of households using health facilities under alternative wealth indices in India, 2005-06*

Group based on wealth index	A single wealth index for the national population (Index 1)			Separate wealth index for rural and urban areas (Index 2)		
	Public	Private	Others	Public	Private	Others
<i>Combined</i>						
Poorest 40%	46.28	42.84	10.88	43.97	47.94	8.09
Middle 40%	45.60	49.78	4.62	42.20	52.48	5.25
Richest 20%	28.38	69.40	2.23	34.34	62.63	3.03
All	40.89	53.44	5.67	40.89	53.44	5.67
<i>Urban</i>						
Poorest 40%	43.81	50.77	5.41	41.64	54.78	3.58
Middle 40%	39.61	57.35	3.04	32.35	65.31	2.33
Richest 20%	25.81	72.00	2.19	20.94	76.71	2.36
All	33.20	64.01	2.79	33.20	64.01	2.79
<i>Rural</i>						
Poorest 40%	46.61	41.79	11.60	46.23	41.30	12.46
Middle 40%	50.84	43.16	5.99	50.73	41.53	7.75
Richest 20%	37.83	59.81	2.36	43.86	52.63	3.50
All	47.45	44.42	8.12	47.45	44.42	8.12

*Note:* The public health centres includes the government health centres such as government hospital or dispensary, municipal hospital, urban health centres, community health centre, rural hospital or primary health centres, sub-centres, anganwadi centres, government mobile clinic and other public sector health facility. The private health centres include private hospital, doctor, clinic, or paramedic. Everything else was classified as 'others'.

between Index 1 and Index 2 varies from 3% to 12% in rural areas and 4% to 18% in urban areas. The pattern also holds true for current contraceptive use but not for unmet need for contraception for currently married women (Table 7). However, the absolute differences in the use of contraceptive among those women who were married at the time of the survey were lower than those for ANC or medical assistance at delivery. The absolute differences ranged from 2% to 4% in the rural areas and from 3% to 9% in urban areas. In case of unmet need for contraception, the pattern was reversed. Unmet need by wealth groups was underestimated in rural areas and overestimated in urban areas in Index 1 when compared to Index 2. Along with the maternal care indicators, two of the child health indicators, namely the percentage of underweighted children aged under-5 and the coverage of children fully immunisation are shown in Table 8. The percentage of underweighted children in urban areas by wealth groups was higher in Index 1 if compared to Index 2. The absolute differences between the two indices in underweighted children by wealth group varied from 3 percent in the richest 20<sup>th</sup> percentile to 13 percent in the middle 40<sup>th</sup> percentile. The differences are also large with respect to child immunisation. Complete childhood vaccination includes BCG, measles, and 3 doses each of Polio and DPT and it was computed for the last two live births in the last three years preceding the survey for the surviving children aged 12-23 months. The differences in estimates of immunisation rates in urban areas between Index 1 and Index 2 were 15 percent, 11 percent and 7 percent respectively in the poorest (bottom 40<sup>th</sup> wealth percentile), in the middle (between 40-80 percent wealth percentile), and in the richest group (top 20<sup>th</sup> wealth percentile). Similarly, childhood immunization rates were overestimated by 3-9% in rural areas in the three wealth groups. In general, if a single wealth index is computed for a country such as India, it is likely to underestimate antenatal care, medical assistance at delivery, contraceptive use and child immunisation by wealth groups in urban areas and overestimate these services in rural areas, compared to a wealth index derived from separate rural and urban wealth indices. On the other hand, the unmet need for contraception and percent of children who are underweight by wealth groups are likely to be higher for urban areas compared to rural areas.

#### 4. DISCUSSION

Demographic and Health Surveys (DHS) data are widely used in academia, research as well as by donors, planners and policy makers. These surveys do not collect data on income or household expenditure. Instead,

Table 6 ó *Wealth index and maternal health.*  
*Percentage of mothers seeking three or more antenatal care and medical assistance at delivery*  
*by alternate wealth indices in India, 2005-06*

Group based on wealth index	A single wealth index for the national population (Index 1)		Separate wealth index for rural and urban areas (Index 2)		Differences in estimates (Index 2 - Index 1)	
	Three or more antenatal checkups	Medical assistance at delivery	Three or more antenatal checkups	Medical assistance at delivery	Three or more antenatal checkups	Medical assistance at delivery
<i>Combined</i>						
Poorest 40%	30.9	25.3	36.2	31.0	5.3	5.7
Middle 40%	61.1	56.9	55.7	51.6	-5.4	-5.3
Richest 20%	86.5	88.4	77.8	76.0	-8.7	-12.4
All	51.1	46.6	51.1	46.6	0.0	0.0
<i>Urban</i>						
Poorest 40%	40.7	39.0	60.2	57.1	19.5	18.1
Middle 40%	70.4	68.1	83.2	85.2	12.8	17.1
Richest 20%	88.8	91.2	94.1	95.4	5.3	4.2
All	74.4	73.4	74.4	73.4	0.0	0.0
<i>Rural</i>						
Poorest 40%	30.2	24.3	27.2	21.2	-3.0	-3.1
Middle 40%	56.8	51.6	46.5	40.8	-10.3	-10.8
Richest 20%	81.7	82.5	72.9	70.2	-8.8	-12.3
All	43.1	37.5	43.1	37.5	0.0	0.0

Table 7 ó *Wealth index and contraceptive use.*  
*Percentage of currently married women using contraception and having unmet need*  
*for contraception by two alternative wealth indices in India, 2005-06*

Group based on wealth index	A single wealth index for the national population (Index 1)		Separate wealth index for rural and urban areas (Index 2)		Differences in estimates (Index 2 - Index 1)	
	Contraceptive use	Unmet need for contraception	Contraceptive use	Unmet need for contraception	Contraceptive use	Unmet need for contraception
<i>Combined</i>						
Poorest 40%	46.5	16.6	48.4	16.0	1.9	-0.6
Middle 40%	59.7	11.7	58.1	11.8	-1.6	0.1
Richest 20%	67.6	7.9	66.0	9.2	-1.6	1.3
All	56.4	12.7	56.4	12.7	0.0	0.0
<i>Urban</i>						
Poorest 40%	49.7	17.0	58.2	12.8	8.5	-4.2
Middle 40%	61.6	10.9	65.2	8.8	3.6	-2.1
Richest 20%	68.5	7.4	71.5	5.9	3.0	-1.5
All	64.0	9.7	64.0	9.7	0.0	0.0
<i>Rural</i>						
Poorest 40%	46.3	16.5	43.9	17.4	-2.4	0.9
Middle 40%	58.7	12.1	54.8	13.2	-3.9	1.1
Richest 20%	65.4	9.2	63.7	10.6	-1.7	1.4
All	53.0	14.1	53.0	14.1	0.0	0.0

Table 8 ó *Wealth index and child health.*  
*Percentage of children underweight<sup>a</sup> and children immunised<sup>b</sup> by alternate*  
*wealth indices in India, 2005-06*

Group based on wealth index	A single wealth index for the national population (Index 1)		Separate wealth index for rural and urban areas (Index 2)		Differences in estimates (Index 2 - Index 1)	
	% of children underweight	% of children aged 12-23 months fully immunized	% of children underweight	% of children aged 12-23 months fully immunized	% of children underweight	% of children aged 12-23 months fully immunized
<i>Combined</i>						
Poorest 40%	53.3	28.2	52.2	30.8	-1.1	2.6
Middle 40%	38.1	50.5	39.7	48.2	1.6	-2.3
Richest 20%	19.7	71.2	24.8	64.4	5.1	-6.8
All	42.5	43.6	42.5	43.6	0.0	0.0
<i>Urban</i>						
Poorest 40%	50.9	30.3	43.7	44.8	-7.2	14.5
Middle 40%	38.6	51.8	25.6	63.2	-13.0	11.4
Richest 20%	19.8	72.4	16.7	79.1	-3.1	6.7
All	32.9	57.5	32.9	57.5	0.0	0.0
<i>Rural</i>						
Poorest 40%	53.5	28.1	55.3	25.5	1.8	-2.6
Middle 40%	37.9	49.9	44.1	43.0	6.2	-6.9
Richest 20%	19.6	68.6	26.9	59.8	7.3	-8.8
All	45.7	38.7	45.7	38.7	0.0	0.0

Notes: <sup>a</sup>% of children under age 5 who are underweight.

<sup>b</sup>The full immunization includes BCG, measles, and three doses each of DPT and polio vaccine for children aged 12-23 months.

they use a composite index based on economic proxies, such as consumer durables, housing qualities, sanitary facilities and size of land holdings that reflect the long-term economic status of households. A wealth index is increasingly used to explain the economic differentials in health outcomes and health care utilization in many countries, including India. A common practice in the computation of a wealth index is to derive a single PCA-based wealth index for the national population, rather than separate indices for rural and urban areas. Using the India NFHS 3 data, this paper examined whether the health estimates by wealth groups were sensitive to rural and urban specifications of the wealth index. In the first scenario (Index 1), all the variables were used to derive the wealth index for the country. In the second scenario (Index 2), separate wealth indices were computed for rural and urban areas. The analyses focused on differentials by three broad wealth groups: the poorest 40 percent, the middle 40 percent and the richest 20 percent. The health estimates considered are a set of reproductive and child health services, namely, antenatal care, medical assistance at delivery, contraceptive use, unmet need for contraception, immunisation of children and underweight of children.

Both wealth indices exhibited internal coherence and reliability. However, the agreement between the two wealth indices was weak. Only 40 percent of households remained in the same quintile of the wealth index and the kappa statistics were low. The health estimates by wealth groups differed significantly across these two methods. When comparing the estimates of reproductive and child health services in urban India, using Index 1 and Index 2, results showed that the estimates of antenatal care, medical assistance at delivery; contraceptive use and childhood immunisation coverage of children were substantially lower across all wealth groups when using Index 1. Similarly, the estimates of the underweighted children and the unmet need for contraception in urban areas were higher using Index 1. The reverse pattern was observed in the rural areas. The differentials in the estimates by wealth groups were large for antenatal care, medical assistance at delivery and immunisation coverage and lower in the case of contraceptive use. Estimates of reproductive and child health services were sensitive to the rural and urban specifications of the wealth index. If it were common practice to compute a single wealth index for the country, the service coverage by wealth groups would be underestimated in urban areas and overestimated in rural areas, compared to when a wealth index derived from rural and urban areas were used. Furthermore, the theoretical and statistical significance of indicators included in the construction of country-specific wealth index, are critical and hence should be debated and discussed. It may also be useful to provide cut-off points for the poor and

non-poor, so that the health estimates specific to these groups, can be derived. One possibility for such cut-off points is to fix different poverty levels for urban and rural populations, using the national poverty level estimates available for many countries. It is particularly useful for planners and policy makers.

## 5. CONCLUSION

For small and large-scale surveys lacking income or expenditure data and using wealth index, the inclusion of variables sensitive to rural and urban areas should be debated and their theoretical and statistical significance in the construction of a wealth index should be examined. The results of this study suggest the construction of a separate wealth index for rural and urban areas. Although the value of consumer durables varies considerably across countries it is useful to try and derive information about the quantity and market prices of consumer durables in constructing a more context-specific and robust wealth index. Lastly, providing additional wealth variables for poor and non-poor, for example, as per official estimates of poverty, is recommended for.

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