Journal of Quantitative Methods (JQM)
Volume 9 Issue 1, Spring 2025
ISSN$_{(P)}$: 2522-2252, ISSN$_{(E)}$: 2522-2260
Homepage: https://ojs.umt.edu.pk/index.php/jqm

Article QR

Title:	**Asset Index as an Indicator of Household Permanent Income in India: Comparison with Total Expenditure and Income**
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DOI:	https://doi.org/10.29145/jqm.91.03
History:	Received: August 13, 2020, Revised: April 22, 2021, Accepted: April 09, 2025, Published: June 30, 2025
Citation:	Bhar, S. (2025). Asset index as an indicator of household permanent income in India: Comparison with total expenditure and income. *Journal of Quantitative Methods*, *9*(1), 33-65. https://doi.org/10.29145/jqm.91.03
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Conflict of Interest:	Author(s) declared no conflict of interest

A publication of
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Asset Index as an Indicator of Household Permanent Income in India: Comparison with Total Expenditure and Income Data

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Abstract

Finding an appropriate proxy of permanent income has always remained a challenge to empirically analyze a diverse range of microeconomic questions. This challenge gets even more complicated in developing economies where adequate and reliable household survey data is limited, to say the least. As the commonly employed measures of economic status, in this case, that is, total consumption expenditure and income are prone to various errors, especially so in developing economies, asset indices, constructed through different methods, are employed as an alternative. The current study attempted to examine how far these measures correspond with each other. More importantly, it also represented the permanent income of households in the context of India through both phases of India Human Development Survey (IHDS). The assumption employed to determine which one of these is a better proxy of permanent income was that the permanent income of households would remain relatively the same over a decade or less. IHDS's approach of surveying exactly the same households over 7–8 years ensures that which one of these is a better proxy of permanent income can be discerned based on the aforementioned assumption. All these measures were found to be positively correlated with each other to a moderate extent, affirming the relationships explored in the literature. Asset index was found to be a strong and much better proxy of permanent income than the other two. This study highlighted the need to explore the potential in order to employ asset index as a proxy of permanent income in different research contexts, beyond current areas of its application.

Keywords: asset index, consumption expenditure, India Human Development Survey (IHDS), permanent income

JEL Codes: D10, D31, D33

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Introduction

The current study aimed to empirically test how far different measures of the economic status of households, such as income, total consumption expenditure, and asset index can accurately represent the permanent income or wealth of households. This exercise is conceptualized for the following reasons: firstly, measuring or representing permanent income in some form is always considered an extremely important challenge as it denotes the actual economic status of households (Friedman, 1957; Modigliani & Brumberg, 1954). Furthermore, this actual economic status directly or indirectly interacts with all other aspects of the households, be it well-being, consumption pattern, health status, education enrollments or the overall standard of living. Secondly, since permanent income is difficult to measure or considered as rather unobservable (Naga & Burgess, 2001), different proxies, such as income, total consumption expenditure, even education status are employed widely in literature to represent it in some possible manner. Recently, there is an introduction of asset index or weighted asset index as an alternative measure of the economic status of households, especially for economies where other aforementioned measures are either not available or not reliable. The appropriateness of this index has already been examined to address questions related to health conditions and poverty estimation (Ucar, 2014). In the case of India, the comparability between these different measures in the context of aforementioned research was evaluated; however, to a very limited extent, the only prominent example being Srivastava and Mohanty (2010). Thirdly, no systematic comparison was carried out between these measures from the perspective of how far these represent the permanent income of households.

In the current study, the basic conceptual understanding employed to meet the primary objective was that the permanent income of households by definition has remained stationary at least over a decade or even when changes, it changes steadily. Therefore, over a period of 7-8 years, the permanent income of households would remain the same or change steadily as well as evenly, ensuring the relative quintile position of a household within a particular sample may remain the same. In order to test the above postulate, one requires a dataset that measures different aspects of the same household over the said period. India Human Development Survey (IHDS), the newly conducted pan-country survey, does precisely the same and thus, presents a unique opportunity to test this postulate in the context of India.

Moreover, the findings of this exercise in the context of India, a rapidly developing economy, could be generalized for other developing economies where such comparisons are not yet conducted.

Along with this crucial advantage, both phases of IHDS also made a pioneering attempt to estimate income, which is not measured in the most widely used National Sample Surveys (NSS) in India. Therefore, all the articulated facets of the above postulate may be examined with the help of this dataset. In the next section, necessary literature review was conducted to substantiate the objective as well as to place the findings of this exercise in the literature. Afterwards, the construction of weighted asset index was carried out through the employment of Principal Component Analysis (PCA). The internal coherence and robustness of the constructed index were also evaluated subsequently. After that, these three measures were compared with each other. Followed by that, the appropriateness of these measures was evaluated in terms of representing permanent income. The study concluded by highlighting the relevance as well as limitations of the findings.

Literature Review

Friedman (1957) argued in his permanent income hypothesis that income or the total income of a household is composed of two components: permanent and transitory. The former is primarily determined by the production and human capital of the concerned household or the individuals of that household. Whereas, the latter is induced by the market fluctuations and also other shocks that the household might undergo. At any given moment, the total income of a household is a sum of these two components. Friedman (1957) and even Modigliani and Brumberg (1954) argued that the current income does not entirely determine the consumption expenditures. Instead, the permanent income of a household influences the consumption expenditures the strongest, especially, when the household can borrow based on future-projected income.

Since permanent income cannot directly be measured, different proxies are employed to measure the permanent component of income. These proxies can be divided based on whether these measures observed assets or stocks, measure flow like expenditures or income over a period or indirectly attempts to get a sense of permanent income through the years of education (Dynan et al., 2000) or occupation. Based on Friedman's theory, total

household consumption expenditure is widely used as a proxy of permanent income when collected over a period, either a month or a year or for subsequent years. Data collected over a longer duration would be a better measure of permanent income. However, there are multiple challenges in employing total consumption expenditures of developing countries as a measure of permanent income. Firstly, households in the developing nations may not always have a smooth consumption behavior maintained through borrowing and saving. This gets even more complicated when a large proportion of the population is dependent on variable income sources, such as agriculture. Secondly, there is evidence from earlier studies that measures of consumption expenditures can be entirely erroneous (Bouis, 1994; Scott & Amenuvegbe, 1990).

Sahn and Stifel (2003) charted out some additional issues associated with the employment of total consumption expenditure as a proxy of permanent income. Firstly, the method of expenditure surveys in developing countries is predominantly based on the interviewees' recall data and not by registering the actual consumption. This recall data could contain large measurement errors. Pradhan (2000) noted that the more commodities listed on the recall sheet, the more possibility is there that the aggregate consumption is reported higher. Secondly, the use-value of commodities needs to be derived when consumption aggregate is derived. This is quite difficult in developing countries as prices of goods, depreciation rates of durable or semi-durable goods, and nominal interest rates are not readily available across the country. Even in the case of valuation of houses, the rental equivalent is almost impossible to evaluate. This is because in rural areas, there is no rental market for houses.

To overcome the shortcomings associated with total consumption expenditures as a widely available proxy of permanent income, asset information of household is used to construct a measure of asset index. The asset index could be a strong proxy of permanent income. Collecting information on asset holdings is substantially less problematic in comparison to income or total consumption expenditures (Kolenikov & Angeles, 2009). The reporting error, in this case, is negligible as the interviewer may quite easily observe the possession of various assets or ask direct questions, such as 'do you own a TV set? Is it black and white?', or 'whether you have piped water connection at home?'. The use of a single asset variable may not lead towards reliable results and thus, the most

commonly employed strategy is to construct an index with the help of information about various asset variables. This, in a way, makes the asset index a far better proxy of permanent income (Kolenikov & Angeles, 2009). The next question that arises here is how to aggregate the ownership of different assets in a single measure. The first and simplest alternative is the use of equal weights. This could be seen as a rather objective way to construct an asset index. However, it is hard to accept that the ownership of a TV set and a car implies the same contribution to the asset index of a household. This approach, eventually, simplifies things and thus, masks deeper nuances of a household's permanent income.

The second approach is to use implicit and explicit prices of assets as "weights" to construct an asset index (Filmer & Pritchett, 2001). This approach seems quite logical and intuitive. However, the current price of a particular asset could vary significantly, such as presently, a TV set may cost between 5000 (INR) to 50000 (INR) anywhere or even more in India. Owing to this fact, this method would be appropriate to employ where the purchase price, date of purchase, and also the probable depreciation rate of each asset are collected in the survey. It is not the case in IHDS and thus, applying an average price for each of the assets might not produce a robust and internally coherent index. Moreover, approximating the price of each asset may also be rendered as arbitrary and subjective.

The most commonly adopted approach to construct a composite index is by applying principal components. Through the application of principal components, the weights of different assets are determined. Principal components is a widely employed statistical method to extract a few orthogonal linear combinations that capture most of the common variation in a cluster of variables. In this manner, principal components can be seen as extracting the common information from those variables. As indicated, this analysis would generate a number of orthogonal combinations capturing a different portion of the variation; however, the first principal component may capture the highest variation among the rest of the components.

Several scholarly attempts indicated that the weighted asset index is a good proxy of long-term economic status (Filmer & Pritchett, 2001; Sahn & Stifel 2003; Vyas & Kumaranayake, 2006). However, studies indicate that asset index is a weak predictor of total consumption expenditure (Howe et al. 2008; Lindelow 2006; Montgomery et al., 2000). In this regard, Ucar

(2014) presented a comprehensive review of studies across countries which offered a measure of comparability between asset index and total consumption expenditure. The commonly employed methods for comparison are through respective quintile ranks, the number of households appearing in the same quintile, rank correlation coefficient, sensitivity analysis, correspondence matrix, or the R^2 value obtained in OLS regression (Ucar, 2014). On average, the review demonstrated that, there exists moderate comparability between asset index and total consumption expenditure. However, not much comparison is available in literature between income and asset index or even between income and total consumption expenditure; as already indicated, Ucar (2014) made a pioneering attempt in this regard. The current study extended this exploration in the context of India. Furthermore, it also made a novel contribution to the literature in terms of empirically discerning that which one of these measures performs as a better proxy of permanent income.

Materials and Methods

Data

The dataset used for the analysis was IHDS,[1] a nationally representative household-level dataset prepared by the University of Maryland and the National Council of Applied Economic Research, New Delhi (Desai, Reeve and NCAER 2009). The advantages to choose this dataset over NSS as the more conventional one in India are mentioned as follows:

1. The second phase of this dataset comprised a reinterview of the households covered in the first phase. In the first phase conducted in the year 2004-05, a total of 41559 households were interviewed across the country. In the second phase during 2011–12, 83% of the households were reinterviewed, accounting to 34621 households. This phase also included spilt households (5397) from the first round and a number of fresh randomly selected households (2134). However, in the context of this study, households which were interviewed for both the phases were only considered, that is, 34621 households. Due to reinterview process, this survey presents a unique scope for the current study to examine how

[1]This survey is quite exhaustive as it covers all the states and union territories of India barring Andaman and Nicobar and Lakshadweep, two union territories which put together account for less than 0.05% of India's total population.

far all the discussed measures could represent the permanent income of households.

2. This survey makes a pioneering attempt to estimate the income of households, as per Khamis et al. (2012), this is the first such attempt after the 1931 census. The availability of income along with total consumption expenditure makes this study more nuanced.

Both phases of IHDS employ a stratified random sampling method and provide weight for each household. On the basis of weights, the 34621 samples from both phases account for 163202488 households in the 1st phase and 211302771 in the 2nd. The significant difference in the number of represented households indicates the population rise the country has witnessed in these 7-8 years.

Methodology

Firstly, the issues concerning the construction of income and expenditure quintile are discussed. Aftewards, asset index is constructed for both the phases[2] separately by employing the method of PCA on phase-specific datasets. Then, the strengths of these indices are evaluated on the count of internal coherence and robustness. Following that, the constructed asset index is compared with income and total consumption expenditure. Here, the comparison is made within the weighted quintile ranks of households based on each of the three measures. Finally, the comparisons between both the phases of each measure (asset index, income, and total consumption expenditure) are carried out to discern their ability in order to represent the permanent income of households.

The extent of comparability, both inter-measures as well as intra-measures, would be determined as per the percentage of households falling in the same quintile and adjacent one(s), and the percentage present in the farthest quintile. Along with this, weighted Spearman-rank correlation coefficients are also evaluated to substantiate the inferences.

[2]The rationale behind constructing these indices separately for phases is that the inclusion of replacement households in the second phase. So it is thought to be a better strategy to consider each phase as independent and then merge the datasets to focus on the 34621 households interviewed across phases.

Constructing Income and Expenditure Quintile

Consumption per capita is provided for both the phases of IHDS, while total consumption expenditure is available in the 2nd phase. In total, there are 47 categories for which consumption expenditures are noted in the 1st phase, and the same is 52 in the 2nd. Out of these 47 categories, the first 30 categories are measured in monthly or 30 days time frame, while the rest of the 17 are collected over the yearly time frame or 365 days. The categories measured in a monthly frame are converted to the yearly one by multiplying it by a factor of 12 to construct a measure of annual total consumption expenditure in the 1st phase. The total annual consumption provided in the 2nd phase is used directly.

The income data presented in both the phases of IHDS comprises the sum total (measured at the household level) of wages and salaries, non-farm business income, net agricultural income, remittances, property, and other income, and public benefits. All of these measures are constructed from more than 50 different sources of income actually collected in both phases. Due to incorporating losses or debts in the measure of income, around 1% of households in both phases recorded negative incomes. For the ease of interpretation of results, the negative incomes of both phases are converted to zero.

In this regard, Ucar (2014) highlighted that the total income and consumption expenditure fail to represent the actual economic status of households. The underlying logic is that a household with fewer members would tend to have lower total consumption expenditure. Instead, per capita income or consumption expenditure perform quite well in this regard and may be considered as much better representations of economic status. Now, the challenge is how to construct a per capita measure. Ucar (2014) employed the OECD-modified equivalence scale to calculate per capita estimates, which basically accounts 1 for the first adult and then 0.5 for subsequent adults, and 0.3 for each child defined as being younger than 14 years of age.

Along with this, recent OECD studies (Sarfati, 2009; The Organization for Economic Cooperation and Development [OECD], 2011) employed square root of household size as another scale, especially for countries that do not possess any separate equivalized scale. IHDS does not employ any equivalence scale in both the phases. Therefore, the current study evaluated

weighted Spearman-rank correlation coefficients between per capita measures of total income and total consumption expenditure constructed with both the aforementioned strategies (OECD-modified equivalence scale and square root of household size) and with the total number of members as a simple count provided in both the phases. The coefficients in Table 15 in Appendix I show that there is no major difference between these two strategies and the conventional one of using simple count. Owing to this, the conventional one was employed since no equivalence scale is present for India. Furthermore, the available ones are constructed in the contexts of different economies, mostly the developed ones. The mean, SDs, and range of per capita total consumption expenditure and income are presented in Table 4.

Construction of Asset Index

The critical assumption that needs to be highlighted here is that households' long-term wealth explains the maximum variance in the asset variables. Although, there are no means available to determine the above hypothesis, Filmer and Pritchett (2001) employed the test for robustness and internal and external coherency to indicate the asset index, particularly in developing economies. Similar tests were conducted to showcase the strength of the constructed asset index. According Filmer and Pritchett (2001) methodology to employ PCA in order to construe a composite asset index gained fame within a short period. This is because it was adopted by the World Bank (Gwatkin et al., 2003, 2007) and Demographic and Health survey (DHS). Appendix I shows the mathematical formula based on which PCA is operationalized.

The asset variables that are chosen for the PCA can be binary or categorical. Filmer and Pritchett (2001) demonstrated a method based on the use of binary variables only. Even if there is a need to include a categorical variable, it is first converted into dummy binary variables and then included. In this regard, Angeles and You (2007) summarized the variables of DHS that can be incorporated in the construction of asset indices by reviewing surveys conducted during 1994-2007. Their findings indicate that two mostly included categories of variables are: housing characteristics and possession of durable goods. The average number of variables was found to be 20, ranging from 11-42. Kolenikov and Angeles (2009) presented a detailed comparative study of different approaches to employ PCA in order to construct asset index. They primarily focused to

incorporate categorical variables in the construction of indices that are not necessarily binary and juxtapose with the approach of Filmer and Pritchett (2001) which is based on using binary variables only. The primary finding of their study is that Filmer and Pritchett's approach is not that efficient, especially when the number of dummy variables in place of categorical variables increases. However, the asset index (which is a simple sum of possession of different assets) provided in the IHDS dataset is primarily based on binary variables. Furthermore, the method of Filmer and Pritchett is also widely regarded (Kolenikov & Angeles, 2009) and simple to employ. Owing to these points, the current study entirely followed the approach of Filmer and Pritchett (2001) .

The primary approach to construct weighted asset index is to use asset information in constructing simple count asset index of IHDS in both the phases[3]. Furthermore, two housing quality-related dummy variables are added in place of categorical and non-ordinal variables to determine the quality of roofing, wall, and flooring of houses and a continuous variable denoting land ownership of each household, as similarly done by Filmer and Pritchett (2001). The variables can be divided into two broad categories: possession of goods or assets and housing characteristics. Under goods or assets, there are a total of 21 variables in the first phase. These include cycle, sewing machine, generator, mixer/grinder, motor cycle/scooter, black and white TV, color TV, air cooler, clock/watch, electric fan, chair/table, cot, telephone, cell phone, refrigerator, pressure cooker, car, ac, washing machine, computer, credit card. Moreover, there are 25 variables in the second phase mentioned for the first phase and dish/cable TV, laptop, microwave, and books more than 5 (this one is a dummy variable). Under the housing characteristics, there are 8 variables in both the phases. These include piped indoor water, separate kitchen, flush toilet, electricity, lpg, all-low quality materials, all-high quality materials, and land owned more than 4acres. All-low quality materials and all-high quality materials are dummy variables constructed based on roofing, wall, and flooring quality. Both these variables do not correspond to the *pucca* (concertized) and

[3]I have dropped 2 clothes, footwear for the reason that these are not really marker of wealth or affluence, rather these are marker of whether the households is below or above poverty line. Along with these two, I didn't include any variables like any vehicle or any TV, rather included all the corresponding assets (like cycle, motorcycle, care or color or B/W TV, color TV) separately. I thought this approach would not mask any information and would ensure more nuanced interpretation.

kaccha (natural materials) classification for roofing, wall, and flooring provided in the IHDS dataset. Here, the author used his discretion to classify the condition of each of these housing characteristics in 3 categories: highest, middle, and lowest. Based on this classification, variables were constructed indicating whether a household possesses all the highest quality materials or all the lowest quality ones.

Table 1

Mean, SD, and Weights of Each of the Assets across Phases

	1st Phase			2nd Phase		
	Mean	SD	Weights[a]	Mean	SD	Weights
Cycle	0.55	0.498	0.074	0.542	0.498	0.032
Sewing Machine	0.266	0.442	0.413	0.261	0.439	0.383
Generator	0.014	0.116	0.797	0.019	0.138	0.593
Mixer/Grinder	0.257	0.437	0.582	0.336	0.472	0.497
Motor Cycle/Scooter	0.187	0.39	0.592	0.287	0.452	0.467
B/W TV	0.26	0.438	0.033	0.05	0.219	-0.048
Color TV	0.297	0.457	0.599	0.615	0.487	0.535
Air Cooler	0.129	0.335	0.59	0.178	0.382	0.47
Clock/Watch	0.853	0.354	0.435	0.859	0.348	0.491
Electric Fan	0.641	0.48	0.494	0.754	0.431	0.517
Chair/Table	0.686	0.464	0.459	0.778	0.416	0.477
Cot	0.848	0.359	0.31	0.894	0.309	0.230
Telephone	0.17	0.376	0.636	0.082	0.274	0.545
Cell Phone	0.087	0.282	0.701	0.804	0.397	0.454
Refrigerator	0.177	0.382	0.7	0.279	0.448	0.575
Pressure Cooker	0.445	0.497	0.511	0.543	0.498	0.502
Dish/Cable TV	-	-	-	0.527	0.499	0.514
Car	0.021	0.145	0.918	0.049	0.218	0.650
AC	0.006	0.077	1.187	0.021	0.143	0.793
Washing Machine	0.044	0.205	0.891	0.099	0.298	0.659
Computer	0.013	0.112	0.996	0.056	0.229	0.672
Laptop	-	-	-	0.027	0.161	0.721
Credit Card	0.015	0.123	0.853	0.031	0.175	0.529
Microwave	-	-	-	0.018	0.131	0.767
Books>5	-	-	-	0.143	0.35	0.379
Piped Indoor Water	0.302	0.459	0.413	0.315	0.465	0.347
Separate Kitchen	0.607	0.488	0.335	0.584	0.493	0.362
Flush Toilet	0.256	0.437	0.484	0.402	0.490	0.439
Electricity	0.777	0.416	0.461	0.87	0.336	0.522
LPG	0.384	0.486	0.565	0.466	0.499	0.53
All-Low Quality Material	0.146	0.353	-0.377	0.114	0.317	-0.42
All-High Quality Materia l	0.195	0.396	0.471	0.201	0.401	0.383
Land>4acres	0.095	0.293	0.565	0.294	0.455	-0.068

Note. [a]Weights are evaluated by scoring factor/SD. Scoring factors are the coefficients in the first principal component.

The weights evaluated across phases (Table 1) correspond to each other, and these also quite closely resemble the weights calculated by Filmer and Pritchett (2001). The weights also correspond to one's intuitive understanding since AC is reported with the highest weights in both phases. AC symbolizes wealth in India and it is indeed one of the luxury goods afforded by a certain affluent section of the society. This is because not only the initial investment, however, the electricity consumption of ACs is quite high, making their regular use a costly affair. While the weights of a car in both the phases are quite high, it is not as high as the same for ACs, or even a microwave. This might be true as one may own a car for business purposes, however, all the latter goods are just for private luxury consumption. Based on the weights, weighted asset indices are created for both the phases. As presented in Table 4, the weighted mean and SD of weighted asset indices for the first phase are 3 and 2.5, whereas 3.38 and 2.13 for the second phase.

To measure the strength of weighted asset indices, tests are carried out for internal coherence and robustness as shown by Filmer and Pritchett (2001). Table 2 and Table 3 are the internal coherency tables for 1st phase and 2nd phase, respectively. These tables present the details of the possession of different assets across the income strata evaluated based on the weighted asset indices. These indicate that the indices for both the phases manage to distinguish the affluent section (the top 20% mainly possesses goods, such as AC, microwave, laptop, symbolizing wealth) from the rest. Whereas, the proportions of possession of commonplace or low-value goods, such as cycle remains unchanged across income strata and the same for all-low quality materials and b/w TV plunge with increasing wealth.

Table 2

Percentage of Households Possessing these Assets on 5 Wealth Levels as Per the Asset Index of the First Phase

	20%	40%	60%	80%	100%
Cycle	0.408	0.558	0.586	0.607	0.591
Sewing Machine	0.011	0.076	0.224	0.409	0.608
Generator	0	0.001	0.002	0.008	0.058
Mixer/Grinder	0.0004	0.006	0.091	0.389	0.801
Motor Cycle/Scooter	0.001	0.010	0.054	0.215	0.654
B/W TV	0.029	0.22	0.499	0.421	0.133
Color TV	0.001	0.006	0.092	0.477	0.911
Air Cooler	0.001	0.002	0.029	0.146	0.465
Clock/Watch	0.425	0.891	0.970	0.988	0.992
Electric Fan	0.019	0.39	0.854	0.951	0.989
Chair/Table	0.116	0.546	0.827	0.949	0.994
Cot	0.643	0.779	0.893	0.946	0.978
Telephone	0.0004	0.002	0.023	0.172	0.654
Cell Phone	0.0004	0.001	0.007	0.052	0.375
Refrigerator	0	0.0002	0.004	0.114	0.766
Pressure Cooker	0.014	0.118	0.392	0.742	0.957
Car	0	0	0.001	0.005	0.102
AC	0	0	0	0	0.03
Washing Machine	0	0	0	0.002	0.218
Computer	0	0	0	0.001	0.063
Credit Card	0	0	0.002	0.007	0.068
Piped Indoor Water	0.021	0.090	0.267	0.463	0.672
Separate Kitchen	0.281	0.458	0.607	0.774	0.914
Flush Toilet	0.005	0.043	0.162	0.392	0.680
Electricity	0.236	0.721	0.990	0.990	0.997
LPG	0.003	0.023	0.226	0.714	0.956
All-Low Quality Material	0.438	0.188	0.072	0.024	0.010
All-High Quality Material	0.005	0.030	0.113	0.281	0.547
Land>4acres	0.061	0.1	0.105	0.111	0.097

Table 3

Percentage of Households Possessing these Assets on 5 Wealth Levels as Per the Asset Index of the Second Phase

	20%	40%	60%	80%	100%
Cycle	0.424	0.588	0.581	0.558	0.555
Sewing Machine	0.021	0.09	0.241	0.339	0.615
Generator	0.001	0.002	0.005	0.009	0.081
Mixer/Grinder	0.004	0.044	0.217	0.584	0.836
Motor Cycle/Scooter	0.01	0.052	0.164	0.421	0.791
B/W TV	0.037	0.090	0.067	0.028	0.03
Color TV	0.017	0.271	0.825	0.970	0.99
Air Cooler	0.004	0.015	0.08	0.217	0.574
Clock/Watch	0.442	0.898	0.967	0.988	0.997
Electric Fan	0.142	0.731	0.919	0.984	0.993
Chair/Table	0.263	0.75	0.903	0.978	0.996
Cot	0.757	0.889	0.903	0.955	0.964
Telephone	0.002	0.008	0.018	0.066	0.316
Cell Phone	0.361	0.769	0.930	0.972	0.989
Refrigerator	0.001	0.006	0.045	0.408	0.939
Pressure Cooker	0.038	0.255	0.539	0.897	0.99
Dish/Cable TV	0.006	0.138	0.636	0.889	0.965
Car	0.0001	0.002	0.006	0.021	0.221
AC	0.0002	0.0002	0.001	0.002	0.103
Washing Machine	0	0.0002	0.003	0.029	0.462
Computer	0	0.0004	0.002	0.018	0.259
Laptop	0	0.0002	0.001	0.001	0.125
Credit Card	0.002	0.007	0.010	0.023	0.116
Microwave	0	0.0001	0.001	0.003	0.084
Books>5	0.026	0.068	0.101	0.175	0.343
Piped Indoor Water	0.064	0.134	0.321	0.321	0.629
Separate Kitchen	0.277	0.431	0.589	0.749	0.875
Flush Toilet	0.065	0.194	0.384	0.583	0.783
Electricity	0.532	0.85	0.980	0.992	0.996
LPG	0.033	0.159	0.438	0.752	0.953
All-Low Quality Material	0.316	0.147	0.062	0.03	0.013
All-High Quality Material	0.025	0.079	0.173	0.287	0.444
Land>4acres	0.306	0.345	0.314	0.260	0.241

To measure the robustness of the indices, alternative asset indices were constructed for both the phases with the ownership of credit card, housing characteristics, and land ownership (total nine variables in each index). The weighted Spearman-rank correlation coefficients between this partial asset index and the complete one ewere 0.9 and 0.8 for the 1st and 2nd phase,

respectively. Additionally, for asset indices based on only goods (like car, bike, TV except housing characteristics and land ownership), the similar correlation coefficients with the total asset index were 0.98 for the 1st phase and 0.99 for the 2nd phase, respectively. These correlation coefficients indicate that the complete indices for both the phases based on ownership of goods, housing characteristics, and land ownership, are robust and not dependent on the choice of variables.

Table 4

Means, SDs, and Range of Three Concerned Measures across Phases

Variables	1st Phase			2nd Phase		
	Mean	SD	Range	Mean	SD	Range
Per capita Total Consumption Exp.	9845.80	9614.80	0 - 471276	25777.03	30432.07	0 - 1461484
Per capita Income	9510.85	14772.23	0 - 878908	26643.39	47708.97	0 - 4161000
Weghted Asset Index	3.02	2.49	(-)0.38 - 15.46	3.38	2.13	(-)0.02 - 12.39

Results

Comparison between Different Measures

The weighted per capita income and total expenditure quintiles were constructed on ten levels. As the sample was quite large, ten levels were constructed. Each level consisted of around 2400-4600 households. The same quintile levels for weighted asset index were also constructed. As all these were weighted quintile, each level may not necessarily account for an equal number of households as shown in Table 5. The trend is that with higher quintiles, the amount of households per quintile tends to rise. This indicates that the IHDS survey, such as NSS, also predominantly focuses to collect data from the poorer sections of Indian society than the well-to-do ones.

Table 5

Number of Households by the Quintiles of Different Measures

Quintile Rank	Weighted Asset Index		Total Consumption Exp		Inome	
	1st Phase	2nd Phase	1st Phase	2nd Phase	1st Phase	2nd Phase
1	3102	2770	3342	3007	3008	2896
2	2393	2884	3005	3107	3136	3122
3	3080	2961	3152	3214	2947	3107
4	3112	3395	3167	3398	3297	3405
5	3112	3546	3251	3529	3243	3336
6	3469	3157	3351	3545	3399	3561
7	3710	3699	3560	3603	3591	3667
8	3992	3875	3675	3668	3771	3664
9	4079	3965	3880	3702	3945	3800
10	4572	4369	4238	3848	4284	4063
Total	34621	34621	34621	34621	34621	34621

The study focused on comparison as well. The introduction of the asset indices constructed in the context of India, based on IHDS, was one of the contributions of the current study. Therefore, the study aimed to compare asset index with total consumption expenditure and income, and then the comparison between total consumption expenditure and income was presented. Each of the comparisons were presented separately for each phase.

The average number of households falling in the same or adjacent quintile between asset index and total consumption exp. was 49% with 10% SD in the 1st phase and 47% with 9% SD in the 2nd phase (Table 6 and 7). The average farthest quintile intersections were 2.1% and 2.3% in the 1st and 2nd phase, respectively. The percentage of intersections in the same and adjacent quintile(s) dropped in the middle and then went up with higher quintiles as the highest intersections occurring in the 10th quintile (71% and 65%) in both phases. This indicates that once the households acquire a certain amount of wealth based on permanent/secured sources of income, their relative economic status would remain the same over a decade at least. The weighted Spearman-rank correlation coefficients between the asset index and total consumption expenditure are 0.59 for both phases. This shows that there is a moderately strong positive correlation between these two measures, and both manage to represent permanent income to some extent as the correlation remains exactly the same across phases.

Table 6

Total Consumption Exp. Quintiles by Asset Index for 1st Phase

Factor Weighted Asset index for 1st Phase	Factor per capita Total Consumption Exp. for 1st Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**29.6**	**18.8**	14.8	11.1	8.0	6.2	5.0	3.3	1.9	1.3	100
2	**24.8**	**18.6**	**14.8**	11.4	9.4	6.9	5.9	3.8	3.0	1.5	100
3	21.7	**17.1**	**15.6**	**12.0**	9.7	8.2	5.7	4.4	3.4	2.0	100
4	15.2	13.6	**13.7**	**12.7**	**12.0**	10.4	8.3	6.3	4.8	3.1	100
5	10.3	11.8	12.0	**12.7**	**12.7**	**12.0**	10.5	8.3	6.4	3.4	100
6	4.7	8.5	10.9	12.9	**13.1**	**13.0**	**13.2**	9.1	8.4	6.3	100
7	3.2	4.6	9.0	11.2	12.4	**13.4**	**15.0**	**13.9**	9.8	7.5	100
8	1.2	3.1	5.4	7.6	11.2	13.1	**15.5**	**16.5**	**14.7**	11.9	100
9	0.6	1.4	2.5	4.2	6.0	9.6	14.3	**18.7**	**21.7**	**21.0**	100
10	0.3	0.3	0.7	1.2	2.3	4.0	6.3	14.1	**25.6**	**45.2**	100

Table 7

Total Consumption Exp. Quintiles by Asset Index for 2nd Phase

Factor Weighted Asset index for 2nd Phase	Factor per capita Total Consumption Exp. for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**32.7**	**18.3**	12.2	10.4	8.8	6.2	4.8	3.6	1.6	**1.2**	100
2	**22.4**	**19.0**	**14.4**	12.8	9.4	7.1	6.1	4.0	3.2	**1.6**	100
3	15.7	**17.0**	**14.5**	**13.5**	11.3	9.3	7.0	5.7	3.7	**2.3**	100
4	11.2	12.6	**14.4**	**13.1**	**12.1**	11.0	8.9	7.5	5.4	**3.7**	100
5	7.6	10.8	12.8	**13.5**	**13.3**	**12.1**	10.2	9.0	6.8	**4.0**	100
6	**5.1**	8.4	11.5	13.0	**13.5**	**12.4**	**11.0**	9.8	9.3	6.1	100
7	**2.9**	6.8	9.4	11.5	12.8	**13.2**	**13.8**	**11.8**	10.8	7.1	100
8	**1.2**	3.8	6.1	8.3	11.9	13.3	**15.0**	**14.5**	**13.8**	12.0	100
9	**0.4**	1.5	2.9	5.0	7.7	11.6	14.8	**18.2**	**19.2**	**18.6**	100
10	**0.1**	0.3	0.7	1.5	3.0	5.3	9.1	15.6	**23.8**	**40.6**	100

Asset index, in comparison with income (Table 8 and 9), also presents a very similar picture when associated with total consumption expenditure, with 47% of households on an average appearing in the same or adjacent quintile(s) across phases. The same trend of increasing intersection was observed with higher quintiles, with the highest of 1st and 2nd phase as 71% and 67%, respectively appearing in the 10th quintile. The weighted Spearman-rank correlation coefficients were 0.56 and 0.54, respectively, for the 1st and 2nd phase, respectively.

Table 8

Income Quintiles by Asset Index for 1st Phase

Factor Weighted Asset index for 1st Phase	Factor per capita Income for 1st Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**17.3**	**20.2**	15.8	14.2	10.6	8.9	6.6	4.1	1.6	0.7	100
2	**15.3**	**18.7**	**15.4**	14.4	13.2	9.7	6.3	3.8	2.3	1.0	100
3	14.2	**15.9**	**15.2**	**14.8**	11.7	11.2	8.0	5.4	2.8	1.0	100
4	11.7	13.6	**12.8**	**14.0**	**12.6**	11.4	9.1	7.4	5.1	2.2	100
5	9.6	11.2	10.9	**12.9**	**11.9**	**12.6**	12.0	9.8	6.4	2.6	100
6	8.4	8.7	9.8	11.1	**12.7**	**12.9**	**12.1**	11.6	7.9	4.8	100
7	6.4	6.1	6.4	9.8	10.1	**12.8**	**15.7**	**14.0**	11.9	6.8	100
8	5.5	3.5	3.9	6.3	8.6	10.6	**15.1**	**17.1**	**17.5**	11.9	100
9	3.3	2.3	2.5	3.5	5.3	7.5	11.9	**17.0**	**22.7**	**23.9**	100
10	2.7	0.8	1.0	1.7	2.3	3.2	5.2	12.1	**23.1**	**47.9**	100

Table 9

Income Quintiles by Asset Index for 2nd Phase

Factor Weighted Asset index for 2nd Phase	Factor per capita Income for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**22.5**	**21.0**	15.0	12.1	9.6	7.4	6.1	3.9	1.8	0.7	100
2	**16.7**	**18.3**	**14.9**	13.5	11.2	10.0	6.8	4.7	2.9	1.0	100
3	12.1	**15.1**	**16.1**	**13.7**	11.4	11.6	8.6	6.0	3.8	1.5	100
4	10.2	12.7	**12.4**	**15.1**	**12.7**	11.9	9.4	7.6	5.4	2.6	100
5	8.0	10.1	11.4	**12.3**	**12.6**	**13.1**	11.6	10.0	7.0	3.9	100
6	6.7	7.9	9.6	10.9	**12.4**	**13.3**	**13.5**	11.3	9.8	4.7	100
7	5.3	6.1	7.5	10.4	11.5	**12.5**	**14.7**	**13.3**	11.5	7.3	100
8	4.6	3.8	5.3	8.3	8.6	11.5	**14.4**	**16.4**	**15.6**	11.5	100
9	3.2	2.5	2.8	4.6	6.3	8.3	12.0	**16.1**	**21.8**	**22.4**	100
10	2.1	1.3	1.4	2.2	3.1	4.5	7.2	11.6	**21.1**	**45.7**	100

Table 10

Income Quintiles by Total Consumption Exp. for 1st Phase

Factor per capita Total Consumption Exp. for 1st Phase	Factor per capita Income for 1st Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**17.9**	**24.0**	19.2	15.5	9.7	6.3	3.9	1.9	1.1	0.5	100
2	**13.7**	**17.9**	**16.1**	15.6	12.2	10.0	7.3	4.2	2.2	0.8	100
3	11.2	**14.0**	**13.0**	**14.7**	13.6	12.5	9.5	7.2	3.1	1.1	100
4	9.5	10.6	**11.7**	**13.1**	**13.8**	14.3	10.9	9.0	5.4	1.7	100
5	7.8	8.4	8.9	**11.6**	**13.3**	**13.2**	14.4	11.9	8.0	2.6	100
6	7.6	6.7	6.5	9.8	**11.2**	**12.7**	**14.4**	14.6	11.6	4.8	100
7	6.9	5.6	5.1	7.8	9.3	**11.7**	**15.8**	**15.3**	15.5	6.9	100
8	5.9	4.0	3.8	5.1	6.6	9.4	**13.7**	**17.2**	**20.0**	14.3	100
9	5.2	2.5	2.9	4.2	4.5	6.9	9.2	**15.0**	**22.9**	**26.6**	100
10	4.0	1.8	2.5	2.4	2.9	3.7	5.2	10.2	**17.7**	**49.6**	100

When both income and total consumption expenditure are compared (Table 10 and 11), the same and adjacent quintile intersection again would be quite similar, 47-48% across phases. Similar correlation coefficients, in this case, were 0.52 in the 1st and 0.54 in the 2nd phase.

Table 11

Income Quintiles by Total Consumption Exp. for 2nd Phase

Factor per capita Total Consumption Exp. for 2nd Phase	Factor per capita Income for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**23.4**	**25.3**	18.6	12.4	8.0	5.7	3.3	1.7	1.0	0.6	100
2	**13.2**	**18.1**	**16.7**	16.0	12.3	10.4	6.7	4.3	1.6	0.8	100
3	10.5	**13.5**	**15.4**	**14.4**	13.7	12.3	9.4	6.4	3.5	0.9	100
4	7.8	10.5	**11.5**	**13.4**	**14.3**	14.5	11.7	9.0	5.7	1.6	100
5	7.0	8.2	9.2	**12.3**	**12.8**	**13.9**	14.0	11.9	8.0	2.6	100
6	6.1	6.4	7.2	10.6	**11.6**	**13.5**	**15.0**	14.8	10.0	4.9	100
7	6.0	5.0	5.9	8.6	8.9	**12.5**	**13.7**	**15.2**	15.6	8.7	100
8	5.3	3.9	4.1	6.1	7.6	9.1	**13.4**	**15.9**	**19.1**	15.5	100
9	4.4	2.6	3.3	4.2	5.4	6.8	10.9	**14.0**	**22.0**	**26.5**	100
10	3.8	1.9	2.1	3.1	3.2	4.5	6.4	9.7	**18.2**	**47.1**	100

Measure of Permanent Income

After presenting the comparability between these three measures, it is important to understand how far these manage to represent the permanent

income or wealth of households. As indicated, the primary assumption here is that permanent income of a household, and its respective quintile position, would remain relatively the same over the period between both the phases. So, intra-measure comparisons across phases would help draw inferences in this regard. As Table 12 shows, the asset indices across phases show strong comparability, with 62% of households maintaining their exact quintile position or appearing in the adjacent one(s). The intersection in this case increases as well with increasing quintile levels, with 9th and 10th quintile accounting 77% and 84% of households in the same or adjacent quintile(s) across phases. The percentage of households appearing in the farthest quintile was extremely low, only 0.6%. The weighted Spearman-rank correlation of 0.78 also demonstrates the strong comparability across phases of asset index.

Table 12

Asset Index Quintiles across Phases

Factor Weighted Asset index for 1st Phase	Factor Weighted Asset index for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**37.6**	**25.6**	15.3	9.8	6.1	3.1	1.6	0.6	0.3	0.0	100
2	**25.9**	**22.9**	**18.8**	13.4	8.7	5.0	3.3	1.2	0.6	0.1	100
3	14.7	**20.6**	**19.9**	**16.0**	11.5	8.1	5.1	2.3	1.3	0.4	100
4	8.4	12.9	**17.2**	**18.8**	**16.3**	11.4	9.0	4.1	1.3	0.7	100
5	4.0	7.4	12.1	**16.4**	**18.7**	**15.8**	13.1	8.6	3.2	0.6	100
6	2.1	4.8	7.1	15.4	**17.8**	**16.2**	**17.2**	11.7	6.2	1.5	100
7	1.3	1.9	4.3	9.7	15.0	**16.2**	**19.1**	**18.8**	10.5	3.2	100
8	0.4	0.7	1.7	4.7	8.9	10.3	**19.5**	**23.6**	**20.5**	9.7	100
9	0.2	0.2	0.7	1.8	3.5	5.0	11.9	**21.8**	**30.8**	**24.1**	100
10	0.1	0.0	0.2	0.6	0.8	1.4	3.4	9.2	**23.7**	**60.6**	100

Table 13

Total Consumption Exp. Quintiles across Phases

Factor Per capita Total	Factor per capita Total Consumption Exp. for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**29.7**	**19.0**	13.6	11.5	8.5	5.6	4.3	3.6	2.9	1.5	100
2	**18.1**	**16.4**	**15.3**	12.7	10.7	9.5	6.7	4.9	3.1	2.8	100
3	14.3	**14.9**	**13.5**	**13.7**	11.7	10.1	8.0	6.3	4.7	2.9	100
4	9.3	11.7	**13.9**	**12.9**	**13.5**	10.3	9.8	8.0	7.0	3.7	100
5	6.5	10.0	11.3	**11.7**	**13.1**	**12.6**	11.1	9.8	8.1	5.9	100
6	4.7	8.2	9.5	11.3	**12.5**	**12.4**	**13.2**	12.0	9.5	6.8	100
7	3.4	5.9	8.0	10.7	11.6	**13.6**	**13.2**	**13.0**	11.3	9.4	100
8	3.2	3.8	5.6	7.3	10.1	12.4	**14.0**	**14.6**	**14.6**	14.5	100
9	2.0	2.9	4.0	5.5	7.5	9.9	12.6	**16.0**	**19.0**	**20.6**	100
10	1.0	1.9	2.5	4.1	5.0	6.6	9.9	14.5	**21.0**	**33.5**	100

Table 14

Income Quintiles across Phases

Factor Per capita	Factor per capita Income for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**15.9**	**15.6**	13.1	11.4	9.8	8.6	8.0	7.0	5.6	5.1	100
2	**14.9**	**17.2**	**14.7**	12.9	10.4	9.5	7.5	6.3	4.8	1.8	100
3	12.7	**15.4**	**13.2**	**14.1**	11.5	11.6	8.5	6.2	4.3	2.4	100
4	9.9	12.2	**12.5**	**14.0**	**12.6**	11.6	10.3	8.3	5.5	3.0	100
5	8.7	10.9	11.7	**12.6**	**12.4**	**12.8**	11.0	9.9	6.5	3.5	100
6	7.7	8.4	10.0	11.5	**11.7**	**13.2**	**13.2**	11.2	8.4	4.7	100
7	6.1	6.2	8.2	9.6	11.0	**12.5**	**14.2**	**13.8**	11.4	7.0	100
8	5.1	4.9	5.4	8.6	9.8	11.0	**13.3**	**15.4**	**15.5**	11.2	100
9	4.4	3.4	3.9	4.9	6.2	8.1	11.8	**15.0**	**21.1**	**21.2**	100
10	2.8	1.8	1.9	2.8	3.5	5.5	7.4	10.0	**19.9**	**44.3**	100

The comparability across phases for total consumption expenditure and income was substantially weaker than the asset index (Table 13 and 14). The similar correlation coefficients, in this case, were 0.5 and 0.43, respectively. These demonstrate a weak positive correlation against a strong one in the case of asset index. The average percentages of households falling in the same and adjacent quintiles in the case of total consumption expenditure and income were both 44%, with SDs of 6% and 9%, respectively. The percentages appearing in the farthest quintiles in these cases were 3% and 5%, respectively, substantially higher when compared to the same for asset index. The highest intersection in the case of total consumption expenditure was only 56%, but for income, it was slightly higher at 64%, both appearing in the respective 10^{th} quintile. Figures 1-3 also affirm the same conclusion where for asset index quintiles, the intersection was strong, particularly for the higher quintiles, however, not to that extent for total consumption or income.

Figure 1

Boxplots of Total Consumption Expenditure Quintiles across Phases

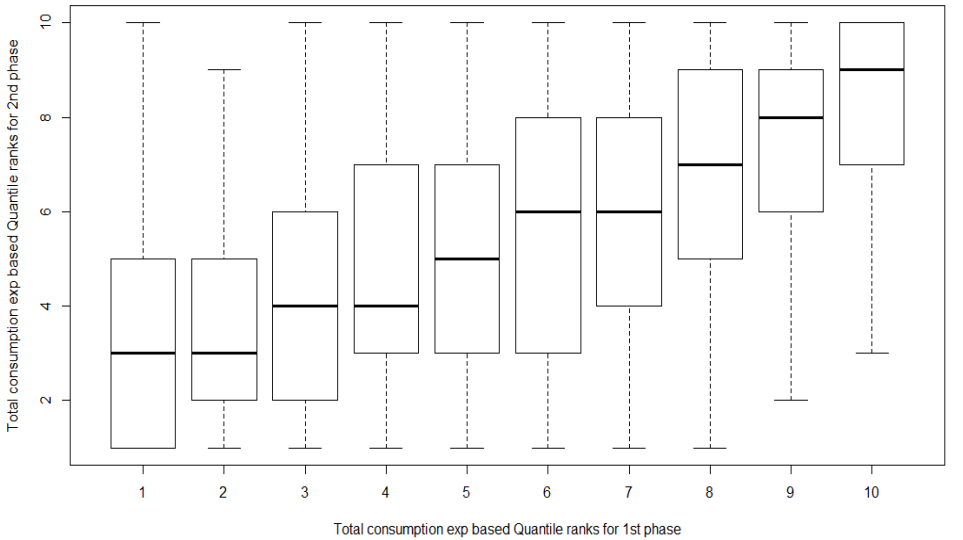


Figure 2

Boxplots of Income Quintiles across Phases

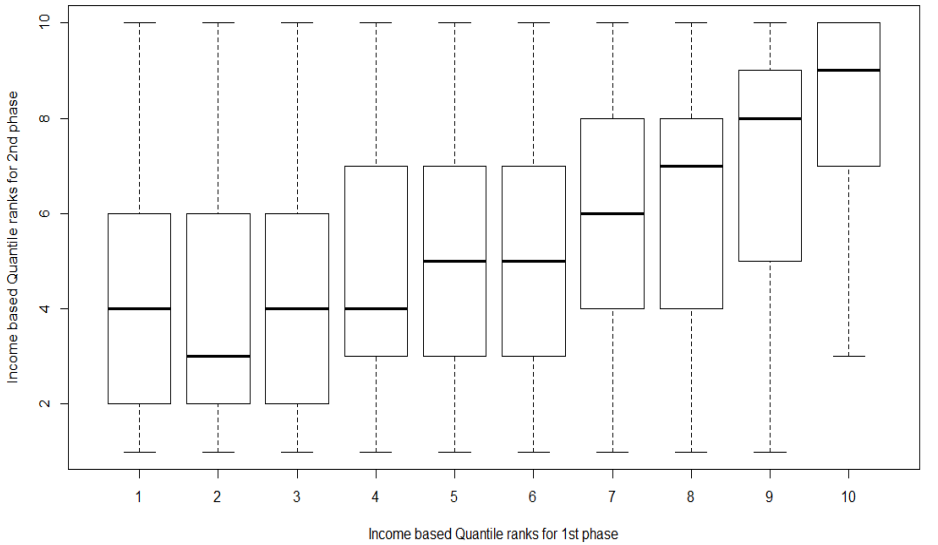
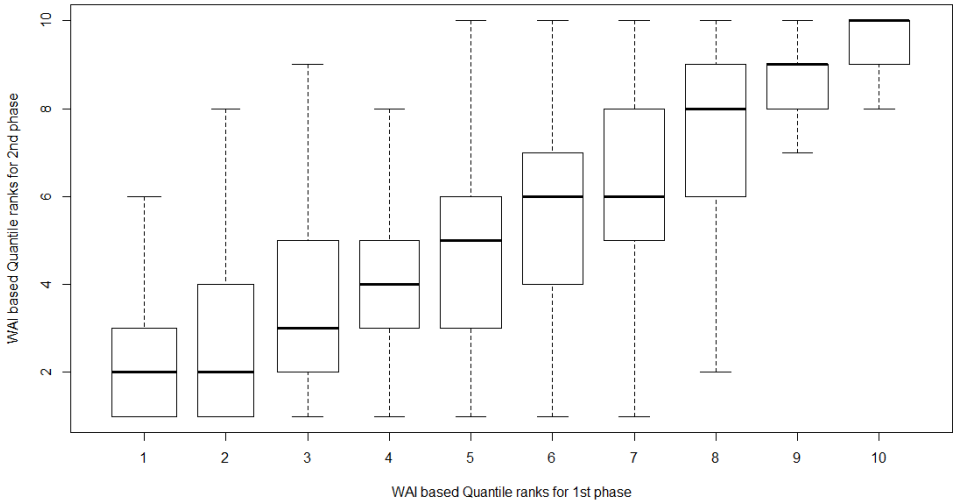


Figure 3

Boxplots of Asset Index Quintiles across Phases



Discussion and Conclusion

The inter-measures comparability showcases that there are moderately strong positive correlations present among these three measures, especially between asset index and total consumption expenditure. This is quite expected since asset index and total consumption expenditure are considered as better proxies of permanent income than yearly income. This is because the latter may be transitory, particularly when a large share of the population is dependent on agriculture, as in the case of India. The overall positive correlations and the respective strength commensurate with the findings of Ucar (2014) and Srivastava and Mohanty (2010)[4].

Although, the correlations indicate that these measures are reasonably comparable, the intra-measure comparison establishes asset index as a significantly better measure in terms of representing the permanent income of households. There is a significant difference in the way asset index fares

[4]Although the reported percentages in those two studies are significantly higher than the ones obtained in this essay, the point to be noted is that they employed 5 quintile levels as against 10 employed here. In the light of that information the results obtained here is closely comparable with theirs. I have also run these comparability for 5 quintile levels to revalidate the results are comparable with theirs, albeit not presented in this article.

in representing the wealth of households which remain relatively the same over a decade. This indicates that considering the constructed asset index includes variables (like possession of durable consumer goods, and household characteristics) that manage to capture how long-term expenditure of a particular household had been. It does intuitively seem that asset index manages to be a better proxy of permanent income of households than the other two measures. On that same vein, the asset index manages to differentiate households based on their long-term economic status or permanent income. Table 2 and 3 show that household appliances, such as AC, washing machine, and other durable consumer goods or assets including cars are completely absent from the poorest 20-40% and even 60% of households in both phases. Even though, the role of taste or preferences cannot completely be ruled out in this regard, especially when a common critique of asset index is its urban bias (Rutstein, 2008), the possession of the aforementioned consumer goods, not only for the ever-increasing cosmopolitan consumers emerging in its rapidly globalizing economy but also for India as a whole, truly indicate the presence of wealth or long term economic status.

To confirm the robustness of the correlation across phases obtained for the asset index, the study further evaluated similar correlation across phases for the partial asset index[5] constructed earlier. The coefficient was 0.74, affirming the robustness of this result. Even the correlation coefficient between just the count of assets was also 0.8. The similar intersection tables across phases for the simple count and partial asset index, as shown in Appendix I (Table 16 and 17), represent that even the correlations are similar or even slightly stronger for the simple count one, the main weighted asset index manages to differentiate the well-do-sections in a much better manner than the other two. This is expected as weighting over a wide-range of assets is supposed to perform better in this regard. This concludes that weighted asset index can be considered a better measure of permanent income than income or total consumption expenditure.

To strengthen the findings, correlations were carried out between these measures with the education level[6] of the households. Education and

[5]Constructed with only ownership of credit card, housing characteristics, and land ownership (total 9 variables in each index).

[6]The years of education of the highest educated male and female adult are added to create a composite index denoting the education level of the household.

occupational background are seen in literature as strong determinants of permanent income. Naga and Burgess (2001) employed them as one of the determinants in the theoretical formulation of permanent income. The correlation of education level with asset index was around 0.66 across phases, whereas for income and total consumption expenditure, these were below 0.4. Findings suggest that asset index being positively correlated with one of the determinants of permanent income, would perform as a better proxy than the other two measures. For further reinforcement of the results as shown by Howe (2009), simple OLS regressions were carried out with the second phase of each measure as the dependent variable and the first phase being the independent one. Adjusted R square for asset index was 0.63, whereas the same for per capita total consumption and income was less than 0.1. This again validates the comparability across phases between asset index far more than the other two, indicating the former is a better proxy of permanent income.

To examine the effectiveness of these measures of permanent income in order to explain a health outcome that is directly contingent upon the economic status of a household, the study evaluated which households have stunted children (World Health Organization, n.d.) up to the age of 5. A GLM model was run to evaluate how far these different proxies of permanent income are managing to explain the variance in the presence/absence of such stunted children in households. It was found that in both the phases, asset index manages to explain comparatively much higher variance than total consumption expenditure or income. As per the regression results, all these three measures manage to explain only a small portion of the presence/absence data on their own. For both phases, the asset index explains about 2-2.5% of the variance. Whereas, total consumption expenditure explains about 0.2% in the first phase and 0.5% in the second phase, and income explains 0.3% and 0.5%, respectively. This clearly shows that asset index comparatively performs much better. The reason behind all these measures which explains only a small portion of the variance is that a small fraction of households, that is, 2532 and 1635 households were found to have stunted children in the 1st and 2nd phase respectively, out of 12903 and 11298 households having a child up to the age of 5. Further work that may shed more light on this needs to be based on datasets that focus more on stunted children.

Although, this study presented a comprehensive picture of a substantially-effective proxy of permanent income, there are further scopes of improvement. Firstly, the assumption that permanent income remained the same for a household throughout 2004-05 to 2011-12 may be brought under the scanner. There is no way to test the feasibility of this assumption otherwise, as permanent income is considered unobservable (Naga & Burgess, 2001). One may easily argue that in those 8 years, as India registered an average GDP growth rate of more than 8% in spite of the global economic recession, some of the households' permanent income could have grown beyond remaining relatively the same. Along with this, since still a significant portion of India's population is directly or indirectly dependent on highly uncertain agricultural activities as indicated by rampant farmer suicides (Mukherjee, 2018), a period of 8 years is too long for the overall economic status.

Secondly, this study should be repeated at regular intervals with every new round of IHDS dataset, not only to assess its methodological consistency, however, also to assess the quality of data in India.

Limitations

The asset information employed in this study does not provide a count of each asset, for instance, whether a household possesses multiple ACs or cars. If that becomes available, albeit that kind of surveys are rare in the context of developing economies, then it would perform far better in terms of differentiating households, especially the very wealthy ones. Furthermore, investigations need to be conducted in the direction of how far asset index is correlated with the other theoretical determinants of permanent income, as delineated by Naga and Burgess (2001). The main challenge again is the availability of adequate data. This challenge can be overcome either by creating closest proxies of those determinants from the available secondary dataset, such as IHDS, NSS or by conducting a more focused primary study with a much modest sample. In spite of these limitations, it can be concluded that this study in the context of India or such developing economies made a pioneering as well as an important contribution to the empirical literature. It examined various questions across disciplines, be it economics, sociology, or development/environmental studies but all require some representation of household's permanent income/economic status in their analysis. Furthermore, the current study highlighted the need to explore the potential in order to employ asset index

as a proxy of permanent income in different research contexts beyond the current areas of its application.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

Funding Details

No funding has been received for this research.

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Appendix I

Mathematical Representation of PCA

Suppose there are N variables, a1j to aNj, corresponding to N assets owned by each household j. At the very first step of principal components analysis, the variables are specified in a normalized form by its mean and standard deviation: like a1j = (a1j – a1) / (s1), here a1 is the mean of a1j across all the households and s1 is the standard deviation.

These aforementioned variables are represented as linear combinations of a set of underlying components for each household j:

$$a_{1j} = v_{11} \times A_{1j} + v_{12} \times A_{2j} + ... + v_{1N} \times A_{Nj}$$

$$a... \; j = 1,...J$$

$$a_{Nj} = v_{N1} \times A_{1j} + v_{N2} \times A_{2j} + ... + v_{NN} \times A_{Nj}\,, \qquad (1)$$

Here, As are the components and the vs are the coefficients on each component that remain the same for all households. However, as only the left-hand side of the above equation is only observed, the set of equations is indeterminate. Principal Components overcomes this issue of indeterminacy by finding the linear combination of variables with maximum variance, or the first principal components, and then deriving the second one, which is orthogonal to the first one and explains a significant portion of the remaining variance, and this process continues.

The "scoring factors" from the model are evaluated by inverting the Eq. (1), and yield a set of estimates for each of the N principal components:

$$A_{1j} = f_{11} \times a_{1j} + f_{12} \times a_{2j} + ... + f_{1N} \times a_{Nj}$$

$$j = 1,...J$$

$$A_{Nj} = f_{N1} \times a_{1j} + f_{N2} \times a_{2j} + ... + f_{NN} \times a_{Nj}. \qquad (2)$$

The first principal component, comprised of the original (unnormalised) variables, therefore, represents an index for each household based on the following expression

$$A_{1j} = f_{11} \times (a_{1j} - a_1)/(s_1) + ... + f_{1N} \times (a_{Nj} - a_N) / (s_N). \qquad (3)$$

Appendix II

Table 15

Weighted Spearman Rank-correlation Coefficients between Two Suggested Strategies to Calculate Per Capita Estimate and Using Directly Total Number Persons across Phases

Different Stategies	1st Phase		2nd Phase	
	Income	Total Consumption Exp.	Income	Total Consumption Exp.
Sqrt of total person	0.97	0.92	0.97	0.92
OECD-Modified Scale	0.98	0.96	0.98	0.96

Table 16

Simple Count Asset Index Quintiles across Phases

Factor Count Asset index for 1st Phase	Factor Count Asset index for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**47.0**	**19.8**	13.6	11.8	3.7	2.4	0.9	0.4	0.2	0.1	100
2	**29.9**	**21.2**	**18.2**	17.2	7.1	3.9	1.4	0.8	0.1	0.2	100
3	16.9	**18.4**	**19.3**	**22.8**	9.9	6.8	3.6	1.5	0.5	0.3	100
4	8.6	12.3	**16.1**	**25.0**	**15.7**	11.7	6.1	2.9	0.7	0.9	100
5	4.5	7.3	11.0	**23.9**	**18.6**	**15.3**	10.9	5.5	2.1	0.8	100
6	1.9	3.4	6.3	17.7	**17.1**	**20.3**	**17.1**	10.5	4.3	1.4	100
7	0.7	1.6	2.6	9.5	13.5	**20.1**	**21.5**	**17.4**	8.4	4.6	100
8	0.2	0.5	1.3	4.5	7.8	14.7	**21.2**	**23.7**	**16.8**	9.4	100
9	0.2	0.2	0.4	1.6	2.8	7.1	12.8	**23.2**	**25.6**	**26.2**	100
10	0.1	0.0	0.1	0.4	0.6	1.3	3.6	9.1	**19.6**	**65.1**	100

Table 17

Partial Asset Index Quintiles across Phases

Factor Partial Weighted Asset index for 1st Phase	Factor Partial Wesighted Asset index for 2nd Phase										Total
	1	2	3	4	5	6	7	8	9	10	
1	**30.9**	**29.8**	10.5	13.4	7.8	3.4	2.4	0.9	0.6	0.2	100
2	**19.0**	**26.7**	**11.0**	21.4	11.5	4.6	3.5	1.4	0.6	0.3	100
3	10.1	**22.8**	**10.3**	**22.2**	15.2	7.7	6.5	3.2	1.4	0.6	100
4	4.7	10.5	**10.7**	**25.3**	**18.0**	11.5	10.0	5.3	2.5	1.5	100
5	4.2	8.3	10.2	**23.4**	**9.7**	**18.0**	13.3	5.7	5.3	1.9	100
6	2.1	6.5	6.7	21.9	**17.1**	**16.0**	**14.5**	8.3	4.8	2.1	100
7	1.0	2.5	3.5	11.9	12.0	**17.2**	**20.5**	**14.1**	11.7	5.5	100
8	0.7	0.5	1.5	4.7	6.2	11.5	**21.1**	**23.6**	**17.1**	13.0	100
9	0.3	0.3	0.5	1.4	2.6	6.2	19.5	**23.3**	**25.0**	**21.1**	100
10	0.5	0.1	0.1	0.6	0.9	2.6	9.5	18.4	**32.0**	**35.4**	100