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Evaluating the Performance of Five Asset-based Wealth Indices in Predicting Socioeconomic Position in Rural Bangladesh

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Abstract

Social scientists have developed numerous asset-based wealth indices to assess and target socioeconomic inequalities globally. However, there are no systematic studies of the relative performance of these different measures as proxies for socioeconomic position. In this study, we compare how five asset-based wealth indices—the International Wealth Index (IWI), the Standard of Living portion of the Multi-Dimensional Poverty Index (MPI-SL), the Poverty Probability Index (PPI), the Absolute Wealth Estimate (AWE), and the DHS Wealth Index (DHS)—predict benchmarks of socioeconomic position across 11 communities in rural Bangladesh. All indices were highly correlated. The IWI best explained variation in individual and community ranking of economic well-being, while the PPI best explained variation both between and within communities for total household wealth and a general measure of subjective social status.

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Introduction

Social scientists and policymakers frequently use asset-based wealth indices as proxies for socioeconomic position to monitor socioeconomic inequalities in health and well-being and access to education and other social services (Filmer and Pritchett 2001; Godoy et al. 2010; Gupta et al. 2017; Gwatkins et al. 2007; Hruschka et al. 2014; Mohsena et al. 2010; Ozodiegwu et al. 2020; Pollack et al. 2007; Rutstein and Staveteig 2014; Smits and Steendijk 2015; Woolard et al. 2021). Such indices assign households a relative wealth value based on a weighted checklist of easy-to-assess household assets and access to services (Kaiser et al. 2017; Woolard et al. 2021). The use of asset-based measures is particularly common in low- and middle-income countries, where measuring another common measure of socioeconomic position—household income—is particularly challenging for a variety of reasons (Howe et al. 2011, 2012; Kaiser et al. 2017; Rutstein et al. 2004; Sahn and Stifel 2003).

In the last decade, researchers have proposed a variety of ways to use assets to capture the socioeconomic position of households. Some of the most commonly cited include the International Wealth Index (IWI), the Standard of Living portion of the Multi-Dimensional Poverty Index (MPI-SL), the Poverty Probability Index (PPI), the Absolute Wealth Estimate (AWE), and the DHS Wealth Factor Score (DHS). Each index uses a weighted sum of a household's assets and access to services. However, each index also relies on different assumptions about what assets to count and how to weight those assets when comparing households (Woolard et al. 2021). The IWI uses a universal set of assets and weights these assets the same across all contexts worldwide. The one context-sensitive aspect of the measure involves two survey-specific categories—"cheap utensils," which includes any locally relevant items valued below 50 USD, and "expensive utensils," which includes any locally relevant items valued at above 300 USD (Smits and Steendijk 2015).

Like the IWI, the standard-of-living component of the MPI relies on a universal set of assets based on the millenium development goals that are all given the same weights across contexts. However, the MPI-SL involves a much smaller set of assets than the IWI and assumes the weights for all assets are equal. In contrast to these universal measures, the PPI is a fully context-dependent measure of wealth developed to predict how likely a household is to be below a country's poverty line. Like the MPI-SL, the PPI indicators are based on the millennium development goals, but these indicators and assets vary widely from survey to survey, even within the

same country. PPI is primarily used in poverty targeting programs and it is not comparable across different years or regions.

Another context-specific measure is the DHS wealth index, which is calculated by the Demographic and Health Survey program for each survey (Rutstein et al. 2004). The DHS wealth index uses a large variety of assets and indicators collected in DHS surveys, many of which are unique to specific countries or surveys. Unlike the IWI and MPI-SL, the DHS wealth index assigns country-specific weights for each asset. The AWE relies on the DHS wealth index but uses it to estimate the wealth of a household in absolute units (2011 international dollars, purchasing power parity). AWE has a monotonically increasing relationship with DHS, but the shape of the relationship is nonlinear (Hruschka et al. 2015).

Despite diverse assumptions, assets, and weights, each of these measures aims to capture the same concept— socioeconomic position. However, few studies have compared the performance of each of these indices as a proxy for socioeconomic position. One recent study compared the performance of four popular asset-based measures at predicting one indirect correlate of socioeconomic position—improved health and growth. Specifically, this study examined the association of these diverse asset-based wealth measures with women's Body Mass Index (BMI), children's height-for-age *Z*-scores, and infant mortality across DHS data from 84 countries and over 22 years (Woolard et al. 2021). The study found that an index based on universal weightings of assets—the IWI—best explained between- and within-country variation in all health and growth outcomes. It also found that measures relying on GDP per capita to calibrate between-country differences in wealth (e.g., AWE), performed the worst.

Some studies have also examined how specific asset-based wealth measures are associated with other measures of economic well-being, such as consumption expenditures or income. In one systematic review, Howe et al. (2012) found that asset-based wealth indices were typically a poor proxy for consumption expenditures. However, the inclusion of additional assets and indicators to these indices may increase their associations. In a recent synthesis, Poirier et al. (2020) found that wealth indices, consumption expenditures, and income measures all present related but distinct methods of measuring socioeconomic status. This synthesis also found that asset-based wealth indices, household consumption expenditures, and income measures were all fairly equally related to a range of health and educational outcomes, despite relying on three unique models of socioeconomic status (Poirier et al. 2020). However, to our knowledge, no studies have compared

the relative performance of different asset-based wealth measures at predicting diverse benchmarks of socioeconomic position.

Here, we compare the performance of five of the most popular and commonly used asset-based wealth indices in predicting several benchmarks for socioeconomic position across 11 ethnically and economically diverse communities in northwestern Bangladesh. This approach allows us to examine additional proxies of socioeconomic position that are traditionally not included in large-scale international studies, such as Demographic and Health Surveys (Woolard et al. 2021). Specifically, we use four benchmarks for socioeconomic position: (1) an absolute measure of the household's wealth based on a full inventory of the household's assets and their estimated value; (2) a respondent's subjective social status using a "ladder" method; (3) a respondent's subjective self-assessment of his or her own economic standing relative to specific individuals in the community; and (4) the average of community member's assessments of a person's economic standing. The goal of this comparison is to identify which asset-based wealth measures perform best as proxies of both objective and subjective measures of socioeconomic position.

Methods

Setting

Nestled between the Himalayas and the confluence of the Ganges River from the west and the Brahmaputra River from the east, northwest Bangladesh has traditionally been a border zone. Groups from diverse linguistic and cultural backgrounds ranging across Indo-European, Austro-Asiatic, Sino-Tibetan, and Dravidian language families currently converge in this region, and diverse ecological zones permit varying livelihoods. We focused on 11 communities that vary in livelihood—farming, livestock, and rural and urban wage labor—and cultural background—Bengali, Santali, Mandi, and Hajong.

Villages (*gram*) constitute official administrative units, but rural and peri-urban households are usually dispersed across rice fields, orchards, bamboo stands, and ponds in smaller clusters of neighboring households (50–200 households) called *para* in Bangla (*tola* in Santali and *shong* in Mandi, henceforth para). These nucleated neighborhoods provide an important nexus for social interaction, common production activity, and mutual aid (Hackman et al. 2017; Hruschka et al. 2014; Kuhn 2003).

We studied 10 para and one urban area that we cluster into three broader groupings for presentation. Five rural para were composed largely of Bengali speakers. These were differentiated in terms of religion (three predominantly Muslim and two predominantly Hindu), sources of income (three with > 70% of households depending on day labor wages), and location (four landlocked and one based on a *char* [a shifting sand island] in the Brahmaputra River). An additional three rural para were composed primarily of other ethnic groups—Mandi, Hajong, and Santal. Finally, there were two peri-urban para—one consisting largely of artisans and one of Dalit day-laborers—as well as a sample from a town of approximately 30,000 residents.

Sample

We examine the performance of asset-based wealth indices as proxies for socioeconomic position at both the household level (e.g., total household wealth and ladder-style measure of subjective social status for one member of the household) and individual level (e.g., individual and community assessment of economic standing). We analyze data from 507 households from 11 rural, peri-urban, and urban communities. We were not able to measure individual and community assessments of economic well-being in the one urban area, so for those analyses, we consider 633 individuals from the remaining 10 communities. Additionally, in 416 households of the remaining 10 communities, we asked one member of the household to complete a subjective ladder assessment of their status in the community. Further information about these three samples can be found in Supplement A, Table S1.

Measures

Benchmarks for socioeconomic position: We chose four indicators of socioeconomic position: (1) total value of all assets; (2) a ladder style self-ranking of status; (3) individual self-ranking of economic well-being; and (4) a community ranking of economic well-being.

Total Wealth: We measured total household wealth by conducting detailed household asset surveys within each household, including consumer goods, vehicles, housing, land, livestock, and savings accounts. For each asset, we asked respondents for the total value of each owned asset in Bangladesh Taka. We then summed these values across all assets and analyzed the natural log of this value.

Ladder Ranking: Subjective rating of social status within a community has often been measured using a subjective status ladder, where participants rate hypothetical community members on the top and bottom rungs, and then indicate which rung on the ladder they would be part of (Adler et al. 2000). Previous research has demonstrated that these subjective social status ladders correlate with a variety of health outcomes and can predict measures of ill health (Demakakos et al. 2008; García et al. 2017; Singh-Manoux et al. 2003). To measure ladder ratings, we asked one individual in the household to rate themselves on a ladder with 10 rungs, using this prompt:

> Now, look at this ladder with steps numbered from 0 at the bottom to 10 at the top. Suppose we say that the top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. Compare to other people from your para - On which step of the ladder do you feel you stand at this time?

Self-assessment of Economic Standing: To examine subjective assessments of economic standing based on direct comparisons with actual community members, we used an alternative technique with passport photos. Passport photos of all consenting adults in the community were obtained for ranking economic standing relative to others in one's community (Hackman et al. 2017). Each consenting adult was sequentially given each community member's photos and asked to place the photo in one of three bins where the person in the photo was either in greater, lesser, or comparable economic need to the respondent. The respondent was assigned the average score across all target photos (1 = respondent in greater need, 2 = in comparable need, 3 = in lesser need).

Community Assessment of Economic Standing: Community ranking was determined using the same responses from the self-rating. However, the measure for an individual was the average of others' responses about that target individual (1 = target individual is in greater need, 2 = in comparable need, and 3 = lesser need). The correlation between self and community assessment was substantial ($r = 0.76$, $p < 0.001$).

Asset-based wealth measures: For each household, we calculated IWI, MPI-SL, PPI, AWE, and DHS. These measures were treated as continuous in regression analyses but were also binned categorically to best graphically represent the relationship between the wealth indices and outcome variables.

IWI Index: The IWI relies on 12 common assets and indicators, some with many levels. These are: the presence in the household of a television, refrigerator, phone, car, bicycle, cheap utensil or expensive utensil, type of flooring (three levels: high, medium, and low) toilet type (three levels: high, medium, and low), number of rooms (three levels: zero to one, two, three or more), access to electricity, and water source quality (high, medium, and low). Weights for these assets were originally derived by applying principal components analysis (PCA) to a pooled database of 165 household surveys from 1996 to 2011 in 97 low-and middle-income countries, covering 2.1 million households in total (Smits and Steendijk 2015). We used IWI estimates drawn from the Global Data Lab (Smits and Steendijk 2015). We also created a categorical version of the IWI that consisted of 20 categories moving up in five-point increments.

MPI-SL Index: The MPI was created to align with the millennium development goals, and later the sustainable development goals (Alkire and Jahan 2018a; Alkire and Santos 2010). The MPI measures three dimensions of well-being, including health, education, and standard of living (Alkire and Santos 2010). Here, we use only the MPI-SL score, which is most easily comparable to other wealth indices (Woolard et al. 2021). The MPI-SL measures whether a household is deprived and relies on six indicators: (1) quality of cooking fuel commonly used; (2) sanitation quality; (3) drinking water quality; (4) access to electricity; (5) quality of housing materials (roof, wall, or floor); and (6) possession of more than one of any of 10 assets (radio, TV, telephone, computer, animal cart, bicycle, motorbike, refrigerator, car, and truck). Unlike the IWI, the MPI-SL does not have any additional levels. MPI-SL was calculated by following guidelines outlined in (Alkire and Santos 2010) and the updates in (Alkire and Jahan 2018b). The MPI-SL is already categorical because there are only seven possible scores (from deprivation in no categories to deprivation in all categories), so we did not create a separate categorical version.

PPI Index: We estimated the PPI using the most recent version of the Bangladesh PPI, which was developed in 2013 by Mark Schreiner (2013) using indicators from Bangladesh's 2010 Household Income and Expenditure Survey. The Bangladesh 2010 PPI measures 10 indicators with 19 levels: number of children in the household (four levels: 3, 2, 1, or 0), school attendance (three levels: all children, no children, or not applicable), employment status, number of rooms (three levels: one, two, or three plus), wall material (three levels: hemp/hay/bamboo or other, mud brick or C.I. sheet/wood, and brick/cement), ownership of television, ownership of fans (three levels: no fan, one fan, or two or more fans), ownership of mobile

phones (three levels: no phone, one phone, or two or more phones), ownerships of bicycles or vehicles, and possession of cultivatable agricultural land. We then created a categorical version based on 5-point increments according to the categories already outlined in the guidelines for the Bangladesh PPI, which represent meaningful increases in the probability of meeting certain poverty indicators (Schreiner 2013).

DHS Wealth Index: The DHS Wealth Index is calculated by the DHS program using principal components analysis applied to data on assets, access to services, and household construction collected during the survey process (Rutstein et al. 2004). We calculated the DHS wealth index by using asset weights from the 2014 DHS wealth index. We also created a categorical version consisting of 20 categories, with the top and bottom category representing the 5% wealthiest and 5% poorest, and the remaining 18 categories increasing in even intervals.

The AWE Index: AWE calculates the shape of the wealth distribution for each country and survey year using: (1) mean wealth per capita in a country in a given year; (2) a measure of wealth variance and inequality (the Gini); and (3) the best combination of Pareto and log-normal distributions to achieve optimal skewness of the wealth distribution (Hruschka et al. 2015). Next, households are mapped onto the shape of the overall wealth index based on their DHS wealth ranking. This produces an estimate of absolute wealth for each household. We also created a categorical version of the AWE that was binned into 19 separate categories with each representing an approximately 50% increase in household wealth per capita (in international dollars: cutpoints at roughly <90, 135, 200, 300, 450, 680, 1030, 1540, 2300, 3500, 5200, 7800, 11700, 17500, 26300, 39400, 59100, > 88600).

Covariates for individual level analyses: We used three covariates for individual analyses: individual's age, gender, and marital status. To account for any nonlinear associations with age, age in years was treated as a categorical variable by year (with 41 years as the reference category). Gender was included as a covariate with male as the reference category. Finally, marital status was included as a categorical variable, with values including never married, married, widowed, and divorced. Married was used as the reference category.

Analysis

Analyses were conducted with SPSS and figures were generated in *R*.

Correlation of household wealth indices with each other. We estimated Pearson's correlation coefficient across the five continuous wealth indices—IWI, MPI-SL, PPI, AWE, and DHS—for the 516 households.

Variation in socioeconomic position explained by asset-based measures of household wealth. Household Level: We used mixed effects linear regression models with community-level random effects for intercept to examine the relationships between IWI, MPI-SL, PPI, AWE, and DHS with total household wealth and ladder-style status rankings. We then calculated the proportion of variance explained in total wealth or ladder rankings relative to a null model. We calculated R^2 for each wealth measure for the within para variation *(1-(full model residual/null model residual))* and the between para variation *(1-(full model variance in random intercept/null model variance in random intercept))*. We also plotted the values of each outcome variable for each category of the categorical wealth indices to further examine their relationship.

Individual Level: The two individual-level measures of economic-well-being—individual and community assessments—are based on within-community comparisons and thus do not vary substantially between communities. For this reason, we did not use a mixed model with a community random effect. Rather, we used linear regression models to examine the relationships between IWI, MPI-SL, PPI, AWE and DHS with each of the individual level measures of socioeconomic position. Based on variance estimates from the mixed effects linear regression, we also calculated the proportion of variance explained relative to a null model including all covariates except for the wealth measure. We calculated R^2 for the variance explained for each wealth measure *(1-(model residual/null model residual))*. We also plotted the values of each outcome variable for each category of the categorical wealth indices to further examine their relationship.

Total wealth and ladder rankings explained by community-level means across the four wealth indices. Next, we examined bivariate associations between para-level means of each wealth index with para-level means of total wealth and ladder rankings using Pearson's correlation coefficients and scatterplots.

Variation in associations between paras. To explore variation in para-level associations, we also examined Pearson's correlation coefficients for the association between each of the four outcome variables and each wealth index at the para-level.

Results

Sample Descriptives

The 11 communities represented a diverse range of wealth index scores and outcomes. The urban community had the highest mean score for each of

the five wealth indices across all communities, and island-dwellers, had the lowest mean score for each index as well as total wealth (Table S2, Figure 1). The Mandi group had the highest ladder self-rating score (there are no data available for this outcome in the urban group), and the Potters peri-urban group had the lowest average.

Correlations between outcome variables. All outcome variables were significantly correlated between 0.35 and 0.45 except for the association between community- and self-ranking of economic standing, which had a much stronger correlation of 0.78.

Correlation of Household Wealth Indices with Each Other

All asset-based wealth measures were highly correlated (all $r \geq 0.62$, Table S3). The highest correlations were between the IWI and AWE (0.93) and AWE and DHS (0.90), as well as the AWE and MPI-SL (0.87). The lowest correlations were between the MPI-SL and the PPI (0.62), and the DHS and PPI (0.64).

Within and between-para variation in individual community ranking and self-ranking explained by the measures of wealth

Total Wealth. At the household level, PPI best explained within para variation ($R^2 = 0.27$), followed by the AWE ($R^2 = 0.25$). PPI also best explained between para variation in total wealth ($R^2 = 0.50$), followed by the AWE ($R^2 = 0.40$) (Table 1, Figure S1).

Ladder Score. At the household level, PPI best explained within para variation ($R^2 = 0.15$), followed closely by the IWI ($R^2 = 0.14$). PPI also best explained between para variation in the ladder score ($R^2 = 0.42$), followed by the IWI ($R^2 = 0.29$) (Table 1, Figure S1).

Self-assessment of Economic Standing. After controlling for age, gender, and marital status, the IWI best explained variation in Self-Assessment of Economic Standing ($R^2 = 0.27$), followed by the PPI ($R^2 = 0.24$) (Table 1, Figure S1).

Community Assessment of Economic Standing. Controlling for the same covariates as above, the IWI again best explained variation in Community-Assessment of Economic Standing ($R^2 = 0.29$), followed by the PPI ($R^2 = 0.26$) (Table 1, Figure S1).

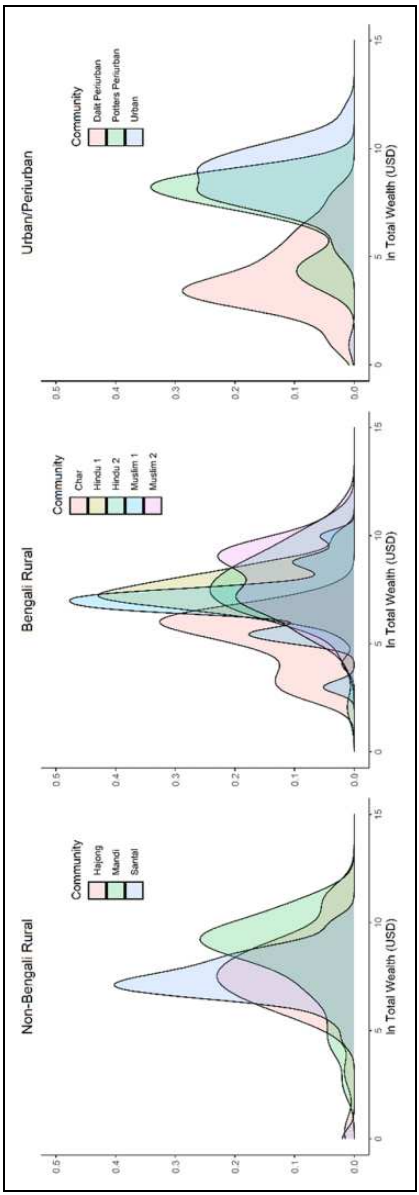

Figure 1. Density plots of total wealth by para.

Table 1. Proportion of Variance Explained by Wealth Measure for Each Outcome.

Measure	Level of Variation	IWI	MPI-SL	PPI	AWE	DHS
Ln Total Wealth	Within Para	0.22	0.16	0.27	0.25	0.18
Ln Total Wealth	Between Para	0.38	0.34	0.50	0.40	0.27
Ladder Score	Within Para	0.14	0.11	0.15	0.12	0.12
Ladder Score	Between Para	0.29	0.10	0.42	0.21	0.21
Self-Assessment of Economic Standing	Within Para	0.27	0.14	0.24	0.21	0.23
Community-Assessment of Economic Standing	Within Para	0.29	0.18	0.26	0.22	0.23

Community-level Total Wealth Predicted by Community-level Means in the Four Asset-based Wealth Measures (see Figure S2)

After plotting the relationship between community-level wealth measures and ln total wealth and ladder ratings, we found that PPI has the tightest linear relationship with both total wealth and the ladder self-ranking value.

Para-specific Correlations

Across all 11 communities in the household sample, there was quite a bit of variability in terms of which measures performed the best (Table S2). However, the MPI-SL consistently performs worse than all other measures.

Discussion

We compared the performance of five asset-based household wealth indices—the International Wealth Index, the Multi-Dimensional Poverty Index Standard of Living score, the Poverty Probability Index, the Absolute Wealth Estimate, and the DHS Wealth Index—as proxies for socioeconomic position assessed in four ways. We found that IWI best explained variation in self-and community-ranking of socioeconomic position, whereas the PPI best explained both within-and between-community variation in total household wealth and ladder wealth rankings.

Interestingly, the asset-based measure of wealth that relies on a universal set of assets and weightings—the IWI—best explained variation in local subjective assessments of relative economic well-being. The better performance of IWI in predicting these local measures of economic well-

being is consistent with prior findings that IWI also performs best among other wealth indices in predicting other measures of well-being, such as infant growth, adult BMI, and infant mortality (Woolard et al. 2021). An additional benefit of IWI is its relative simplicity and relatively clear documentation of how to calculate the index (Smits and Steendijk 2015). However, future work should focus on improving guidance for how to classify items as "cheap utensils" and "expensive utensils" in the calculation of IWI.

The Poverty Probability Index performed best at explaining both within- and between-household variation in two other measures of socioeconomic position—total wealth and ladder-based status rankings. Unlike the IWI, the PPI is completely context specific, and this version was developed specifically for Bangladesh. Despite its better performance as a proxy for these two kinds of socioeconomic position, the PPI does have limitations. First, it is difficult to compare PPI scores across a range of different countries and years since the PPI score is calculated differently for each survey. Second, assets used for the PPI scorecard are not always available in commonly used demographic and health surveys.

Future studies should address several limitations of the current study. First, despite the diversity of ethnic background and livelihoods represented in the current sample, these analyses were limited to a single region within one country, so it is difficult to know if these patterns of performance would translate similarly across other regions and contexts. Future research should examine if the pattern of IWI best predicting subjective measures of wealth and PPI best predicting objective measures of wealth remains consistent across larger-scale datasets in multiple contexts, countries, and years. Second, while the sample size is sufficiently large for relatively reliable estimates of correlation at the household and individual level, the between-community correlations are based on only 10 or 11 communities and should be interpreted with caution.

Additionally, future work should identify why the assumptions and calculations underlying these specific measures lead them to perform better as proxies. For example, the poor performance of the MPI-SL may be because there are only six items that contribute to that particular measure, making it potentially less reliable. Another issue to consider is that certain asset-based measures show stronger correlations with the chosen benchmarks because of common method variance. That said, we were careful to identify measures of socioeconomic position that did not have overt similarity in the items used in the asset-based measures.

One challenge in extending this study to additional settings is the photo methodology used to assess the subjective measures of self-and community-ranking of economic standing. These required conducting the study in a small face-to-face community, where residents can readily identify and rank their neighbors. In a larger or more urban setting this may not be possible, meaning that further work is needed to develop community assessments of socioeconomic position in urban settings.

Further research could follow the format of comparing multiple wealth indices to a diverse range of outcomes, as outlined in this article. While many studies focus on one or two wealth indices (Gupta et al. 2017; Vandemoortele 2014), fewer studies have compared multiple indices or multiple outcomes (Woolard et al. 2021). These studies have important implications for policy and measurement by assessing which wealth indices best proxy socioeconomic inequalities relevant to well-being and access to services. Our study contributes to this literature by examining the performance of wealth indices at explaining a range of novel measures of socioeconomic position in a single region as opposed to a more limited range of measures compared across countries.

We find that an asset-based wealth index that relies on a universal set of assets and indicators outperforms even indices created specifically for Bangladesh as proxies for self- and community-assessments of economic well-being. By contrast, the context-specific PPI outperforms all other measures at explaining variation in total household wealth as well as subjective ladder measures of social status. Further investigations in diverse contexts in different countries will help assess the generalizability of these findings and determine why some asset-based wealth indices perform better than others at predicting other benchmarks of economic well-being.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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