Cross-Population Comparability and PPPs: Using Micro-Data on Indicators of Consumer Durables

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Abstract

This paper addresses the issue of cross-population comparability of economic status indices estimated from household-level indicator variables on consumer durables using latent variable statistical models. The problem is similar to the one faced in estimation of PPPs. The same basket of consumer durables need not imply the same level of economic status across countries. This is because, even for the same level of the true economic status, the likelihood of owership of a given consumer durables is not the same across countries. This may be due to different prices structures, preferences, or other enviornmental factors. The problem we face is similar to that faced by psychometricians in intelligence testing using question banks: even for the same level of intelligence some questions exhibit differential item functioning (DIF) in that the likelihood of responding correctly for these questions varies significantly across socio-demographic groups. We propose one way of making the estimates of economic status comparable across countries which relies on assuming that the entire set of consumer durables not exhibit DIF. This enables us to estimate economic status on a common scale across countries. We apply the model to indicator-variable data from the Demographic and Health Surveys (DHS). The results seem promising in that there is a high degree of association between the economic status index and PPP-based economic status measures from other sources.

1 Introduction

Cross-population comparability of data is a major issue, especially in areas of research pertaining to international comparisons. The problems of intertemporal and interspatial comparability of macro-level GDP data are well-known. Overcoming these problems was one motivating factor behind the initiation of the International Comparison Program (ICP) in the 1960s. The issue of international comparability is also pertinent in the measurement of economic status across countries at a more micro-level: for instance in household income measurement for cross-country survey data analysis. This paper proposes a method for

constructing an cross-population comparable index of "permanent income" using indicator variables of consumer durables and other household characteristics.[1] The problem of cross-population comparability is similar to the one faced in estimation of PPPs: the same basket of consumer durables need not imply the same level of permanent income across countries. This is because – even for the same level of internationally-comparable permanent income – the likelihood of owership of a given consumer durable need not be the same across countries. This may be due to different prices structures, preferences, or other enviornmental factors. The problem we face is similar to that faced by psychometricians in intelligence testing using question banks: some questions (or "items") exhibit differential item functioning (DIF) in that the likelihood of responding correctly for these questions varies significantly across socio-demographic groups even after controlling for the latent trait being measured (in this case, intelligence). We propose one way of making the estimates of permanent income comparable across countries which relies on assuming that the entire set of consumer durables does not exhibit DIF. Those consumer durables and other indicators that are likely to be functions of the environment (e.g., air-conditioners) and those that have substantial non-traded good characteristics (e.g., housing) are allowed to differ in their mapping to permanent income across countries. This enables us to estimate permanent income on a common PPP-like scale across countries by allowing some indicators to act as anchors. The strategy we propose is similar to that used by psychometricians in dealing with DIF in large question banks. However, one significant difference between the model presented here and that used by psychometricians is that we allow for covariates to help predict the latent trait (permanent income). We find that this relatively simple micro-data based approach yields PPP-like conversion factors that are consistent with those reported by the World Bank.

It is important to note the context within which the problem of cross-population comparability of household economic status occurs. It is well-known that self-report income from household surveys is fraught with systematic measurement error. Research has shown that income tends to be severely under-reported in household surveys, and is inconsistent with income estimated using national accounts statistics.[2] This has led many to prefer the use of consumption expenditure rather than income to measure poverty and economic status. Consumption data, however, are not immune to measurement problems: discrepancies and inconsistencies in consumption calculated using surveys versus the numbers from national accounts statistics have been found in the US as well as several other countries across the income spectrum.[3] In addition, the degree of under-reporting in both income and consumption has been found to vary by income decile: lower-income households tend to be more likely to under-report than higher-income households. In several instances, poorer household have been found to report expenditure levels that far exceed reported income levels – possibly because of greater under-reporting of income than of expenditure – indicating the implausible implication that the poor are chronic dissavers.[4] In addition to having

[1] We use the term permanent income to denote a longer-term measure of household economic status.

[2] Visaria, P. (1980), "Poverty and Living Standards in Asia: An Overview of the Main Results and Lessons of Selected Household Surveys," *Living Standards Measurement Survey Working Paper No. 2*, Washington, DC: World Bank.

[3] Deaton, A. (2001), "Counting the World's Poor: Problems and Possible Solutions," *World Bank Research Observer*, 16(2):125-147.

[4] Anand, S. and C.J. Harris (1994), "Choosing a Welfare Indicator," *American Economic Review*, 84(2):226-231.

lower measurement error, consumption expenditure have tended to be preferred to income data since: (a) consumption tends to be less volatile than income, and (b) consumption is thought to be more closely linked to permanent income than (current) income. Consumption data, though, are relatively difficult and expensive to collect and are often not available in dedicated surveys that focus on issues such as health – e.g., the Demographic and Health Surveys (DHS) – precluding any cross-country analyses of the relationship between health status and economic status, for instance. Also, in poorer subsistenc-based economies, income and expenditure numbers tend to not have any meaningful information content.

Even when reasonably accurate income and consumption data are available from surveys, these must be converted to some common international scale to allow for cross-country comparisons. The norm has been to use reported purchasing-power parity (PPP) conversion factors to calculate, say, the number of households living below the $1/day poverty line, or some other such similar internationally-comparable measure of economic status. However, recent analyses have called into question the use of PPP conversion factors. Earlier reports of PPP were based on and extrapolated from non-representative price surveys in a handful of countries. More recent rounds of the ICP have increased the coverage of countries but questions remain regarding the the quality of the price data and the methodology underlying the construction of PPPs from these data.

Problems with reported income and expenditure data – and problems with international convertibility even when income and expenditure data may be reliable – has prompted researchers to look for alternative ways of constructing cross-country comparable measures of economic status or living standards from household survey data. Measures of housing quality and of consumer durable goods are often used as a proxy for the economic status of households.[5] Advantages of such measures include the fact that information on ownership of consumer durables is routinely available from household surveys – e.g., these data are available in the DHS and the Living Standards and Measurement Surveys (LSMS) – and the data tend to be less prone to measurement error than income and expenditure data.[6] To be meaningful in an international context, these consumer durable indicators must be weighted by the value of the indicators in the respective countries, information on which is often not available from survey data. One approach is to contruct weights from exogenous sources and then derive an index based on the weighted sum of observed consumer durable ownership patterns. An alternate approach is to derive implicit weights as in Filmer and Pritchett (2001) using principal-components analysis.[7] However, the principal-components ot factor analysis approach does not overcome the problem of international comparability. First, if the principal components or factor analysis is performed on a country-by-country basis using data from different survey instruments, it is not possible to compare the results across countries. An index of household economic status estimated in such a manner can neither be compared across populations nor over a period of time in the same population.

[5]Bollen, K., J.L. Glanville, and G. Stecklov (2002), "Economic Status Proxies in Studies of Fertility in Developing Countries: Does the Measure Matter?" *Population Studies*, 56(1):81-96.

[6]In pre-test data for the World Health Survey, the test-retest reliability of consumer durable indicators was found to be relatively high.

[7]Filmer, D., and L.H. Pritchett (2001), "Estimating Wealth Effects Without Expenditure Data – Or Tears: An Application to Educational Enrollments in States of India," *Demography*, 38(1):115-132.

Even when the same survey instrument is used, the tendency to acquire an asset such as a boat or an air-conditioning unit is likely to differ among households of different cultural backgrounds living in different environments. Similarly, supply and demand for assets such as electronic devices can change rapidly in the same setting over even a few years time, rendering inter-temporal comparisons invalid. Second, principal components and factor analysis do not provide information on the level of income at which different assets or goods and services will be purchased. Finally, this approach does not provide prospective guidance on the best assets or goods and services to include in future surveys to obtain more refined estimates of household permanent income.

The remainder of the paper is organized as follows. Section 2 elaborates the statistical model. Section 3 details the World Health Survey pre-test data used in the analysis. Section 4 presents the results. Section 5 concludes with a brief discussion.

2 The Model

2.1 Country-Specific Index

In order the elaborate the statistical model, we first abstract from the issue of cross-population comparability and focus on the one-country case. The goal is to estimate household-level permanent income and the statistical model we use follows from Ferguson *et al.* (2001).[8] Permanent income is not directly observed. The model is developed in terms of permanent income for household i being a latent variable, y_i^*. What are observed are a series of consumer durable ownership and other indicator variables for each household. These variables are dichotomous, taking the value of 0 if the household does not possess or have access to the consumer durable, and 1 if it does. Examples of these indicators include whether the household has a television, a car, electricity, and so on. In addition, we utilize a series of socio-demographic covariates that are expected to be predictors of permanent income such as education, age, sex of household head, household size, and occupational status. In mathematical terms, the model stipulates:

$$y_i^* = X_i'\beta + \nu_i + \epsilon_i \qquad i = 1, ..., N,$$

where X_i is a vector of covariates of permanent income.$\nu_i \sim N(0, \sigma_v^2)$ is a household-level random effect, capturing the systematic component of the error term, and $\epsilon_i \sim N(0, 1)$ is the regular statistical noise term. Since this is a latent variable model, identification is achieved by setting the variance of ϵ_i to 1 and by setting the constant term to 0. The observation mechanism is specified for each indicator variable $a = 1, ..., A$ in household i such that the indicator variable y_i^a:

$$y_i^a = 0 \qquad \text{if} \qquad -\infty < y_i^* \leq \tau^a$$

[8]Ferguson, B., A. Tandon, E. Gakidou, and C.J.L. Murray (2002), "Estimating Permanent Income from Indicator Variables," *Global Programme on Evidence for Health Policy Working Paper No. 44*, Geneva: World Health Organization.

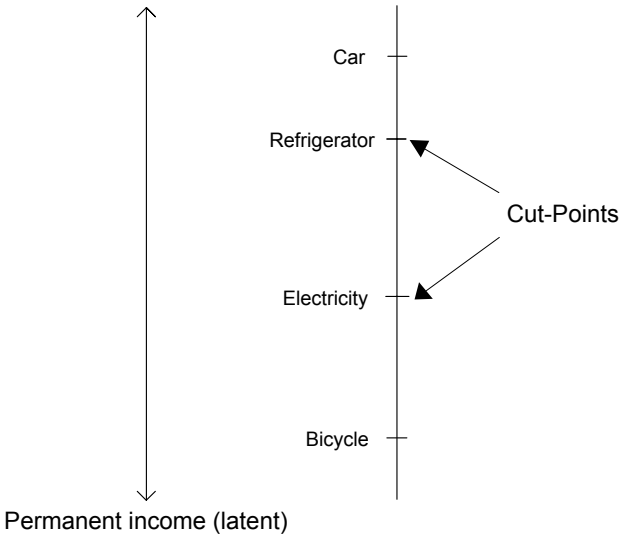

Figure 1: Indicator-variable ladder

$$y_i^a = 1 \quad \text{if} \quad \tau^a < y_i^* \leq +\infty,$$

where τ^a is an indicator-specific cut-point (which is estimated from the model). This indicator-specific cut-point (or threshold) τ^a is the value of the latent variable at which households are more likely to own a given indicator than not. Given the assumptions on the error term, the probabilities for any given household owning each indicator variable can be easily specified. The model is then estimated using standard maximum likelihood methods (with the household-level random effect being integrated out using Gauss-Hermite quadrature). Details can be found in Ferguson *et al.* (2001).

Figure 1 visualizes the model. The solid line on the left of the graph represents the latent variable of permanent income, while the line to the right shows the estimated cut-points for indicators such as ownership of a car, refrigerator, bicycle, or having electricity in the household. These indicator cut-points represent ownership thresholds on the underlying latent variable of permanent income. Given the ordering of the cut-points on the permanent income scale yields a "ladder" analogy: consumer durables that are lower on the ladder require a relatively low level of permanent income before which households become more likely to be observed to own them than not. On the other hand, those indicators that are at the top end of the ladder are more likely to be observed to be owned only at relatively higher levels of permanent income. Hence, the mapping from permanent income to the indicator cut-points implictely weights the indicators based on the levels of permanent income at which they help discriminate between households.

If there is a household-level random effect in the data – i.e., when covariates in the model do not capture all the systematic variation in the latent variable permanent income – then there remains information content in the set of responses across indicators for each household that has not been fully exploited. In order to exploit the information content in

the set of responses we can make use of Bayes' theorem to obtain estimates of the mean level of permanent income conditional on the observed set of responses for a given household. Let $\mu_i \equiv X_i'\beta + \nu_i$ be the mean level of permanent income predicted by the model. Then $\Pr(\mu_i \mid y_i^1, ..., y_i^A)$ can be estimated using Bayes' formula:

$$\Pr(\mu_i \mid y_i^1, ..., y_i^A) = \frac{\Pr(y_i^1 \mid \mu_i)...\Pr(y_i^A \mid \mu_i) \cdot \Pr(\mu_i)}{\int \Pr(y_i^1 \mid \mu_i)...\Pr(y_i^A \mid \mu_i) \cdot \Pr(\mu_i) d\mu_i}, \tag{1}$$

where y_i represents the vector of categorical responses on all indicator questions for household i. Hence, the final output from the model is a series of indicator-specific cut-points and a posterior estimate of permanent income for the household, $\Pr(\mu_i \mid y_i^1, ..., y_i^A)$, that exploits information from the observed set of indicators owned by any given household.[9]

2.2 Cross-Population Comparability

In the previous subsection, we assume there exists an unobserved latent variable that measures permanent income. Given dichotomous indicators on ownership of consumer durables – and on covariates that help predict the economic status latent variable – we can estimate indicator-specific cut-points or thresholds that can be interpreted as points on the latent variable scale at which a household is more likely to own the given consumer durable than not. If the latent variable scale were comparable across countries, then in theory, we would observe a cross-country generalization of Figure 1 as depicted in Figure 2. As before, the solid line in Figure 2 depicts the latent variable permanent income. Take population A first for which the dotted line plots the hypothetical cut-points for four consumer durables: bicycle, electricity, refrigerator, and car. As noted earlier: the ordering of the consumer durables is meaningful. There is a ladder analogy in that it takes a relatively low value on the latent variable before households become more likely to own a bicycle than not. By comparison, since the cut-point for ownership of a car is much higher, it takes a relatively higher level on the latent variable before we begin to observe cars being more likely to be owned than not.

Herein lies the issue of cross-population comparability of the latent variable and the indicator cut-points. In particular, the question is on the differential functioning of cut-points in different countries. Suppose we assume that the latent scale is measured in cross-population comparable units, then the consumer indicator cut-points need not be the same across countries. Figure 2 shows the consumer durable thresholds for three populations (A, B, and C). The estimated cut-point for bicycle is the same across countries implying that at roughly the same level of the latent variable bicycle ownership becomes more likely than not in households in all three population. The same is not true for cars though: it takes a higher level on the latent variable to begin to observe likely car ownership in populations B and C than it is for population A (this could be the case if cars are much cheaper in population A than they are in populations B and C, for instance). The flip side of this is the implication that the ownership of the same basket of consumer durables in different countries does not imply the same level of the cross-population comparable latent variable

[9] Additional details can be found in Ferguson *et al.* (2001).

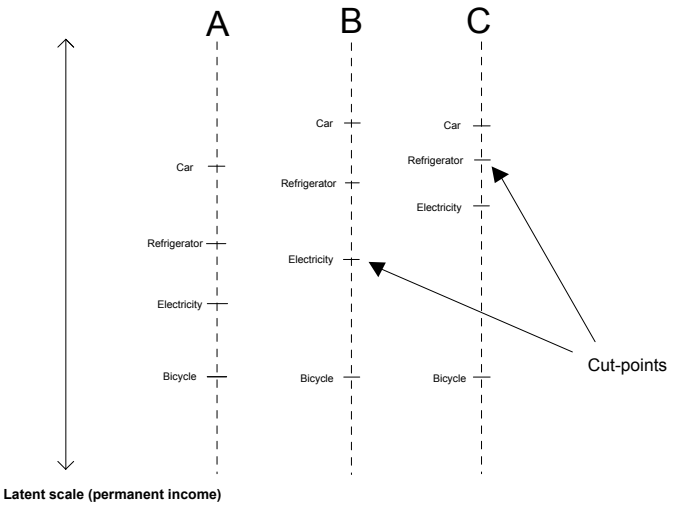

Figure 2: Cross-country indicator-variable ladder

in the three countries.What if we have data from several countries on consumer durable ownership and want to create an economic status index that reflects differences in living standards across countries. How could we utilize information on these indicators to estimate a latent variable that was cross-population comparable? This problem is similar to that faced by those aiming to construct some measure of economic well-being (e.g., GDP per capita) on a common scale such as the PPP so as to accurately reflect differences in living standards across countries.

One strategy would be to simply re-estimate the model in the previous sub-section by including a country dummies as covariates, i.e., in $X_i'\beta$. This strategy would work if consumer durables were assumed to have the same cut-points across countries. This scenario is depicted in Figure 3 with one consumer durable indicator variable and a cross-population comparable latent variable estimate. As the graph shows, assume that in country A a given set of households have true levels of economic status given by the arrow on the latent variable scale. Let us also assume that in country B the set of households have a true level that is higher than in country A. Now if the cut-points for the consumer durable was exactly the same in the two countries, then this would be reflected by the fact that the households in country B ought to be more likely to own the durable than not (i.e., a greater proportion should own the durable).

For a variety of reasons which include price distortions and other environmental factors such as geography and preferences, the same consumer durable need not have the same cut-points across countries even on a cross-population comparable scale. The second alternative would be allow, in the same model, country as a covariate for the latent variable *as well as* for all the indicator cut-points. Unfortunately, such a model is not identified. This is because, in the absence of exogenous information, the model will be unable to disentangle the effects of country residence on both the latent variable as well as the cut-point. This

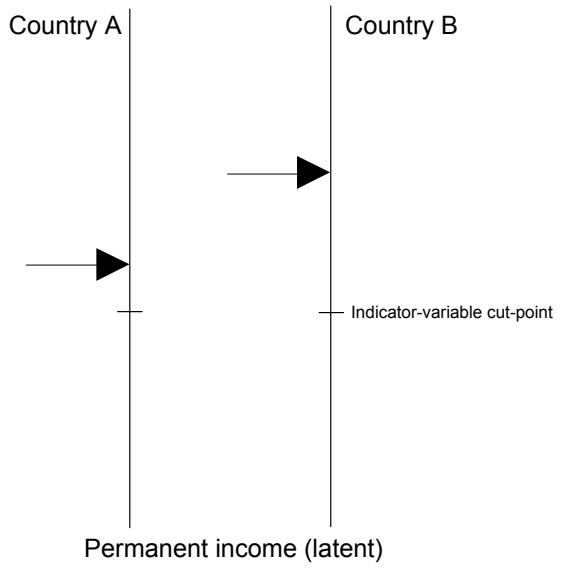

Figure 3: Scenario A: Different levels of latent variable, same cut-point

point can be better understood using a hypothetical example. Suppose that the cut-points in the two countries for the same consumer durable are not the same. Because wages are higher, suppose that the same consumer durable is more expensive to buy in country B as in country A. And, as a result, the cut-point for the durable in country B is higher. This basically implies that it takes a higher level on the latent variable for the consumer durable to be likely to be owned in the country B than in country A. This scenario is depicted in Figure 4.

In such a situation, the model which allows both the latent variable and the cut-point to be a function of country dummy will be unidentified. In the absence of additional information that will allow an "anchor" for the latent variable, the model will estimate the latent variable associated with the households to be about the same in the two countries. This problem is akin to that of differential item functioning (DIF) in psychometric literature. There the problem is one of measuring intelligence (the latent variable) using performance on a series of questions. The problem is that, even for the same level of intelligence, some groups of people find some questions to be more difficult than other groups do, rendering the comparability of responses to such questions for intelligence testing of suspect value. The problem with the indicators of consumer durables is similar.[10]

In psychometrics, the problem of DIF is eliminated by either dropping questions that exhibit DIF and replacing them with those that don't, or having enough of a core set of questions that do not exhibit DIF such that these can be used as an anchor allowing the remaining to have estimated difficulty levels being different for different populations. The analogy with the estimating economic status is that we assume that the collective set of

[10]Holland, PW, and H Wainer eds. (1993), *Differential Item Functioning*, Hillsdale, NJ: Lawrence Erlbaum.

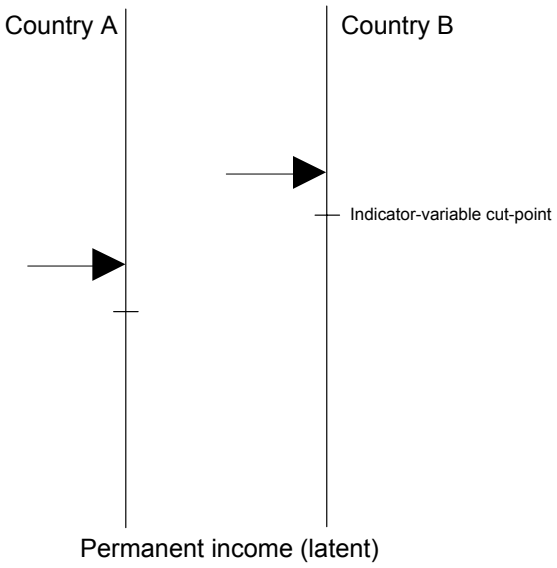

Figure 4: Scenario B: Different levels of latent variable, different cut-points

indicators does not exhibit DIF – i.e., not all the cut-points are systematically shifted up or down – even if any given indicator does exhibit DIF. This is the strategy we adopt in that we allow a sub-set of indicators to have country-specific cut-points and others not. We choose the country-varying cut-points based on environmental concerns (e.g., air-conditioners), and the extent to which the indicators are non-tradable (e.g., housing). An example of anchoring is depicted in Figure 5. One implication of this approach is that, as long as there are a common set of anchoring indicators, there can be *different* assets in different countries (Figure 6).

3 The Data

We demonstrate the method using data from 106 Demographic and Health Surveys (DHS). Table 1 gives a description of the sample size by country, the type of DHS and the year when the survey was conducted. All the DHS available were included in the analysis. The standard DHS survey consists of a household questionnaire and a women's individual questionnaire. The information of the household module is used in the estimation of an indicator of permanent income that can define the economic status of households. Information used includes ownership of assets such as television, fridge, car; availability of services, such as electricity and phone; and housing characteristics such as type of water and sanitation facilities, type of wall, roof and floor material. The number of these indicator variables available in each survey varies across countries. All assets available in each survey are included in the country specific analyses.

Durable goods and electricity are reported as dichotomous in "yes/no" questions. This

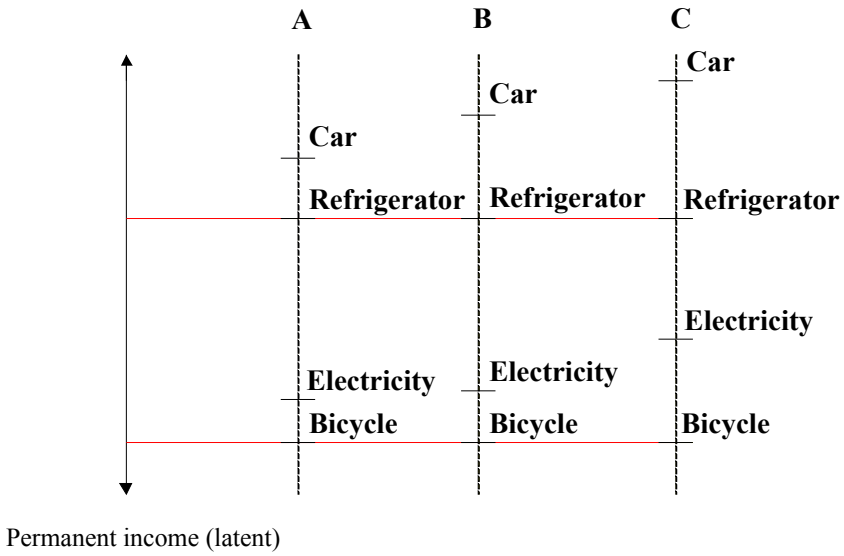

Figure 5: Anchoring indicators for internationally-comparable scale

information is homogeneous among countries and among types of DHS. On the other hand, housing characteristics are usually reported in classification categories that are country specific, representing materials that vary across countries and regions. Therefore there is a need to standardize the categories across countries for household characteristics so that comparisons across countries and within countries across different years are feasible. Techniques for standardizing these categories such that they are comparable internationally is reported in Sousa *et al.* (2003).[11] The list of countries in the survey, and the list of assets used are reported in Tables 7 and 1, respectively.

4 Estimates

Figures 8, 9, 10, and 11 plot the estimates of permanent income versus GDP per capita (in PPP) as well as consumption per capita (in PPP), and the logs as well. The estimates are from a version of the model that assumes that the *set* of electricity, radio, TV, fridge, car, and phone had common cut-points across all countries. As can be seen, there appears to be a tremendous amount of information content even in this relatively small set of indicators as evidenced by the high correlations with the PPP measures of consumption and income at the country level.

[11]Sousa, A., A. Tandon, and E. Gakidou (2003), "Permanent Income Measurement: Standardizing the DHS Information on Income Indicators across Countries," *Evidence and Information for Policy Working Paper*, Geneva: World Health Organization.

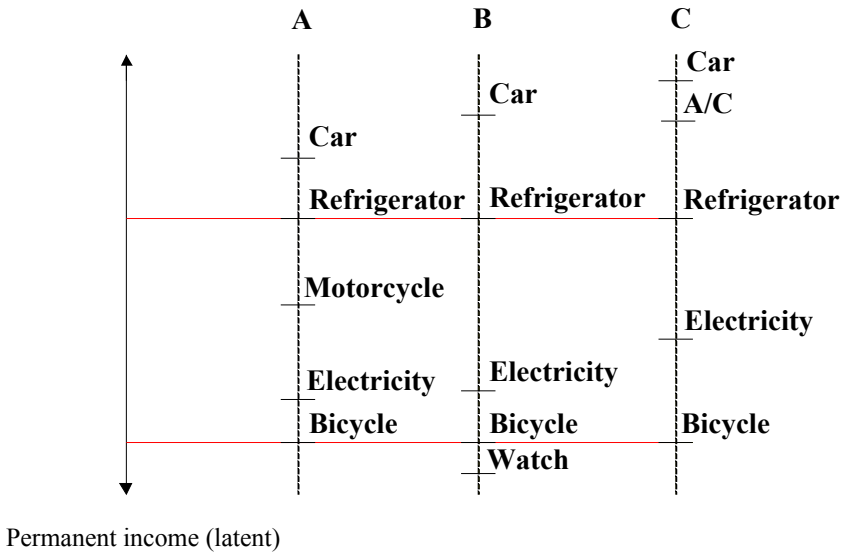

Figure 6: Anchoring indicators, with different indicator sets per country

5 Conclusions

This paper has proposed one way of estimating cross-population comparable estimates on economic status or living standards based on micro-data on consumer durables. These data are routinely collected in household surveys, and given the problems with reported income, are arguably a better indicator of economic well-being. Other advantages of using an indicator variable approach is that the same set of indicators need not be asked in surveys across countries: questionnaires can be adapted so as to better estimate economic status within countries while maintaining a core set of consumer durables for cross-population comparison purposes. The methodology we propose is based on exploiting the fact that, at least on average, most indicators of consumer durables will not exhibit large DIF. As long as such a core set can be identified, the estimated cut-points for these can be used to form the basis of a scale conversion that can then be used to make the estimated economic index comparable across countries.

There are two main shortcomings of this approach. The first is the assumption that the set of consumer durables taken together does not exhibit DIF. If, for instance, we have two countries one of whom has systematically higher cut-points than the other for *all* indicator variables, then we will not be able to convert to a comparable scale using the regression-on-the-mean strategy. The second problem is that we are assuming the latent variable underlying each of the estimations is a linear function of the true latent variable on a comparable (PPP) scale. This need not be the case and merits further research using both simulated and real data with which the method can be validated.

Country code	Country	Year	# women	individual survey	Household survey	DHS type	maternal mortality
1	Bangladesh	1997	9127		yes	III	
2	Benin	1996	5491		yes	III	yes
3	Bolivia	1994	8603		yes	III	
4	Brazil	1996	12612		yes	III	yes
5	Burkina Faso	1993	6354		yes	II	
6	Burundi	1987	3970		raw	I	
7	Cameroon	1998	5501		yes	III	yes
8	Central African Republic	1995	5884		yes	III	yes
9	Colombia	1995	11140		yes	III	
10	Comoros	1996	3050		yes	III	
11	Cote d'Ivoire	1994	8099		yes	III	yes
12	Dominican Republic	1996	8422		yes	III	
13	Ecuador	1987	4713		raw	I	
14	Egypt	1995	14779		yes	III	
15	Ghana	1994	4562		yes	III	
16	Guatemala	1995	12403		yes	III	
17	Haiti	1995	5356		yes	III	
18	India	1993	89777			II	
19	Indonesia	1994	28168		yes	III	yes
20	Kazakhstan	1995	3771		yes	III	
21	Kenya	1993	7540		yes	III	
22	Liberia	1986	5239		raw	I	
23	Madagascar	1997	7060		yes	III	yes
24	Malawi	1992	4849		yes	II	yes
25	Mali	1996	9704		yes	III	yes
26	Mexico	1987	9310		raw	I	
27	Morocco	1992	9256		yes	II	yes
28	Mozambique	1997	8779		yes	III	
29	Namibia	1992	5421		yes	II	yes
30	Nepal	1996	8429		yes	III	yes
31	Nicaragua	1998	13634		yes	III	
32	Niger	1998	7577		yes	III	
33	Nigeria	1990	8781		yes	II	
34	Pakistan	1991	6611		yes	II	
35	Paraguay	1990	5827		yes	II	
36	Peru	1996	28951		yes	III	yes
37	Philippines	1998	13983		yes	III	yes
38	Rwanda	1992	6551		yes	II	
39	Senegal	1997	8593		yes	III	
40	Sudan	1990	5860		raw	I	yes
41	Thailand	1987	6775		raw	I	
42	Togo	1998	8569		yes	III	yes
43	Trinidad and Tobago	1987	3806		raw	I	
44	Tunisia	1988	4184		raw	I	
45	Uganda	1995	7070		yes	III	yes
46	United Republic of Tanzania	1996	8120		yes	III	yes
47	Uzbekistan	1996	4415		yes	III	
48	Yemen	1992	6010		yes	II	
49	Zambia	1996	8021		yes	III	yes
50	Zimbabwe	1994	6128		yes	III	yes
51	Eritrea	1995	5054	special acces	tds		yes
52	Zimbabwe	1999	5907		yes	III	yes
53	Burkina Faso	1998	6445		yes	III	yes
54	Ghana	1998	4843		yes	III	
55	Guatemala	1998	6021		yes	III	
56	Kazakhstan	1999	4800		yes	III	
57	United Republic of Tanzania	1999	4029		yes	III	
58	Turkey	1998	8576		yes	III	
59	Kenya	1998	7881		yes	III	
60	Nigeria	1999	7647		yes	III	yes
61	Bolivia	1998	11187		yes	III	
62	El Salvador	1985	5207		raw	I	
63	Botswana	1988	4368		raw	I	
64	Colombia	2000	11585		yes	III	
65	Indonesia	1997	28810		yes	III	yes
66	Morocco	1995	4753		panel	III	
67	Senegal	1999	17189		raw	III	
68	Guinea	1999	6753		yes	III	yes
69	Chad	1997	7454		yes	III	yes
70	Philippines	1993	15029		yes	III	yes
71	Senegal	1993	6310		yes	II	yes
72	Madagascar	1992	6260		yes	II	yes
73	Niger	1992	6503		yes	II	yes
74	Ethiopia	2000	15367		yes	III	yes
75	Cote d'Ivoire	1998	3040		yes	III	
76	Egypt	2000	15573		yes	III	
77	Krygyz Republic	1997	3848		yes	III	
78	Peru	2000	27843		yes	III	yes
79	Nepal	2001	prelim		yes	III	
80	Bangladesh	1993	9900		yes	III	
81	Turkey	1993	6519	8619		II	
82	Sri Lanka	1987	5865		raw	I	
83	Ghana	1988	4488		raw	I	
84	Malawi	2000	13220		yes	IV	yes
85	Mali	1987	3200		raw	I	
86	Tanzania	1992	9238		yes	II	
87	Zambia	1992	7060			II	
88	Zimbabwe	1988	4201		raw	I	
89	Uganda	1988	4730		raw	I	
90	Colombia	1986	5329		raw	I	
91	Colombia	1990	8644		yes	II	
92	Bolivia	1989	7923		raw	I	
93	Brazil	1986	5892		raw	I	
94	Brazil (northeast region only)	1991	6223			II	
95	Dominican Republic	1986	7645		raw	I	
96	Dominican Republic	1991	7320			II	
97	Guatemala	1987	5160		raw	I	
98	Peru	1986	4999		raw	I	
99	Peru	1992	15882			II	
100	Morocco	1987	5982		raw	I	
101	Indonesia	1987	11884		raw	I	
102	Indonesia	1991	22909			II	
103	Benin	2001	6219		yes	III	
104	Cameroon	1991	3871		yes	II	
105	Togo	1988	3360		raw	I	
106	Egypt	1992	9864			II	
107	India	1998	90303		yes	III	yes

Data not to be used for analysis
DHS I
DHS II
DHS III
DHS III coded like DHS II

Figure 7: List of DHS countries

Table 1: List of indicator variables included

Indicator variable
Best/good/medium/bad/worst toilet
Best/good/medium/bad/worst water
Best/good/medium/bad/worst floor
Best/good/poor/worst wall
Best/good/poor/worst roof
Electricity
Radio
TV
Fridge
Car
Phone

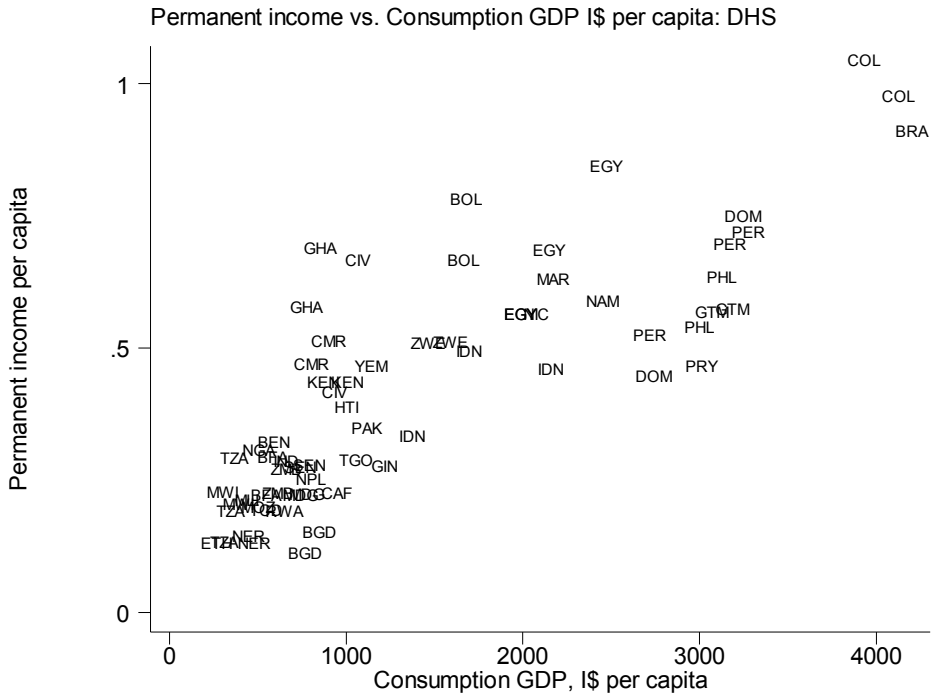

Figure 8: Permanent income versus consumption per capita

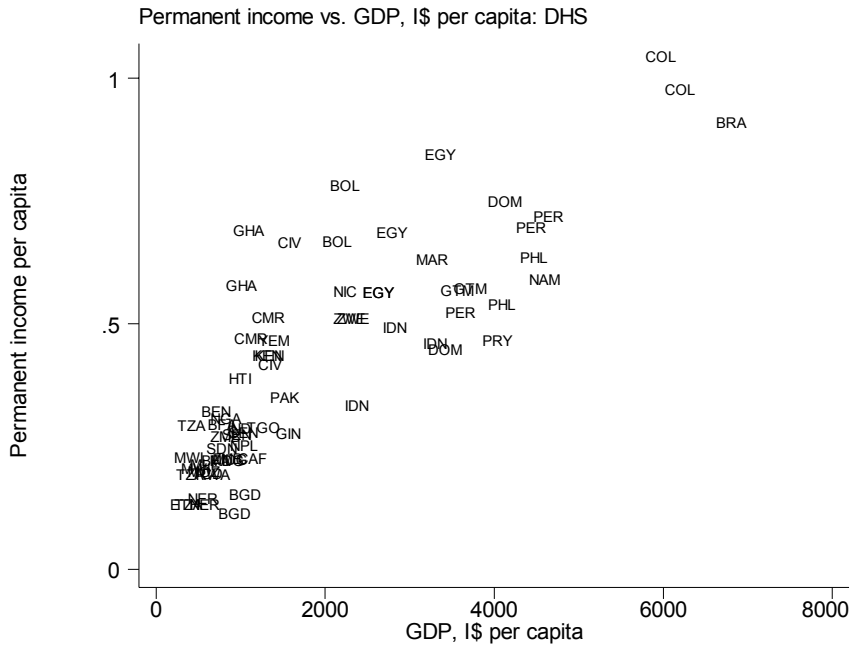

Figure 9: Permanent income versus GDP per capita

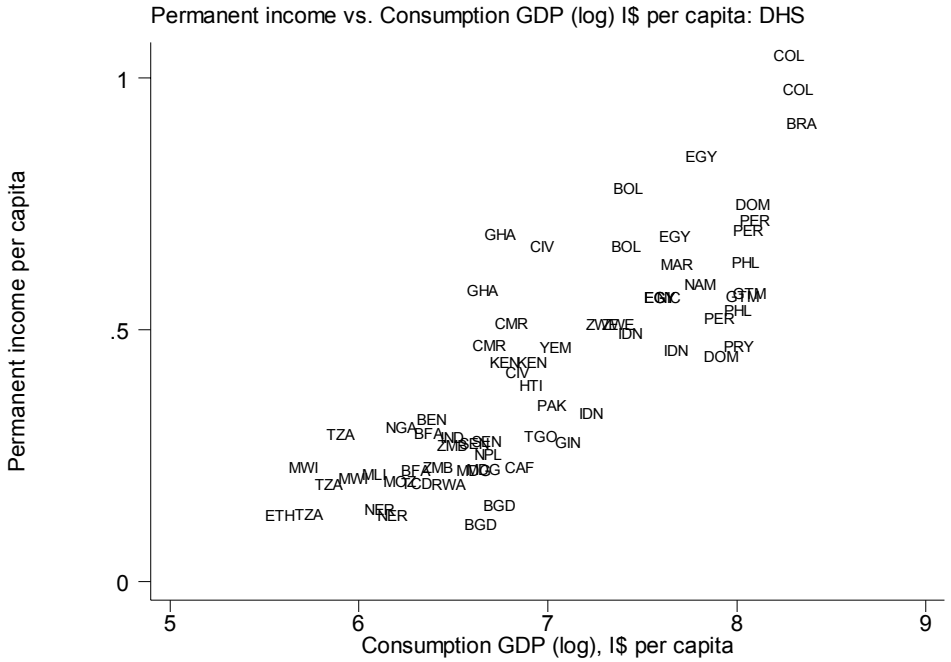

Figure 10: Permanent income versus log of consumption per capita

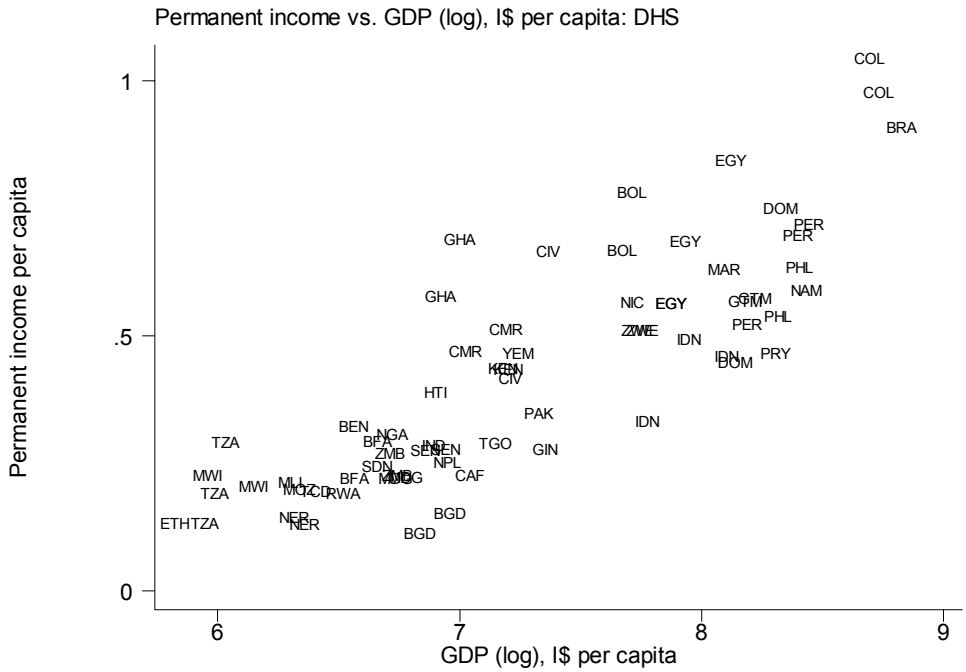

Figure 11: Permanent income versus log of GDP per capita