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# GIVE AND TAKE BETWEEN HOUSEHOLDS AND THE STATE: DEVELOPMENT AND APPLICATION OF A BENEFACTION–CONTRIBUTION RATIO

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This study defines a "Benefaction–Contribution Ratio" (BCR), describing the extent to which households are net beneficiaries of or contributors to the economy in relation to income and consumption. Such issues are central to assessment and targeting of policies such as social welfare and taxation. We apply the ratio to 21,144 South African households. South Africa employs various taxation-funded social grants and subsidized services. A central question is how such transfers affect real household income and consumption. We find that the constitution of social transfers as a function of tax adjusted earned income significantly augments household buying power. Furthermore, we hypothesize and find a negative curvilinear shape which has implications for design of taxation and welfare. This constitution and distribution of this ratio may be useful for international benchmarking and household planning, and as an economic predictor of outcomes such as job seeking, entrepreneurial behavior, family planning, migration, and tax evasion.

**JEL Codes**: D31, H24, I32

**Keywords**: households, income, social grants, South Africa, taxation

## 1. INTRODUCTION

Household income analysis is fundamentally affected by various contributions or taxes of the state to income. Taxation usually reduces household income through proportional systems with a higher incidence on wealthier individuals, higher taxed consumption patterns, and the like. On the other hand, many governments offer social welfare such as child or elderly support through cash grants or subsidized services, generally focused on lower-income households. Analyses of household income and expenditure are incomplete until they incorporate such transfers to and from the state.

Methods for assessing household income commonly incorporate taxation, but do not adequately incorporate state transfers to households in balance with tax.

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This paper accordingly develops a net measure, the Benefaction–Contribution Ratio (BCR). Mainly, we seek to explore the overall value of consumption relative to before-tax income. An assumption is that low income households endure low tax and enjoy higher grants and state subsidized service, generating relatively higher consumption per income unit. As income increases, taxes increase and grants or free services decline, suggesting less benefit per income unit earned. We test specific hypotheses regarding the shape of this progression, focusing on household income deciles since this is the conventional practice of most economic reports.

This ratio could be useful for macroeconomic comparisons and microeconomic analysis. Our index is able to demonstrate a cross-section of the fiscal relationship between government and society per income decile, which in turn can translate into the relative dependency of specific population groups on the state, and indeed the relative dependency of the state on specific population groups.

### 1.1. *The South African Context*

As our empirical example, South Africa suffers from extreme income inequality distributions and unemployment, with Gini coefficient estimates ranging between 0.59 and 0.80 (Statistics South Africa, 2008; Bosch *et al*., 2010; Woolard *et al*., 2010). Income inequality has complex causes (Fedderke *et al*., 2001; Fedderke and Luiz 2008), partly rooted in the "apartheid" legacy of the country (Oosthuizen, 2007). Income disparity has ongoing potential consequences and attendant possibilities for social unrest (Lichbach, 1989; Thorbecke and Charumilind, 2002).

Three state policies currently address these issues. First are social grants, such as child support and pensions, which can constitute a significant portion of monthly income for poorer households (Whiteford and Van Seventer, 1999; Woolard *et al*., 2010). Second are subsidized or free services for the poor, including education, healthcare, electricity, water, housing, and sanitation. Third, differential income tax is used aggressively to fund these programs. Thus, relatively affluent households receive little social assistance and pay substantial income tax (Oosthuizen, 2007; Statistics South Africa, 2008).

This comment does not seek to assess the relevance or success of these policies, although there is debatable evidence of positive impact (e.g., Van der Berg *et al*., 2008; Bosch *et al*., 2010; Woolard *et al*., 2010; although see Whiteford and Van Seventer, 1999; Meth and Dias, 2004; Özler, 2007). These policies have produced polarization of income sources. For instance, McEwen *et al*. (2009) show that the single richest income decile receives 83 percent of its income from wages whilst decile 1 receives only 25 percent from wages. Total social grants constitute 67 percent of income in income quintile 1 and only 2 percent in income quintile 5. Such differences invite analysis. The following sections accordingly discuss and model a measure capable of assessing the consumption of households relative to earned income, taking into account all social transfers including wages, services, and tax.

### 1.2. *A Household Benefaction–Contribution Approach*

The aim of this paper is to construct and analyze an index (the household BCR) assessing average household "spending power" (consumption) relative to

income for analysis of economies where social welfare has a potentially significant role to play.

First, we construct the BCR measure. The BCR captures ways in which lower income households in social welfare systems accrue higher levels of free social services and cash social grants, and incur lower levels of (or no) taxation. Conversely, households in higher deciles are taxed at substantially higher rates and usually consume fewer or no grants and subsidized services. Thus, the consumption of each household relative to pre-tax wages earned is different depending on the percentage of income tax paid and social grants. It is this set of relationships that the proposed ratio captures, the BCR is defined as:

$$BCR = \frac{\text{Net consumption (adjusted for consumption tax and free services)}}{\text{Net income (adjusted for income tax and cash grants)}}$$
$$= \frac{\text{Conventional taxed household consumption} + \text{Free services consumed}}{\text{Income inflated for tax and decreased by cash grants}}$$
$$= \frac{E(1-T_c)+SS_i}{(I-CS_i)\big/(1-T_i)}$$

where $E$ = total household consumption per year; $T_c$ = average consumption tax paid; $SS_i$ = total cash equivalent of free water and electricity per household per year; $I$ = total household income; $CS_i$ = total cash social wages (transfers) per household per year; and $T_i$ = average household income tax.

The BCR is a classic output/input ratio. The numerator reflects all consumption values including taxed paid-for consumption and non-taxed free government services. Therefore the household becomes more dependent on the state and the BCR grows as the free services share of consumption increases. The denominator reflects all income-related items including earned income, and therefore income potentially subject to income tax and cash grants. The BCR should grow when the household is relatively more dependent on the state via grants or is a lower tax contributor, therefore grants are subtracted out of total income and income is divided by the non-taxable rate to achieve this result.

The BCR therefore reflects relative dependence versus contribution of households to the economy through the impact on household consumption value. An alternative interpretation is that it reflects the relative consumption value of each dollar earned. Households with low income, commensurately low consumption and tax, but with significant added services and grants will have more relative consumption value per dollar earned and therefore higher BCR scores.

Initial measurement of the BCR components occurs at either the individual or the household level. However, we aggregate to income deciles in accordance with common reporting usage in such fields.

A measure of relative household dependency on the state, such as the BCR, may be useful in several ways, such as analysis of incentives faced by households and cross-country comparisons. The final section of the paper lists these in more detail.

### 1.3. *Hypotheses Regarding the Shape of the BCR*

We suggest two hypotheses regarding the shape of the BCR across income deciles, with the purpose of establishing whether certain claims regarding economic distribution in the sample reflect in the BCR.

The major issue we examine is the differences in benefit of earned income across income deciles. As discussed earlier and established by various analyses, percentage of total income from social grants tends to decrease (e.g., from 67 percent in income quintile 1 to around 2 percent in quintile 5 in research by McEwen *et al*. (2009), with a similar trend in free services). Conversely, progressive tax rates in countries such as South Africa ensure that income tax proportions increase exponentially in the last few income deciles, whilst being near zero for the rest. Value Added Tax (VAT) is also charged at a differential rate depending on the income group of the household, since the constitution of the basket changes considerably and certain staple goods which form a bigger proportion of low-income baskets are VAT exempt. Therefore, we expect the BCR to differ across income deciles. However, how should it differ? Specifically, we do not imagine a linear trend but suggest an inverse curvilinear trend as deciles increase, for several reasons.

First, because the delivery of state services and grants (social and infrastructural) is dependent on access and localized resources, they are not distributed equally amongst the poor. Specifically, extreme poverty has the effect of excluding people from even free services. This effect occurs for several reasons, including the tendency of such poverty to occur in remote rural areas, illiteracy among such households making it harder to apply for services, and the like (e.g., Dutton, 1978; Allard *et al*., 2003; Pandey *et al*., 2007). We therefore argue that households in very low income deciles, especially below the poverty line, will have less access to such services, thus reducing their BCR index compared to households with slightly more resources and therefore ability to access services and grants. Of course, once households enter higher income deciles they receive little or no access to free services. Therefore, we suggest free service consumption peaks at some low income decile, but higher than the lowest. Prior research indeed reported funding elements that seem to follow such a curvilinear shape; for instance, Van der Berg (2009) finds an inverse curvilinear shape of housing subsidies over income deciles.

With regard to taxation, the lower income deciles pay little or no income tax on average as their income falls below the minimum threshold, their consumption baskets contain a high proportion of zero-VAT products, and they engage more heavily in untaxed informal sector and subsistence activities (e.g., Leibbrandt *et al*., 2010), raising BCR scores. Conversely, households in income deciles 7–10 have purchasing power significantly eroded by income tax, reducing their BCR scores.

Therefore, the BCR likely rises relatively from income decile 1 to decile 6, due to increasing access to social grants and social delivery but low tax rates. Thereafter, the BCR should begin to fall again across the deciles to an absolute minimum at income decile 10, because of increasing tax incidence with little or no access to grants or free services. This should produce an inverse curvilinear curve:

*Hypothesis 1*: Average BCR per income decile follows an inverse curvilinear trend, increasing from income decile 1 to decile 5 or 6 and then decreasing to decile 10.

The second hypothesis examines households within decile 10—the richest tenth of the country. Here we propose a strong downward trend in the mean BCR within decile 10. The challenge with measuring income decile 10 as one discreet group is that there are large variations in household BCR scores within this decile. In South Africa, any household receiving more than the approximate equivalent of $18,500 per annum in income as of the Income and Expenditure (IES) survey in question (exchange rates as of time of submission) is considered to be in the top income decile; however, at the top end of this decile are earnings of millions of dollars. At the bottom end of the decile the marginal tax rate is well below the maximum, and this household maximum may be garnered by several individuals (for example, if there are two equal providers of income to a household of $18,500 per annum, the household would have the minimum possible income tax rate of 18 percent; however, the richest household in income decile 10, even with multiple earners, should accrue an income tax rate of 40 percent). As discussed earlier, one does not expect much social assistance in this decile. Thus, since the entire spectrum of the progressive tax rate could be observed in income decile 10, it is advisable to break this income decile up for greater granularity of analysis. From this information we assume that the top income decile, broken into ten percentiles equal in magnitude, will demonstrate a significant downward trend from the 90th to the 100th percentile. This leads to the second hypothesis:

*Hypothesis 2*: The BCR of individual households within decile 10 has a negative linear trend.

## 2. Research Methodology

This research utilizes quantitative analysis of South African household data to both construct the BCR and analyze it across income deciles. We analyze deciles instead of the raw household data from which they are constructed because this parallels common governmental and economic practice as discussed earlier, therefore providing comparability and fit to policy and practice.

### 2.1. *Research Design*

The outcome of this study is, first, quantitative modeling of the multiplicative BCR score. The source of data for this quantitative analysis is a cleaned version of the 2006 IES data, from which we model the decile-specific constructs and then test the hypotheses regarding the shape and distribution of the index. We utilize this dataset and not the more recent 2012 version because the latter has yet to be fully cleaned, and the purpose of this assessment is more to illustrate the BCR than to assess South African data per se.

### 2.2. *Population and Sample*

The population is that of the Republic of South Africa, which was 47 million in 2005 and 50.59 million in 2011 (Statistics South Africa, 2011). The country is

separated into nine provinces, with the majority of people living in Kwazulu-Natal, Gauteng, and the Western Cape. The demographics of the country show 79.3 percent of the population are African, 8.9 percent "Colored" (a specific race group identified in South African legislation), 9.2 percent White, and 2.6 percent Asian/Indian.

Although the population being analyzed is that of South Africa, it might be possible to generalize these results to other countries with similar socioeconomic landscapes. These results may not, however, generalize to populations in which large portions of low-income household consumption come from external aid and are not captured under the free services category, which is not the case in South Africa.

The sample is a selection of 24,000 households taken from 3,000 distinct primary sampling units to represent the spread of household income and expenditure. These households are then divided into 10 distinct groupings, each containing roughly 2100 households from the poorest to the richest households (lowest income to the highest, or income deciles 1–10 respectively). The sampling method for the primary data was a diary method where a fieldworker visited all sampled households on five separate occasions, filling in an aspect of the survey questionnaire each visit. Households were required to account for all goods and services procured over the 11-month duration (Statistics South Africa, 2008). The households were required to keep a daily diary for the purpose of recording the data more effectively and accurately. These samples were then consolidated into the IES (Statistics South Africa, 2008). The actual data used in this study is a version of the IES cleaned by DataFirst, a division of the University of Cape Town (www.datafirst.uct.ac.za). The data comprises two relevant files, the first representing every economically active individual (n = 47,150) within the household sample group and their sources of income, the other having consumption and income totals as well as many other service metrics per household (n = 21,144).

We undertook comparisons of the sample to other published datasets to assess representivity. The percentages of population per demographic group, as well as per income decile, were compared to those published in the NiDS 2009 studies (Leibbrandt *et al*., 2010). The proportions are very similar and indicate potentially good representation of the population—the NiDS reports can be accessed for demographics.

### 2.3. *Measures*

To create the BCR per household, the research requires the following measures per household.

*Average total expenditure per decile (E)*. Annual household consumption is the key measure of benefit in this study. This IES wave measured consumption in a more robust way than before, through the introduction of the diary method and by increasing the number of household consultations. Also, non-income sources of consumption, such as subsistence farming and bartering of services and goods, although outputs of work, are captured in the consumption variable and not the income variable.

*Total income (I)*. Income is conventionally recorded as reported, earned income from wages, business income and the like. Unfortunately, initial analyses

of the income measures display significant issues, including expenditure significantly exceeding income in a number of instances, significant underreporting of income, and issues with separation of income into its correct sources (Statistics South Africa, 2008). Oosthuizen (2007) has pointed out manifest artifacts between income and expenditure due to generally underreported income, savings, credit, and capital. Since the BCR is an index, we take advantage of this where necessary by deducting informal, subsistence, free, and interest-derived consumption from total consumption to approximate earned income.

*Income tax (Ti)*. It was necessary to have a tax rate for each individual within the sample of households that earned income through wages. We applied standard South African tax rates of the time to reported income, which we then weight and average in the consolidation of individual data records into household data records, giving average income tax rate (*Ti*) for that household. This is in similar vein to Van Heerden and Schoeman (2010) and others, who note differences between IES data in this regard and formal South African tax reports.

*Consumption tax ($T_c$)*. Consumption tax (VAT) should be different per income decile depending on the specific spending within given baskets of goods. We use data from the IES analysis to assess categories of spend, such as food, fuel, clothing, and the like. We then apply disaggregated consumption tax weights to the various categories and multiply by actual reported consumption to obtain average consumption tax percentage per household. This forms the metric $T_c$ in the BCR.

*Average cash transfer social grants received per household per decile (CSi)*. For the calculation of this metric we sum all cash grants recorded in the IES into one non-discriminating field called *CSi*, including cash transfers from child grants, social pensions, disability grants, and grant in aid.

*Subsidized social services in cash equivalents (SSi)*. Figures for free services were not available in the IES as such, and need to be calculated accordingly. The average unit price of free services was multiplied by the free service provision for every household that had access to an electrical terminal and was between income deciles 1 and 6. These figures were then summed as total subsidized services.

## 3. Results

In order to construct the index and then to test the hypotheses, we apply several procedures. First, we create the BCR for further analysis. This step is a simple arithmetic implementation of the BCR equation for each household. Once the BCR is created, some data cleaning is required for outliers, as discussed below. Second, Hypothesis 1 implies that the BCR will differ significantly between deciles, requiring comparisons of means between each income decile. We therefore apply an ANOVA-type approach. Third, Hypothesis 1 suggests more specifically that the BCR will follow an inverse curvilinear trend, requiring curve fitting procedures. Fourth, Hypothesis 2 suggests differences between and a downward linear trend in the top ten percentiles, and also involves ANOVA and curve fitting procedures.

### 3.1. *Creating and Assessing the BCR*

As indicated above, the first step is to create the actual BCR which is a non-trivial process of data acquisition, creation, and manipulation. We apply the

procedures discussed in the Methods section and ultimately generate a single household BCR score.

While the initial analysis of the BCR uses the whole cleaned sample, in order to use the BCR for the purposes of parametric hypothesis testing it is necessary to adjust the data for some substantial outliers. We accordingly compare both the original dataset with outliers (via non-parametric analysis) and create a second winsorized dataset appropriate for parametric analysis. This is necessary as the index score represents a ratio past which a particular point loses its meaning. For example, when 98 percent of income for consumption comes from social grants, the index exceeds 50. This procedure is subjective to a degree as the parameters are predetermined and not dependent on the sample fundamentals, however non-parametric analysis on the whole dataset should help to provide comparison and possible corroboration of findings. Table 1 shows the different BCR versions; the constituent inputs of the raw score are given in Appendix 1.

It is immediately apparent from Table 1 that the BCR differs substantially between deciles, and indeed holds an inverse curvilinear shape as suggested in Hypothesis 1.

As can also be seen in the constituent BCR elements in Appendix 1, the mean consumption per income decile increases exponentially toward decile 10. However, until income decile 5, consumption exceeds income in average. Thereafter, consumption decreases monotonically as a percentage of income, indicating savings to a maximum of 38 percent. As discussed earlier and inferred by Hypothesis 1, the peak of social transfers only occurs in income decile 5, and constitutes the maximum percentage of total household consumption at 36 percent. Thus the state seems unable to deliver services and aid to the most needy population deciles, and the value of social wage provision seems to be distributed about the economic median of the national population. Income deciles 9 and 10 receive similar social transfers to those in dire need at income decile 2 and more than those in income decile 1, which seems counterintuitive until viewed as a percentage of total consumption.

TABLE 1

BCR by Decile on Different Datasets (Including ANOVA and Multiple Comparison Tests)

| | BCR (Raw Data) (nonparametric ANOVA) | | | BCR with Winsorized Data (GLM ANOVA) | | | BCR with Outliers Deleted (GLM ANOVA) | | |
|---|---|---|---|---|---|---|---|---|---|
| Decile | N | Median Rank | Z | N | Mean BCR | S.E. | N | Mean BCR | S.E. |
| 1 | 2103 | 1.01[a] | 25.69 | 2103 | 1.22[a] | 0.026 | 2065 | 1.14[a] | 0.014 |
| 2 | 2461 | 1.01[ab] | 21.95 | 2461 | 2.09[a] | 0.027 | 1967 | 1.36[a] | 0.014 |
| 3 | 2500 | 1.10[ab] | 21.62 | 2500 | 2.25[b] | 0.027 | 1979 | 1.53[b] | 0.015 |
| 4 | 2309 | 1.04[b] | 19.26 | 2309 | 2.11[b] | 0.026 | 1887 | 1.47[b] | 0.014 |
| 5 | 2272 | 0.98[c] | 11.69 | 2272 | 2.25 | 0.028 | 1735 | 1.40[b] | 0.014 |
| 6 | 2151 | 0.95[c] | 11.25 | 2151 | 1.92[c] | 0.029 | 1822 | 1.36 | 0.013 |
| 7 | 1981 | 0.76 | –13.25 | 1981 | 1.27[c] | 0.028 | 1840 | 0.99 | 0.014 |
| 8 | 1952 | 0.72 | –25.59 | 1952 | 0.95[d] | 0.029 | 1910 | 0.86 | 0.014 |
| 9 | 1848 | 0.72 | –39.27 | 1848 | 0.82[de] | 0.030 | 1833 | 0.79 | 0.014 |
| 10 | 1566 | 0.68 | –47.55 | 1566 | 0.73[e] | 0.032 | 1558 | 0.71 | 0.016 |
| | | $\chi^2 = 6250.85$*** | | | $F = 483.86$*** | | | $F = 440.01$*** | |

*Notes*: ***p < 0.01. Results of multiple comparison tests indicated by superscripts: scores with same superscript are statistically similar at 5% level of significance. Kruskal–Wallis estimated for ties, number of ties = 140.

Free service constitutes a relatively small portion (maximum of 3.6 percent in decile 1) of household consumption until decile 6, after which services are paid for. The relative contributions of free social services are meager, and will not make as significant an impact for this time period as initially anticipated in the design of the BCR. With the increase in the price of utilities, and the increasing access provided by the state, this could become an important element in future measurement of such indices.

### 3.2. *Comparisons of the BCR between Income Deciles and Different Versions of the Data*

Hypothesis 1 infers that the BCR differs significantly across deciles. This can be assessed using ANOVA-type procedures. In addition, due to substantial outliers as discussed in the previous section, we approach the ANOVA comparisons through both non-parametric analysis of the original, full dataset and parametric analysis of a windsorized dataset. We also perform parametric ANOVA on a dataset with outlier deletion rather than automatic windsorization. Comparing the BCR across these different datasets allows for analyses of sensitivity.

First, to generate non-parametric comparisons, we perform a one-way Kruskal–Wallis ANOVA of the raw index values in NCSS for the 21,144 households. The first section of Table 1 displays the median reversed ranks of the BCR across deciles. As can immediately be seen, the index peaks at income decile 3 and falls steadily to income decile 6, after which the index drops sharply toward income decile 10. Furthermore, the last row of Table 1 shows the results for the Kruskal–Wallis ANOVA test, which shows statistically significant differences at $p < 0.01$.

To ascertain the exact differences, the superscripts in Table 1 show the results of a Kruskal–Wallis multiple comparison test using an adjusted z-value Bonferroni multiple comparison test (deciles with the same superscript are statistically similar in BCR magnitude). As can be seen, income deciles 7 through 10 are individually significantly different from all other groups, with progressively and significantly lower BCR scores. Deciles 5 and 6 are similar to one another, and deciles 4 and 1 are similar to one another, flanked by similarities to deciles 3 and 2. These results provide initial support for Hypothesis 1, showing differences between deciles on the BCR and a statistically significant peak at decile 4 with significant declines toward the extremes.

Second, for the parametric comparison of means on the windsorized dataset we employ a General Linear Modeling (GLM) implementation of ANOVA ($F = 483.86$, $p < 0.01$). The second section of Table 1 displays means for the windsorized BCR scores across various deciles, which peak at deciles 3 and decile 5 and drop steeply from deciles 6 to 10. Tukey–Kramer multiple comparison tests suggest various structural breaks. The peaks at deciles 3 and 5 are statistically distinct, as is the stages of decline immediately after decile 5. Interestingly, the tests suggest statistically equivalent BCR scores for very different deciles, namely deciles 1 and 7. This is discussed later. These results again provide support for Hypothesis 1, since BCR differs across income deciles and has a significant interior peak.

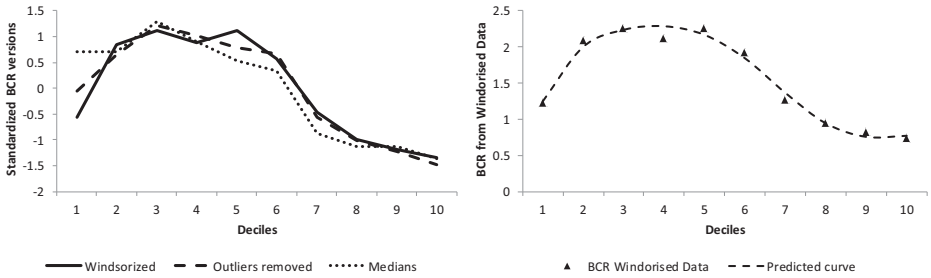


Figure 1. Left Panel: Standardized BCR Data Findings. Right Panel: Smoothed Trend Prediction

Third, we perform a further GLM ANOVA for observations after outlier deletion. Analysis of Table 1 suggests substantially similar results to those found in the first two tests.

A further note concerns the differences in the magnitudes of the three index versions presented so far. Outlier retention, windsorization, and outlier deletion respectively produce indices of quite different magnitudes, albeit similar shapes. To illustrate further the underlying consistency of the index, we standardize the BCR scores in each of the three variations to a mean of zero and standard deviation of one, and compare them graphically. The left panel of Figure 1 shows that all BCR iterations follow the same basic trend when standardized, as expected, all of which are notably curvilinear, which adds support to Hypothesis 1. The next section expands further on the curve analysis.

### 3.3. *Establishing the Shape of the BCR Using Curve-Fitting*

This section seeks to formally test Hypothesis 1, which predicted an inverse curvilinear shape to the BCR, specifically proposing a peak at deciles 5 or 6 due to increasing incidence of taxation thereafter.

The evidence presented so far already strongly supports a curvilinear trend. The data in Table 1 (represented in standardized format in Figure 1) suggest such a shape, as does the results of the multiple comparisons in Table 1. This provides partial and initial support for Hypothesis 1, although the peak has been found to be lower, around the deciles 3 to 5 level.

In order to test consistency of a curve, we employ the NCSS general curve fitting function on both the mean windsorized BCR and the outlier deleted BCR, allowing for several non-linear iterations. In fact, in both cases a cubic PolyRatio (3,3) curve has the best fit, with a bootstrapped $R^2$ of 0.98 and all bootstrapped parameters significant at 95% confidence including the cubic. The right-hand panel of Figure 1 shows the curve fitted with the resulting equation, which for interest in the case of the windsorization is $BCR = (-102.88 + 210.57D - 42.23D^2 + 2.37D^3) / (1 + 67.95D + 15.35D^2 + 1.05D^3)$. Results for the BCR with outliers deleted are very similar to this. This suggestion of a cubic shape results from the leveling off of the BCR from deciles 8 to 10, however the overall shape is substantially inverse curvilinear (a single maximum with decreases on either side). This provides support to the fundamental premise of Hypothesis 1,

although this hypothesis had proposed a peak at deciles 5/6, whereas in all analyses the empirical data peaks lower (at around deciles 3–5) and the fitted curve peaks at decile 4.

### 3.4. *Closer Analysis of Decile 10*

Hypothesis 2 predicts that a negative linear trend within decile 10 households may increase markedly in wealth here from affluent to super-rich. To test this, we separate and analyze the top 10 percentiles of the total sample using GLM ANOVA, which is significant at $F = 8.50$, $p < 0.05$. The BCR generally trends downwards (from 0.74 in the 91st percentile to 0.64 in the 100th percentile; exact data are available in the online appendix). A linear estimation finds $R^2 = 0.81$, and fits a curve with equation BCR = 0.77 – 0.01 decile (both parameters are significant at 95% confidence), lending support to Hypothesis 2.

## 4. Discussion of Results

This research aims to propose, construct, and test a measure of household dependency on the state, namely the BCR, with hypotheses that such an index will differ significantly between income deciles, be essentially inversely curvilinear in shape, and downward sloping across the top ten percentiles of wealth.

The index is in itself a novel construction, and hence the majority of this paper has defined its structure and use. Having created the index and dealt with outliers, we find satisfactory statistical evidence for most essential elements of the hypotheses. A summary of findings is as follows:

1. Various ANOVA analyses strongly suggest significant differences in the BCR across income deciles.
2. More specifically, analyses suggest a roughly curvilinear shape to the BCR (albeit with a slowing tail as wealth increases).
3. Two unexpected findings exist in the shape of the BCR across deciles for South African data. First, the BCR consistently peaks around income deciles 3 to 5 (more consistently 3) instead of the expected peak at 5 or 6. Second, a flattening of the index after decile 6 produces a somewhat cubic shape, although the shape maintains essential curvilinear elements (a single maximum with decreases on either side).
4. As expected, the BCR mostly declines steadily across the top ten income percentiles, which is likely due to increasing tax incidence.

The following sections discuss possible reasons for and implications of the BCR's shape, the possible uses and significance of the BCR, as well as potential areas for future research of the BCR.

### 4.1. *Shape of the BCR*

Several points of interest arise in the discovered shape of the BCR.

#### 4.1.1. Curvilinearity and Maxima in the BCR

The expected curvilinearity in the BCR is driven by increasing grants and consumption tax from deciles 1 to 5, and increasing income tax with decreasing grants and free services thereafter, as expected.

The unexpected maximum around deciles 3 to 4 requires more discussion. This result can partly be explained by the provision of free services, which peaks at decile 3. However, this facet was not a major feature of household consumption in this time period, and use of grants does only peak at decile 5. More influential is consumption patterns and taxation. First, consumption as a percentage of income drops steadily as deciles increase. Relatively high reported consumption to income ratios at early deciles is likely because of unreported income from informal trading and the like. Deciles 3 and 4 therefore rely less on income for consumption. Perhaps more importantly, however, consumption tax is substantially higher for decile 5 (9.5 percent) than for decile 3 (7.6 percent). Therefore, because of a higher consumption of zero-VAT staple goods at deciles lower than 5, income and non-income effort produces higher levels of consumption which is taxed less, producing a peak in the BCR. More analysis with contemporary data is needed, however this result may indicate that judicial design of consumption tax may have as much or more effect on social support than does free services and grants.

An anonymous reviewer also notes that under-reporting of both income and tax could distort the curvilinear shape somewhat, as lower households report little and under-reporting leads to high income households being misallocated to middle deciles.

#### 4.1.2. The Similarity in the BCR of Some Low and High Decile Levels

Because of the curvilinear shape of the BCR, in some cases very low and much higher deciles have substantially similar BCR scores. For instance, in the windsorized dataset, income deciles 1 and 7 are statistically similar to one another although they fall on either side of the "social grant bubble" caused by the negative curvilinear shape, and have fundamental differences in the constitution of their income. Similar results can be found in other analyses.

This result suggests that, despite the very different constitution of the elements in their index calculations, these households enjoy similar net purchasing power of earned income. This does not of course by any means suggest equality of wealth or living standards. Decile 1 is so impoverished and isolated that most households cannot even access social assistance, earn very little in the way of formal wage, and consume substantially through subsistence agriculture, bartering, begging, and piece jobs. Each household in income decile 1 receives on average 13.8 percent of the social grants of the average in decile 7, despite residing in dire poverty. However, decile 1 attracts almost zero taxation. So, despite the fundamental difference between such households, they have the same purchasing power for each dollar of earned income, albeit that income decile 1 has only a small proportion of decile 7's income. This may have significant consequences for economic and social behavioral patterns, as argued further below when we discuss the uses of the BCR.

### 4.2. *Possible Uses for the BCR*

Several uses for such a measure of household dependence on the state may arise.

### 4.2.1. International Comparison and Benchmarking

Comparison of the BCR across economies (be they countries or localized economies) is one useful application of the index. An analogous commonly utilized comparative measure is the Gini coefficient, which measures income inequality. This is possible because the Gini coefficient is calculated using either income or consumption, varying in some cases between total income and income from wages, on the shaped Lorenz curve which can be presented as a single figure determining the shape of that curve.

The BCR, on the other hand, needs to be viewed as a discrete value per income decile on a Cartesian scale, and is thus not as eloquent for popular consumption. Indeed, the BCR is a representation of the fiscal relationship between the state and its citizenry, and will need to be contextualized for analysis in terms of the history and desire of a particular country's growth path. Nonetheless, the BCR considers an array of interesting metrics that can be very informative when analyzing the fundamentals of an economy, and we argue that the index is a robust, novel, and enlightening tool for the analysis of populations. The BCR, like the Lorenz curve, measures population in households from lowest to highest "income" on the x-axis, and the dependent variable representing the index on the y-axis.

The reason that international comparison and benchmarking is a likely use for the index is that the BCR consolidates the interaction between the state and its citizenry into a single score per income decile. It would be extremely interesting to plot the BCR for countries such as Brazil, the United States, and Britain on the same axes as the BCR for South Africa. In one snapshot a comparison of the fundamental state relationship with its citizenry across nations is possible, without purchasing power parity considerations. For example, in Brazil personal income tax is higher than that in South Africa as the state has well entrenched social policies, grants, and assistance (Barrientos *et al.*, 2013). Thus it is likely that the BCR in Brazil could be similar to that in South Africa, but potentially with even greater range. It would be interesting to see when access to social assistance peaks and how effective the state has been in reaching those in dire poverty. Similarly, Britain has a very well entrenched social policy, and a progressive tax rate, so the magnitude and shape of its BCR would be of great interest for comparison. In developed economies such as the United Kingdom, however, it is likely that social services are provided more effectively in the lowest incomes, as these countries have fewer rural populations without access to services. Thus it is likely that access to social services would occur earlier than in South Africa. Also, as household employment is more common in developed economies, it is likely that the magnitude of the index would be less than in South Africa. It is also likely that households in developed economies would show a sub 1 dependency factor (net money flow from household to state) in an earlier decile than income decile 8, as in South Africa. Thus the best area for additional research would be to compare and contrast several different economies on one Cartesian scale, having constructed their dependency indices from raw data in a similar census/national survey year.

Comparison of the index across developing and developed nations would likely show the greatest difference in magnitudes and shape, which is interesting in

itself as a single graph can represent much about an economy. However, most useful would be a comparison of the index across similar countries whose policies and state implementation could be benchmarked. These benchmarks could form part of the economic policy roadmaps in the transformation of the economy on a macro scale with micro inputs.

#### 4.2.2. Provision of State Services

Although the state attempts to provide services and assistance to those most in need, the reality, as can be seen from the BCR, is that the neediest groups in income deciles 1 and 2 receive far less social assistance than those near the income median. Use of the BCR can assist policy makers to adjust the implementation and eligibility requirements of social grants to attempt to smooth out this curve in order to maximize assistance to needy households and reduce dependency on state resources. For example, a road map figure could be to increase the index score of income decile 1 to 1.5 by 2015, whilst reducing those outliers who receive more social assistance than they consume. The BCR shows how effective poverty alleviation is being across the full income range, and benchmarks progress of various initiatives.

In addition, the BCR can be used at the level of the individual household. For instance, it may become an analysis tool for use by social workers to aid in an assessment of state dependence and to analyze interventions such as consumption changes.

#### 4.2.3. Analysis and Design of Tax Regimes

Similarly, the extent and location of the tax burden can be visualized through the BCR. The index can indicate the extent to which income tax is eroding buying power per income decile. Threshold values could be identified in these deciles indicating when the burden is likely too large to encourage growth and investment. This could give an indication of when the pressure on a particular income category is starting to discourage legitimate tax returns and fiscal obedience. The revenue stream from income tax is often the largest contributor to the state fiscus, the index variously allows consideration of scenarios as to how this revenue can be maximized without affecting the purchasing power of households significantly.

#### 4.2.4. Contributors or Consumers of State Capital

One possible interpretation of the BCR is that, for the limited portion of state activities covered by the measure, the index reflects relative household contribution to the state's fiscus. As an anonymous reviewer points out, the bulk of government expenditure going to common goods such as defense or education and consumed by households is not reflected in the BCR. As such, the index would not therefore reflect a complete view of the relative contribution of the state to a household or vice versa. However, to the extent that the BCR reflects other flows as discussed (tax, grants, free services), then if an income decile has an index score below 1 it has a net positive effect on the state's fiscus for these portions;

conversely, when the income decile has an index score above 1 it has a net negative effect on the state's fiscus excluding consumption of broader state expenditure. This viewpoint suggests that the state can construct scenarios of various initiatives to ensure it maximizes revenue, whilst providing the largest amount of support to needy groups for human capital development. For example, the BCR could inform the state that income decile 5 is receiving the greatest relative benefit from the state for the portions measures, and in many cases is becoming wealthier from the state provision (consumption less than social grants). Thus the state could consider reducing these grants to be redistributed to households in income deciles 1 and 2, which benefit the least from such state provisions.

#### 4.2.5. Analysis of Economic Behavior

The BCR may help to explain or predict economic behavior. In general, social choices and economic bottlenecks are usually predicated on considerations of complex trade-offs. The BCR reflects many such issues, being a household level index of both the consumption and income landscapes.

For instance, significant employment changes have the potential to substantially affect the benefit of each dollar of earned income as measured by the BCR. Where a job change could be effected for the betterment of a household's BCR, we may predict on average a stimulation of social mobility desire and choices. However, if certain choices would harm the BCR, this may cause stickiness in social choices. Of interest here would be to analyze whether job search makes sense in a BCR framework. Other factors such as migratory patterns, family planning, retirement, and entrepreneurial behavior could follow suit (for instance, the choice to bear children in order to gain social grants and better the BCR, to engage in non-taxed informal entrepreneurship, or using the BCR to predict emigration patterns).

To illustrate one of these scenarios in the broad decile-based view, consider the winsorized index shown in Table 1. The BCR rises from 1.22 in income decile 1 to 2.09 in income decile 2. On average, the BCR predicts a strong incentive for households to rise out of income decile 1, because each dollar that they earn in income decile 2 will essentially have a greater purchasing power of 72 percent, as they will gain access to relatively large amounts of social assistance. Between income decile 2 and income decile 5 there are only small changes in the index of a maximum of 6 percent. Thus there is an incentive for households to keep rising in income as their purchasing power remains the same but their income is increasing per income decile.

In contrast, the middle deciles may face a possible disincentive to become wealthier, notably around decile 5 to 7 for which the BCR drops from 2.25 to 1.27, respectively. This bottle-neck in the progression of households can best be illustrated by an example. Income decile 5 had a maximum per-household income of approximately $2700 and income decile 7 had a minimum per household income of about $3700. Therefore, approximately $1000 is the minimum difference in income between the two income deciles. This means that a household at the top of income decile 5 nominally needs to increase its income by some 37 percent ($1000 from a base of $2700) in order to be in the bottom end of income decile 7. However,

making this shift also means a significant drop in social grants as well as a significant average increase in tax burden. Using average data for such a situation, a household making the shift from decile 5 to decile 7 would have to earn a real increase in wage-based income of 59 percent to compensate for the drop in social grants and rise in tax to maintain equivalent benefit in terms of the BCR. This could be a significant disincentive on a return on effort basis.

#### 4.2.6. Sensitivity Testing of Proposed Tax and Social Policies

Proposed changes can be directly inputted into the data so that the net result on the index per decile can be seen. Changes in the cost of services, the value of child care grants, the exemptions from consumption tax, income tax rates and brackets, and the like can all be considered for their effect on the purchasing power of households. This will allow sensitivity analysis on the various policy considerations to see the net effect on the economic wellbeing of the population. It would likely be possible for computer simulations to be run to allocate resources for the effective achievement of a policy road map derived through selecting index thresholds at different income deciles. For the consideration of comparing income deciles in terms of economic wellbeing it would be necessary to incorporate savings into the higher income deciles, as the index does not consider this.

### 4.3. *Limitations and Suggestions for Further Research*

This initial proposal and exploration of the BCR has several important limitations, including but not limited to the following.

The study is not yet longitudinal, showing instead a 2005/06 snapshot of the relative value of income per decile. Differences between the methodology and accuracy of the last three IES reports render the information difficult to interpret over time without complicated statistical alterations. Future research may consider analysis of the trends in such a measure. Notably, future research should assess the 2010/11 IES which was released in 2012, preferably after thorough data cleaning which is still underway. This IES should be a better representative sample, and indicate much of the recent increases in the cost of services and social assistance as outlined in the literature review.

Although the data were cleaned, there are certain fundamental internal discrepancies within the dataset itself, such as the aforementioned income inconsistencies (Statistics South Africa, 2008). As noted by an anonymous reviewer, the BCR denominator is dominated by income and tax, which in the IES are largely underreported. This may lead to mis-allocation of households within deciles, leading to inaccuracies. While some of these inaccuracies may be eliminated through our treatment of outliers, there exists substantial room for data improvement. Further methodological improvements in the sampling of the core survey will provide opportunities for better analysis of the BCR. In addition, qualitative studies investigating the perceived value of wages by households in different deciles would be complementary.

The data are for South Africa only and do not consider the racial or demographic makeup of deciles. Further research could conduct analyses by geography,

demographics, and the like, all of which could have very interesting results and implications.

A few particular studies could work well to increase the validity of the study, as well as show its usefulness for international and microeconomic analysis. Researchers could particularly perform comparative research with the same methodology on other comparable markets (Brazil, U.S., China, India etc.). Further comparisons to important economic outcomes such as poverty or entrepreneurial activity could be informative.

As mentioned above, the BCR could be used as a predictor of a range of interesting economic behaviors, including but not limited to job seeking, migration, entrepreneurship, family planning, and tax evasion. It would be interesting to link the occurrence of social unrest, strike action, service delivery protests etc. to the income decile of households involved in such action and their respective BCR values. This would indicate whether the dependency on the state of specific households leads those households to be more or less likely to increase their demands from the state and employers. Several covariates would likely need to be used in order to account for any causality in this matter.

As indicated previously, the BCR does not include consumption of broader common goods such as security or education. A study indicating the relative value obtained through such state provided services relative to tax paid could in the future be included as a weighting on the BCR. For example, wealthy households often make use of private services (school, security, medical aid etc.) even when a portion of their tax is used to subsidize public services for the same function as they are paying private service providers. On the other hand, lower income households may not always pay substantial income tax but make greater use of the subsidized public services paid for by income tax revenue. Thus, more explicit measures regarding such consumption in future iterations of the ratio may lead to greater accuracies.

The index does not take into account savings and wealth, only income for consumption purposes. Thus the index is not appropriate to demonstrate income disparity, rather the purchasing power of earned income. Further iterations of this measure might build in these considerations.

Assumptions on tax compliance and income earned through wages had to be made in order to obtain the average tax payable per household. Income is known to be underrepresented, and not all eligible households pay tax, so there will be some discrepancy here. It is likely that integrating revenue service information with the IES would yield better results, although the figures are not strictly comparable.

## 5. Conclusion

This paper presents a potentially useful economic measure of household income adjusted for the net fiscal relationship with the state. As stated, many applications could arise in areas such as economic planning, comparisons, and analysis. The BCR has been shown in a South African context to have interesting distributional considerations which could guide policy. Overall, such measures may advance our understanding of measurement and policy in the arena of household income and expenditure studies.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**Appendix 1:** Presentation and Decomposition of BCR Index using Winsorized Data