Measuring progressivity of health care payments

Introduction
Who pays for health care? To what extent are payments toward health care related to ability to pay? Is the relationship proportional? Or is it progressive; do health care payments account for an increasing proportion of ability to pay (ATP) as the latter rises? Or, is there a regressive relationship, in the sense that payments comprise a decreasing share of ATP? The policymaker’s preferred relationship between health care payments and ATP will vary with his or her conception of fairness, but quantification of the relationship [3,9] is of interest from a wide range of equity perspectives.

This note provides practical advice on methods for the measurement of progressivity in health care finance. Throughout, we measure progressivity through departures from proportionality in the relation between payments toward the provision of health care and ATP. There are other approaches to the measurement of progressivity [1]. For the relationship between progressivity and the redistributive impact of health care payments see Technical Note 17.

Definition and measurement of variables
There are two distinct stages to an analysis of progressivity. First, establish the progressivity of each source of finance. Second, establish the overall progressivity of the system by weighting the progressivity of the separate sources. Two types of data are required: survey data to establish the distribution of payments across households and aggregate data to determine the macro-weights to be assigned to each finance source. The most suitable source of survey data is a household income and expenditure survey, which should contain good data on the two crucial variables: payments toward health care and ability to pay.

Ability to pay
In a developing country context, given the lack of organized labor markets and the high variability of incomes over time, household consumption, or even expenditure, is generally considered to be a better measure of welfare, and ATP, than income (Technical Note 5). In principle, ATP should indicate welfare prior to payments for health care, and so, measurement of ATP by consumption requires an assumption, perhaps strong, that the system of health payments does not affect saving decisions. Household consumption net of expenditures assumed non-discretionary, such as those on food, is often used as a measure of welfare [2]. In relation to the assessment of progressivity, such a measure of ATP is can be problematic, depending upon the objective, if the non-discretionary expenditures are, in fact, sensitive to the system of health finance. For example, the relative tax rate imposed on food would be expected to influence, differentially, household decisions with respect to food spending. Then, the distribution of household consumption net of food expenditure is itself a product of the health finance system and does not provide a benchmark against which to assess the distributional impact of that system. But if the objective is simply to assess the degree of proportionality between health payments and some measure of living standards, then household expenditures gross or net of those on food can be used, as preferred.

If one wishes to make an inference about the distributional impact of health finance, then the measure of ATP should be gross of all health care, tax and social insurance payments. Out-of-pocket payments for health care should already be included in measures of household consumption/expenditure but it will be necessary to add direct tax payments, social insurance contributions and, possibly, private health insurance premiums. If household income is used to proxy ATP, then it must be gross of tax and social insurance contributions.

Adjustment should be made for the size and age structure of the household through application of an equivalence scale (Technical Note 5).
Health care payments

Evaluation of progressivity in health care finance requires examination of all sources of health sector funding and not simply those payments that are made exclusively for health care. So, in addition to out-of-pocket (OOP) payments, health insurance contributions and earmarked health taxes, the distributional burden of all direct and indirect taxes is relevant where, as is commonly true, some health care is financed from general government revenues. Social insurance contributions should also be considered. One source of revenue, foreign aid, is not relevant since the purpose is to evaluate the distributional impact on the domestic population. Assuming tax parameters have been set for foreign loan repayment, the distributional burden on the current generation of foreign debt financing will be captured through evaluation of the tax distribution.

In summary, there are five main sources of health care finance to be considered: direct taxes, indirect taxes, social insurance, private insurance and out-of-pocket payments.

Progressivity refers to the distribution of the real economic burden of health finance and not simply the distribution of nominal payments. The incidence of payments must be established, or assumed. For example, the incidence of employer contributions to health insurance is most likely lower wages received by employees. It is not possible to provide a set of universal rules for the determination of incidence but a fairly conventional set of assumptions is as follows [3]:

<table>
<thead>
<tr>
<th>Payment toward health care</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>• personal income and property taxes</td>
<td>legal taxpayer</td>
</tr>
<tr>
<td>• corporate taxes</td>
<td>shareholder (or labour)</td>
</tr>
<tr>
<td>• sales and excise taxes</td>
<td>consumer</td>
</tr>
<tr>
<td>• employer social and private insurance contributions</td>
<td>employee</td>
</tr>
<tr>
<td>• employee social insurance contributions</td>
<td>employee</td>
</tr>
<tr>
<td>• individual private insurance premiums</td>
<td>consumer</td>
</tr>
</tbody>
</table>

Survey data are unlikely to provide complete information on household tax and insurance payments. For example, income tax payments or social insurance contributions may not be explicitly identified and payments through sales taxes almost certainly will not be reported. Various approximation strategies are necessary. For example, tax and social insurance schedules can be applied to gross incomes/earnings. The distribution of the sales tax burden can be estimated by applying product specific tax rates to disaggregated data on the pattern of household expenditure.

Estimates of OOP payments from survey data are potentially subject to both recall bias and small sample bias due to the infrequency with which some health care payments are made. Survey estimates of aggregate payments tend to show substantial discrepancies from production-side estimates, where the latter are available. Whether estimates of the distribution, as opposed to the level, of OOP payments are biased depends upon whether reporting of OOP payments is related systematically to ATP. Under the assumption, possibly strong, of no systematic misreporting, survey data can be used to retrieve the distribution of payments and mis-measurement of the aggregate level can be dealt with through application of a macro-weight that gives the best indication of the relative contribution of OOP to total revenues.

Progressivity by source of finance

The most direct means of assessing progressivity of health payments is to examine their share of ATP as the latter varies. In Figure 1, we show, for Egypt, OOP payments for health care as a percentage of total household expenditure by quintile groups of equivalent household expenditure. On average, OOP payments claim around 2% of household expenditures and there is a tendency for this share to rise with total expenditure, indicating some progressivity.
A less direct means of assessing progressivity, defined as the departure from proportionality, is to compare shares of health payments contributed by sections of the population with their shares of ATP. If payments toward health care always account for the same proportion of ATP, then the share of health payments contributed by any group must correspond to its share of ATP. Under a progressive (regressive) system, the share of health payments contributed by the poor will be less (greater) than its share of ATP. This is the basis of the methods of measuring progressivity considered in this Note.

**Box 1: Progressivity of health care finance in Egypt, 1997**

Health care in Egypt is financed from a number of sources. As is common for developing countries, OOP payments contribute the greatest share, 52% in this case, of revenue. The next biggest contribution, one third, is from general government revenues. Social and private health insurance contribute 7% and 5.5% respectively and an earmarked health tax on cigarette sales makes up the remaining 3% of health revenues.

We assess the progressivity of this system of health finance using data from the 1997 Egypt Integrated Household Survey (EIHS). Where feasible, the incidence assumptions stated above are applied. Payment variables recorded in the survey are: (a) direct personal taxes (income, land, housing and property taxes), (b) out-of-pocket medical expenses and (c) private health insurance premiums. Payment variables estimated from other survey information were: (a) sales and cigarette taxes approximated by applying rates to the corresponding expenditures and (b) social health insurance contributions estimated by applying contribution rates to earnings/incomes of covered workers/pensioners. ATP is approximated by equivalent household expenditure; calculated as total household expenditure, plus direct tax and social insurance contributions, divided by the square root of household size.

In Table 1, for each of the health payments that can be allocated to households, we present the cumulative share that is accounted for by each decile of equivalent household expenditure. Under a proportional system, these shares would correspond to the cumulative shares of equivalent household expenditure (column 2). Comparing the columns, it is apparent that non-earmarked taxes are progressive, with direct taxes substantially more progressive than sales taxes. On the other hand, the earmarked taxes that, in part, finance the social health insurance scheme, are broadly regressive. Private insurance premiums are progressive up to the 6th decile and regressive thereafter. Most surprising is the slight progressivity of OOP payments.
Table 1: Cumulative shares of health payments by expenditure quintile, Egypt 1997

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Equivalent Household Expenditure</th>
<th>Non-earmarked taxes</th>
<th>Earmarked Taxes</th>
<th>Private insurance premiums</th>
<th>OOP payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>poorest 20%</td>
<td>7.86</td>
<td>2.32</td>
<td>4.98</td>
<td>10.70</td>
<td>6.36</td>
</tr>
<tr>
<td>2nd poorest</td>
<td>20.03</td>
<td>8.14</td>
<td>13.85</td>
<td>23.76</td>
<td>20.62</td>
</tr>
<tr>
<td>middle</td>
<td>36.49</td>
<td>17.12</td>
<td>27.06</td>
<td>39.10</td>
<td>40.89</td>
</tr>
<tr>
<td>2nd richest</td>
<td>58.3</td>
<td>35.5</td>
<td>46.24</td>
<td>56.10</td>
<td>64.36</td>
</tr>
<tr>
<td>richest 20%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Gini / CI</td>
<td>0.3314</td>
<td>0.5865</td>
<td>0.4777</td>
<td>0.3269</td>
<td>0.2843</td>
</tr>
<tr>
<td>Robust SE</td>
<td>0.0128</td>
<td>0.1244</td>
<td>0.0518</td>
<td>0.1426</td>
<td>0.0290</td>
</tr>
<tr>
<td>Kakwani</td>
<td>0.2524*</td>
<td>0.14361*</td>
<td>-0.0072</td>
<td>-0.0508</td>
<td>0.0015</td>
</tr>
<tr>
<td>Robust SE</td>
<td>0.1259</td>
<td>0.0427</td>
<td>0.1409</td>
<td>0.0269</td>
<td>0.0727</td>
</tr>
</tbody>
</table>

Notes: CI - concentration index, SE - standard error, * - significantly different from zero at 5%.

See below for interpretation of Concentration and Kakwani indices.

Computation

Group level aggregates, such as those given in Table 1, can be calculated in packages such as SPSS or Stata. Relevant SPSS code is provided in Technical Note 6. In Stata, use the xtile command to generate a variable quintile defining weighted (by wt) quintiles of the ATP variable (eqexp). Then use the collapse command to calculate the weighted quintile sums of both expenditure and the various health payments variables (eqtax ...). Absolute and cumulative percentages can be calculated using egen pc() and gen sum().

```stata
xtile quintile=eqexp [pw=wt], nq(5)
collapse (sum) eqexp eqtax ... [pw=wt], by(quintile)
egen exp_p=pc(eqexp)
gen exp_cp=sum(exp_p)
```

Alternatively, to get quintile specific (weighted) means and sums without collapsing the data,

```stata
tabstat eqexp [aw=wt], by(quintile) stats(co mean sum)
```

Health payments concentration curves

Following the same principles, progressivity can be assessed graphically through comparison of the concentration curve of health payments with the Lorenz curve of the ATP variable (see TN# 6). Both curves are plotted against the cumulative proportion of the sample ranked by ATP (p) on the x-axis. On the y-axis, one has the cumulative proportion of health payments for the concentration curve, \( H(p) \) and of ATP for the Lorenz, \( L(p) \). Under proportionality, the curves coincide. Under progressivity, \( L(p) \) lies outside \( H(p) \) and vice versa for regressivity.

In Figure 2 we illustrate the concentration curves for general taxes, earmarked taxes and OOP payments for Egypt, 1997. Slight regressivity of earmarked taxes is indicated by the fact that the respective concentration
curve lies just inside that of the Lorenz curve. By contrast, the OOP concentration curve lies outside the Lorenz curve, indicating progressivity and non-earmarked taxes are even more progressive.

**Figure 2: Lorenz and health payments concentration curves, Egypt 1997**

![Figure 2: Lorenz and health payments concentration curves, Egypt 1997](image)

**Computation**

Computational methods for graphing concentration curves are described in TN# 6. Figure 2 was generated in Excel, from co-ordinates generated in Stata using `glcurve7`. First, generate the co-ordinates of Lorenz and concentration curves:

```
  glcurve7 eqexp [aw=wt], glvar(Lorenz) pvar(rank) lorenz nograph
  label variable Lorenz "Lorenz curve"
  label variable rank "Cum. Prop. Hholds."

  glcurve7 eqoop [aw=wt], gl(oop_cc) sortvar(eqexp) lorenz nograph
  label variable oop_cc "OOP payments"
```

Repeat for other payment variables. Call these `gtax_cc` and `htax_cc`. To graph in Stata using these co-ordinates:

```
  #delimit ;
  graph Lorenz gtax_cc htax_cc oop_cc rank rank,
  sy(.....) c(l l l l l) xscale(0,1) yscale(0,1)
  ylabel(0 0.25 to 1) xlabel (0 0.25 to 1) 11(Cum. Prop. Exp. and Payments) ;
```

Alternatively, for greater editing control, copy the relevant variables from the Stata data editor into Excel and use Chart Wizard, Custom Types, Smooth Lines (TN#6).
Kakwani progressivity index

Graphs are useful for detecting departures from proportionality and identifying their location in the distribution of payments. But visual inspection of progressivity across sources of finance, time or countries becomes difficult when there are a number of comparisons to be made. In such cases, summary indices of progressivity are useful. Of these, the most widely used is the Kakwani index [4], which is directly related to the graphical method described above.

The Kakwani index is defined as twice the area between a payments’ concentration curve and the Lorenz curve and is calculated as, \( \pi_x = C - G \), where \( C \) is the health payments’ concentration index and \( G \) is the Gini coefficient of the ATP variable. The value of \( \pi_x \) ranges from \(-2\) to \(1\). A negative number indicates regressivity; \( L_H(p) \) lies inside \( L(p) \). A positive number indicates progressivity; \( L_H(p) \) lies outside \( L(p) \). In the case of proportionality, the concentration lies on top of the Lorenz curve and the index is zero.

The simplest method of computing concentration and Gini indices is to make use of their direct relation to the covariance between the variable whose distribution is being described and households’ fractional ranks in the ATP distribution [5, 6]. Implementation of this method by means of convenient regression is explained in Technical Note 7. Since a Kakwani index is the difference between a CI and a Gini, its value can be computed directly from one convenient regression of the form:

\[
2\sigma_i^2 \left[ \frac{h_i - \eta}{\mu} \right] = \alpha + \beta R_i + u_i
\]

where \( h_i \) is a health payment variable for household \( i \) and \( \eta \) its mean, \( y_i \) is the ATP variable and \( \mu \) its mean, \( R_i \) is the household fractional rank in the ATP distribution and \( \sigma_i^2 \) is the sample variance of the fractional rank.

The OLS estimate of \( \beta \) is the Kakwani index. Where weighting is appropriate, the weights need to be applied in the calculation of all means, ranks and variances and then applied again in computation of the regression.

Concentration and Kakwani indices by source of health finance in Egypt are given in Table 1. (Robust) standard errors are obtained directly from the convenient regressions. The indices confirm the progressivity of direct personal and sales taxes in Egypt. The index for cigarette tax is negative but not significantly different from zero indicating that the null of proportionality cannot be rejected. Social insurance is significantly regressive but in a statistical sense rather than in terms of magnitude. The Kakwani indices for private insurance and OOP are marginally positive but proportionality is not rejected in either case.

Computation

\textbf{Stata} and \textbf{SPSS} code for the calculation of Gini and concentration indices is given in Technical Note 7. To calculate a Kakwani index directly by means of convenient regression, proceed (in Stata) as follows. Compute the (weighted) fractional rank using \texttt{gcurve7} (see above), calculate its (weighted) mean and variance as follows (we assume the weights have been scaled to sum to 1):

\begin{verbatim}
egen m_rank=sum(rank*wt)
egen v_rank=sum(wt*(rank-m_rank)^2)
\end{verbatim}

Calculate the weighted means of the ATP and payment (e.g. OOP) variables:

\begin{verbatim}
egen m_eqexp=sum(eqexp*wt)
egen m_oop=sum(eqoop*wt)
\end{verbatim}
Now, create a variable corresponding to the left-hand-side of (1) and regress this on the fractional rank:

\[
\text{gen d_oop} = (2v_{\text{rank}})((\text{eqoop/m_oop}) - (\text{eqexp/m_eqexp})) \\
\text{regr d_oop rank [pw=wt]}
\]

Standards errors can be further adjusted (as in the example) for stratified and/or clustered sampling using Stata’s sample estimator `svyreg`. Alternatively, the standard errors can be adjusted for serial correlation by the `newey` command (see TN# 7).

**Progressivity of total health payments**

The Kakwani index of overall progressivity can be calculated as a weighted average of the indices for the payment components, where weights are equal to the proportion of total payments accounts for by each source. Thus, overall progressivity is dependent both on the progressivity of the different sources of finance and on the proportion of revenue collected from each of these sources.

Ideally, the macro-weights should come from National Health Accounts (NHA). It is unlikely, however, that all sources of finance that are identified at the aggregate level can be allocated down to the household level from the survey data. Assumptions must be made about the distribution of sources of finance that cannot be estimated. Their distributional burden may be assumed to resemble that of some other payment source. For example, corporate taxes as assumed to be distributed as income taxes. In this case, we say that the missing payment distribution has been *allocated*. Alternatively, we may simply assume that the missing payment is distributed as the weighted average of all the revenues that have been identified. We refer to this as *ventilation*. Best practice is to make such assumptions explicit and to conduct extensive sensitivity analysis.

**Box 2: Derivation of Macro-Weights and Kakwani Index for Total Health Finance, Egypt 1997**

The NHA shares of total health revenues in Egypt (1994-95) from various finance sources are given in Table 2. The table also shows which of the various finance sources can be allocated, either directly or through estimation, from the survey data. In this example, as in most others, the main difficulty concerns the allocation of the 33% of all health care finance that flows from general government revenues. Only direct personal and sales taxes, which account for only one sixth of government revenues, can be allocated down to households. Nonetheless, it is possible to allocate to households revenues that account for 72% of all health care finance.

We consider three sets of assumptions about the distribution of unallocated revenues. In case 1, it is assumed that unallocated general government revenues are distributed as the weighted average of those taxes that can be allocated. Essentially, this involves inflating the weight given to the taxes that can be allocated. For example, the weight on domestic sales taxes is inflated from its actual value of 0.0472 of all health finance to a value of 0.2829 (=4.72/5.5*0.3298) to reflect the distribution of unallocated revenues. In case 2, we assume that “other income, profits and capital gains taxes” are distributed as direct personal taxes and import duties are distributed as sales taxes. It is assumed the remainder of the unallocated revenues is distributed as the weighted average of the allocated taxes. Finally, in case 3, we assume that unallocated revenues are distributed as the weighted average of all allocated payments (and not just allocated taxes). Another interpretation of this case is that the Kakwani index is informative of the overall progressivity of only those health payments that can be allocated to households.

The relative emphasis given to such alternative scenarios should depend upon evidence as to the relative validity of the underlying assumptions. For the example, the various assumptions about the distributions of the unallocated revenues makes little difference to the conclusion about the progressivity of the health finance system in general. In every case, the Kakwani for total payments is only very slightly positive, indicating near proportionality.
Table 2: Health finance by source and Kakwani for total payments, Egypt

<table>
<thead>
<tr>
<th>Finance source</th>
<th>Share of total finance</th>
<th>Method of Allocation</th>
<th>Kakwani by source Case 1</th>
<th>Macro Weights Case 2</th>
<th>Macro Weights Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>General government revenues</td>
<td>32.98%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Income, capital gains &amp; property</td>
<td>0.78 reported</td>
<td></td>
<td>0.2524</td>
<td>0.0469</td>
<td>0.0552</td>
</tr>
<tr>
<td>b. Corporate</td>
<td>4.83 ventilated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Other income, profit &amp; capital gains</td>
<td>0.62 ventilated</td>
<td></td>
<td>0.1436</td>
<td>0.2829</td>
<td>0.2825</td>
</tr>
<tr>
<td>d. Domestic sales of goods &amp; services</td>
<td>4.72 allocated /</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Import duties</td>
<td>3.64 ventilated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Other</td>
<td>3.22 ventilated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-tax revenue</td>
<td>15.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earmarked cigarette tax</td>
<td>3.00 estimated</td>
<td></td>
<td>-0.0072</td>
<td>0.0300</td>
<td>0.0300</td>
</tr>
<tr>
<td>Social insurance</td>
<td>6.67 estimated</td>
<td></td>
<td>-0.0508</td>
<td>0.0667</td>
<td>0.0667</td>
</tr>
<tr>
<td>Private insurance</td>
<td>5.57 reported</td>
<td></td>
<td>0.0015</td>
<td>0.0557</td>
<td>0.0557</td>
</tr>
<tr>
<td>Out-of-pocket payments</td>
<td>51.77 reported</td>
<td></td>
<td>0.0656</td>
<td>0.5177</td>
<td>0.5177</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
<td></td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>% revenues allocated</td>
<td>72.51%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Derivation of macro weights:
Case 1 - Unallocated revenues distributed as the weighted average of allocated taxes.
Case 2 - Taxes c. distributed as taxes a.. Taxes e. distributed as d. Remainder of unallocated revenues distributed as weighted average of allocated taxes.
Case 3 - Unallocated revenues distributed as weighted average of all allocated payments.

Sources: [7, 8]

Useful links and references
The (tax) literature on the measurement of progressivity is reviewed in [1]. For health finance applications see [3, 9-10]. In calculating the Kakwani index, one implicitly imposes a value judgement about the relative importance of departures from proportionality along the distribution. In a generalised Kakwani index, this judgment is made explicit through the choice of a parameter [1]. Another alternative to the simple Kakwani is the Suits index, which gives greater weight to departures from proportionality that occurs among households higher up the ATP distribution [11]. For statistical inference on progressivity, see [12, 13]. DAD is a specialized program for distributional analysis that computes concentration curves and indices (plus much more), handles complex sample design and can be used for inference. It can be downloaded (free) at http://www.mimap.ecn.ulaval.ca

Bibliography