Version 7

Draft- Not To Be Quoted

Technical Consultation on Fairness on Financial Contribution to Health Systems

Background Paper

4–5 October 2001
Geneva, Switzerland

World Health Organization

Evidence and Information for Policy
World Health Organization
1211 Geneva 27
Switzerland

Contents

1. A Review of the Fairness in Financial Contribution Construct Presented in WHR 2000

The World Health Organization developed a framework for assessment of health system performance which was utilized as an analytical tool and published in the 'World Health Report 2000' (Murray Christopher J.L. & Frenk J. 2000;The World Health Organization 2000). The framework identified three intrinsic social goals to which the health system contributes: population health (level and distribution), responsiveness (level and distribution), and financial contribution (distribution). While it is well recognized that health financing contributions can play an important instrumental role in modulating the effect of the health system on population health, WHO argued that a more fair distribution of health system contributions was intrinsically valuable.

In the following paragraphs, the logic presented in the WHR2000 and associated documents (Murray Christopher J.L. et al. 2000)is briefly reviewed to lay the basis for more recent developments presented in later sections. The argument to examine the fairness of a distribution of health financing contributions began with the premise that societies do not purchase health systems in order to redistribute income. Societies may have a very important social goal to redistribute income through government tax policy but this can be achieved through many mechanisms unrelated to the overall financing of the health system. A parsimonious list of goals for the health system to achieve is not likely to include income redistribution as one of the main goals. Rather, given income redistribution efforts in society, there are still ways to finance the health system that are more fair than others. Therefore, our concern begins with the question: given a health system that costs x% of GDP, how should households contribute to the total cost of the health system?

To explore notions of fairness in financial contribution, WHO argued that almost everyone would agree that catastrophic payments are undesirable and unfair. Imagine two systems, one in which health, health inequality, responsiveness and responsiveness inequality are identical but in one system two percent of households make catastrophic payments and in the other zero percent. Most would prefer the zero percent. Unequal payments by equivalent households are also unfair. The concern that should be given equal consideration is a powerful influence on the formulation of social systems. For example, widely different shares of income going to pay for health insurance in different German sickness funds was broadly seen as unfair, leading to the risk equalization reforms of the 1990s (Wagstaff A. & Van Doorslaer E. 1998)Finally, many think that fairness should include some notion that the rich contribute more for the health system than the poor on a per capita basis. This concern can be distinct from a general consideration of income redistribution. This special concern for how the health system is financed may stem from the special nature of health itself as an ingredient to opportunity and the pursuit of the good life.

All three of these concerns, avoiding catastrophic payments, equal payment by equivalent households and some element of progressivity, can be captured by examining a household's health financing contribution. Given the efforts the society made to redistribute income fairness of financial contribution to health was defined as: a health system is fairly financed if the ratio of total contribution to health from

each household through all payment mechanisms (*HE*)to that household's capacity to pay (*CTP*) which is the effective non-subsistence income identical for all households, independent of the household's health status or use of the health system. The household financial contribution (*HFC*) to health system can be written as:

$$HFC_i = \frac{HE_i}{ENSY_i}$$

Household health contribution includes all payments households made directly or indirectly to the health system, including general tax revenue used on health through government budgets, social health insurance contributions (both employee's contribution and employer's contribution on behalf of employees), private health insurance premiums, and out of pocket payment.

The household's capacity to pay for health services is defined as the effective income net subsistence expenditure. The effective income is the income that a household is able to consume and would seek to consume accordingly given its current income, assets and access to future earnings. The subsistence expenditure captures people's minimum needs to maintain life. In WHR 2000, the total consumption expenditure was used as a proxy for effective income and the actual food expenditure was used as subsistence expenditure.

To summarize the distribution of household financial contribution (*HFC*) across households, an individual-mean difference family of inequality index was selected based on the normative choice that people are more concerned about the difference between their own contribution and the average level. The distribution was summarized as the index of Fairness Financial Contribution (*FFC*):

$$FFC = 1 - 4\left(\frac{\sum_{i=1}^{n}\left|HFC_i - \overline{HFC}\right|^3}{0.125n}\right)$$

The *FFC* index was designed as an absolute measure that is independent of the mean *HFC* in the sense that if *HFC* for each household increases 0.05, the *FFC* index remains the same because the mean *HFC* will increase by the same amount. Since the *HFC* distribution is skewed to the right, by cubing the difference we put more weight on the right tail of the distribution which includes households facing catastrophic expenditure on health. The instant 0.125 is the maximum of the average cubed absolute difference of all distributions. An arbitrary number 4 was used for the purpose of comparison with other attainments indexes: health and responsiveness.

By separating the financial contribution from the health need and utilization, it is possible that two health systems may have the same score by the *FFC* measure, while still having considerable differences in affordability of health services. We believe that in a system where a significant percentage of the population can not afford health services, the population will have a poorer showing in health measures, especially the distribution of health. So poor access will be reflected in poorer health outcomes and

in lower overall attainment. The *FFC* index was designed intentionally to be independent of the health need and utilization to avoid double counting.

2. Development of FFC concept , methodology and data collection since the publication of WHR 2000

Publication of the health system performance assessment in WHR 2000, of which the *FFC* measure is a part, has generated considerable debate. Policy makers, international organizations and academia have shown great interest in this topic (Williams A. 2001), (Wagstaff A. 2001), (Almeida C., Braveman P., & Gold MR. 2001;Shaw R.Paul 2001),(Ministry of Health Vietnam 2001),(Klavus J. 2000),(Hasegawa T. 2001) , (Goss J. 2001),(Ravi P.Roman-Eliva 2001). The debate about the fairness of financial contribution measure has mainly focused on 4 issues.

First, household survey data were only available for 23 member states. This issue was reviewed in papers by Williams and Wagstaff and also been discussed in regional consultations.

Second, the actual food expenditure used in the calculation might not be a good proxy of household subsistence expenditure (Almeida C., Braveman P., & Gold MR. 2001).(Wagstaff A. & Van Doorslaer E. 2001)

Third, the distribution of *HFC* across households could become more unequal if health financing contributions were highly progressive. (Shaw R.Paul 2001;Wagstaff A. 2001)). In other words, the assessment of fairness in financial contribution could in principle 'penalize' a country for being 'too progressive".

Fourth, (Navarro V. 2000;Navarro V. 2001) argued that the assessment of fairness in financial contribution did not take into account when poor households where unable to access treatment because they could not afford it.

WHO has welcomed these comments and criticisms. Since the publication of the World Health Report 2000 considerable empirical and methodological investigation has been undertaken which can contribute to debates on the development of measures of fairness in financial contribution and financial risk protection. These developments are briefly outlined in the following sections.

2.1. Data collection

WHO is working with member states to identify income and expenditure surveys that can be used to evaluate the distribution of household health system financial contributions and important covariates of the household. Recent surveys are now available from 74 countries and for some countries there are time series data, providing a total of 98 data points (Table 1, for details see Appendix Table 1).

Table 1 Data Collection

WHO region	With data	Total member states
AFRO	10	46
AMRO	15	35
EMRO	5	22
EURO	32	51
SEARO	7	10
WPIO	5	27

Most countries undertake periodic household income and expenditure surveys as a critical input to the development of macro-economic indicators such as national accounts. This means that in principle relevant micro-data exist for nearly every country.

2.2. Alternative rationales for the Construction & definition of fairness in financial contribution

Recently, alternative rationales for assessing fairness in financial contribution have been proposed. One such alternative is outlined here. The fairness of financial contribution to a health system starts with the question: taking society's efforts to redistribute income as a given, what is a fair contribution to the health system? The construct begins with a question: given a health system that costs x% of GDP, how should households contribute to the total cost of the health system? As a normative claim, one could argue that all households should share an equal burden in financing the health system. This type of equal burden argument is equivalent to saying that disutility created by contributing to the health system should be equalized across households.

This can be formalized as :

$$(1)\ \Delta U_1 = \Delta U_2 = ... = \Delta U_n$$

Where ΔU_1 is the utility reduction after health system financing contribution for household number 1. If we adopt a common form of the utility function used in the poverty literature (Mas- colell A., WhinstonM.D., & GreenJ.R. 1995) then:

$$(2)\ U_1 = Ln(C_1 - S_1)$$
$$(3)\ U_1^{'} = Ln(C_1 - S_1 - HE_1)$$

In equation (2) and (3), C_i is household consumption, S_i is consumption required for subsistence and HE_i is the total household health system contribution. So the reduced utility for a household (ΔU_i) can be written as:

$$(4)\ \Delta U_i = U_i - U_i^{'} = Ln(C_i - S_i) - Ln(C_i - S_i - HE_i)$$

Household consumption net of subsistence requirements is (in the setting of stable income and access to capital markets) household capacity to pay (CTP_i), and total household health contribution (HE_i) is household capacity to pay multiplied by HFC_i. So equation (4) becomes:

$$(5)\ \Delta U_i = Ln(CTP_i) - Ln(CTP_i - CTP_i HFC_i) = Ln\frac{CTP_i}{CTP_i(1-HFC_i)} = Ln\frac{1}{1-HFC_i}$$

Then equation (1) becomes

$$(6)\ Ln\left[\frac{1}{1-HFC_i}\right] = Ln\left[\frac{1}{1-HFC_j}\right] = ... = Ln\left[\frac{1}{1-HFC_n}\right]$$

From equation (6), we get

$$HFC_i = HFC_j = ... = HFC_n = \alpha$$

where α is the total health expenditure's share over the total capacity to pay. It can be written as

$$\alpha = \frac{\sum HE_i}{\sum CTP_i}$$

In other words, we can also justify equalizing *HFC* across households as the basis for assessing the fairness of financial contribution from the premise that the distutility due from financing the health system should be equalized across households.

This equal burden approach to raising funds can be assessed for the general class of utility functions $U(C_i\text{-}S_i)$ i.e. consumption (*C*) minus subsistence (*S*). This type of justification for looking at the distribution of the health financing contribution may also have implications for appropriate summary measures of the distribution of *HFC*. Other approaches such as the distribution of household health system contributions that minimize aggregate disutility might also be worth evaluating.

2.3. Defining household financial contribution (HFC)

Household financial contribution was defined at the household level over a one-year period. It is a ratio of total household payment for health through general tax, social health insurance contribution, private health insurance premium and out of pocket payment, to the household's capacity to pay.

$$HFC_i = \frac{HE_i}{CTP_i}$$

2.3.1. The numerator of HFC

The numerator of HFC includes all health expenditure paid directly or indirectly by a household. Theoretically, government spending on health should only include the portion that comes from general tax. It shouldn't include the international and domestic donations and government revenue from investment and state-owned enterprises which are not paid by households. Social health insurance includes the contributions from both employer and employee. Similarly, the private health insurance premium should also include both employer's and employee's payment. The out of pocket payment is what the household paid by cash or by in-kind payment to the provider at the point when they obtained the services. It should be net of the reimbursement from health insurance program.

To be consistent with National Health Accounts (NHA), we used the same definition of health spending through government general tax, social security contribution, private health insurance and out of pocket payment. Also for the same purpose, two scalars are applied to government health spending and social health insurance contribution to health in order to adjust the survey number to the national NHA figures (World Health Organization 2001). Meanwhile the private health insurance premium and out of pocket payment from the survey provide a reference for NHA estimations.

2.3.2. The denominator of HFC

The denominator in the *HFC* formula captures the household financial capacity to pay for health service. It is defined as non-effective income net subsistence expenditure. In the methodology, the household consumption expenditure is used as the proxy for effective income. The choice of consumption expenditure instead of income is based on two considerations. First, the variance of current expenditure is smaller than the variance of current income over time. So the income data reflects random shocks while expenditure data is a better reflection of effective income. Because *HFC* is defined for a year, we need to eliminate the effect of random shocks on income to the greatest extent possible. Second, in most of the household surveys, the expenditure data are more reliable than income data. This is particularly true in developing countries where the informal sector is typically quite large and survey respondents don't wish to reveal their income for many reasons.

We believe the household's capacity to pay for health services shouldn't be the total effective income because households had to first meet their minimum needs for living and only then health services. In WHR 2000, we relied on actual food expenditure for each household as the proxy for household subsistence expenditure.

However, food expenditure may not capture actual subsistence expenditure for the household, even though we tried to specify the items for basic food. The rich family may spend a greater absolute amount on food than the poor family although the food expenditure share of total household consumption expenditure still follows Engel's law. Responding to feedback from the criticism we have been exploring a better proxy for subsistence expenditure.

To eliminate spending for luxurious food and to improve international comparability, the international absolute poverty line (food poverty line) is being used as subsistence expenditure. This poverty line was set at one international dollar a day per person in 1985 currency term. This was adjusted to nominal units for the year of household survey. Considering the food consumption patterns and commodity price, food purchasing power parities (food PPP) rather than overall PPP, are used to convert the resulting estimate in international dollars into local currency units in order to be comparable with the data collected by the surveys. Finally the household size was used to bring the number from individual level to household level[1].

The introduction of the food poverty line eliminates spending for luxurious food and improves the international comparison. Since the food poverty line stays the same as income increases, more progressivity is built into the distribution of *HFC* compared with calculating the distribution of *HFC* using the actual food expenditure. Figure 1 shows the percentages of actual food expenditure and food poverty line as total household consumption expenditure across expenditure deciles. The food poverty line shares of total expenditure declines more rapidly with increases in expenditure (income) than does actual food expenditure. This indicates that the capacity to pay for rich households will be underestimated by using actual food expenditure.

However, in the household survey data, it is possible that a very small portion of households report actual food expenditure lower than the subsistence expenditure (food poverty line), which creates a negative denominator of *HFC*. In household

[1] **The estimation of food purchasing power parities for all member states.**

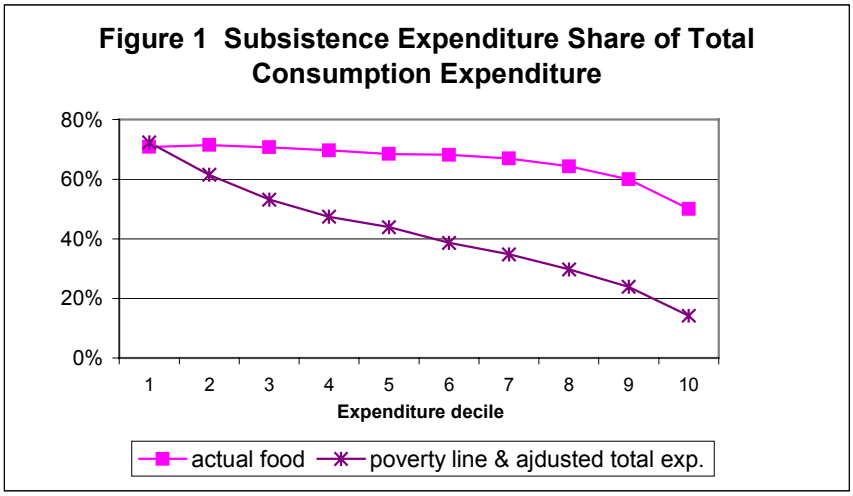
The food PPP data come from International Price Comparison study made by OECD, UN and World Bank. The OECD data is available for the years 1985, 1990 and 1993. The UN data is for the year 1985. The World Bank data is available for the years 1993 and 1998. Totally there are 144 country-years available.

Not all countries have this information or information for the specific survey years. Multiple regression technique is then applied to estimate the food PPP for which this data is lacking. In order to eliminate the influence coming from unstable exchange rates, the food price level, rather than food PPP, is being used as the dependent variable in the regression. The food price level is defined as food PPP divided by the exchange rate.

On the right hand side of the regression equation, the following variables are considered as candidates: GDP Price level, Food Export per Capita, Food Export share Merchandise Export, Food Import per Capita, Food Import share Merchandise Import, Merchandise export per capita, Merchandise import per capita, UN Post Adjustment Multipliers, Agricultural share GDP, Total Consumption per Capita, Private Consumption per Capita, Total Consumption share GDP, Private Consumption share GDP, Dummy variables on WHO region, and interaction terms.

The first round regression equation includes GDP price level, food export per capita, private consumption share of GDP, merchandise export per capita, merchandise import per capita, and the WHO region dummies. The adjusted R square is 0.8.

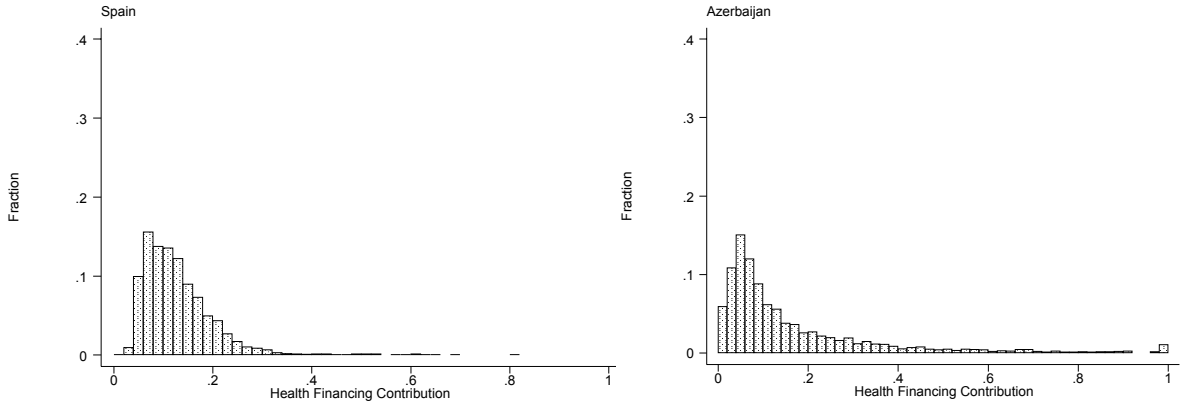
survey data, there are many potential errors. Households may under-report their food expenditure for several reasons including consumption of foodstuffs grown by the household. Examination of household survey data suggests that many households reporting expenditure below the food poverty line may be outliers. To avoid sensitivity to these types of errors, we assume that actual food expenditure may be under-reported by these households because they are facing lower food prices or have underestimated the monetary value of self-production. This hypothesis is particularly true for poor households. Based on this premise, we solve the problem of a negative denominator for households with actual food expenditure below the food poverty line by maintaining the poverty line as subsistence expenditure, and change the total expenditure to reported non-food expenditure plus the food poverty line.



2.4. Summarizing the HFC distribution

How should the distribution of *HFC* across households be summarized to allow for simple comparisons across countries or over time? Figure 2 illustrates the distributions of *HFC* for Spain and Azerbaijan. The *HFC* distribution for Spain is less unequal. In Azerbaijan, there are more households facing catastrophic health expenditure than in Spain

Figure 2 Distribution of Household Financial Contribution (HFC)



We can also present the *HFC* distributions among expenditure deciles using box-and-whisker plots (figure 3, 4, 5). The line in the middle of the box represents the median of the *HFC*. The box extends from the lower 25th percentile to the upper 25th percentile. The upper adjacent value is equal to $HFC_{[75]} + 1.5(HFC_{[75]} - HFC_{[25]})$, and the lower one is $HFC_{[25]} - 1.5(HFC_{[75]} - HFC_{[25]})$. Vertical equity can be seen by comparing the mean or median *HFC* contribution across deciles while horizontal inequity can be seen by the within decile variation in *HFC*. The following three graphs show different illustrations of the *HFC* distribution across expenditure (income) groups.

Figure 3 Distribution of HFC by Decile: Romania

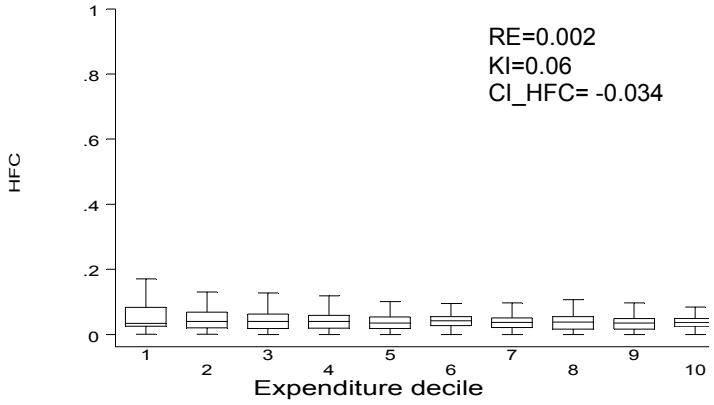


Figure 4 Distribution of HFC by Decile: Burundi

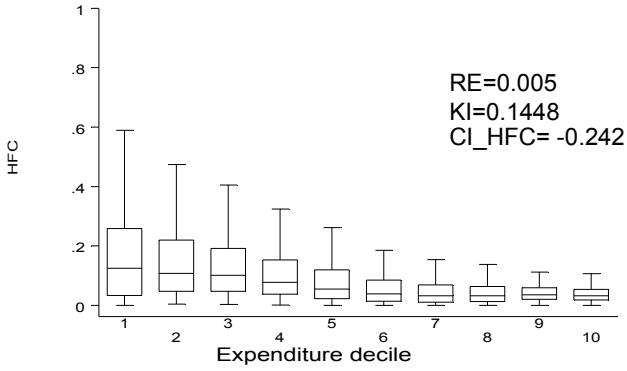


Figure 5 Distribution of HFC by Decile: Latvia

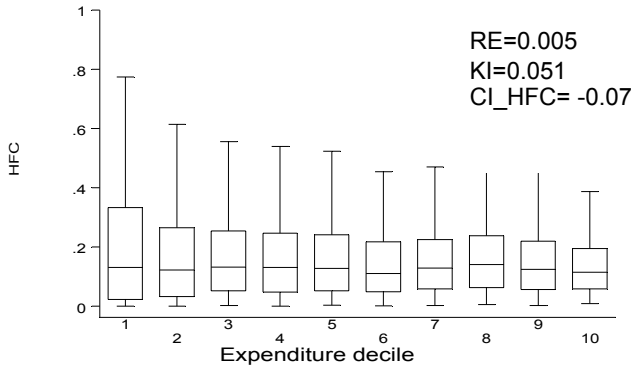


Figure 3 shows that the *HFC* across expenditure groups is quite similar. Furthermore, within each group there is a relatively little variation. In Romania, there appears to be little vertical or horizontal inequality in the space of *HFC*. For Burundi, the graph shows that the lower expenditure group pays larger proportion of capacity to pay than the richer group. Within each decile, there is considerable variation. In Latvia (Figure 5), there is little difference in mean *HFC* between deciles but there are huge variations in household contributions within declines.

To summarize the *HFC* distribution among populations, a variety of measures could be used. For each household survey analyzed, we have calculated a range of measures.

$$FFC = 1 - \sqrt[3]{\frac{\left|HFC_i - \overline{HFC_i}\right|^3}{n}}$$

$$FFC_0 = 1 - 4\left(\frac{\sum_{i=1}^{n}\left|HFC_i - \overline{HFC}\right|^3}{0.125n}\right)$$

We also explored other indexes from simply standard deviation to Theil index (*T*), Atkinson index (*A*) with different choice of epsilons (*e*=0.20, 0.25, 0.30,0.35), Mean logarithmic deviation (*MLD*), and percentage of household with catastrophic health expenditure, in order to measure the potential impoverishment.

The standard deviation is the most commonly used measure in statistics of dispersion within distributions. As a summary measure of the distribution of *HFC*, it would be:

$$std = \sqrt{\frac{\sum (HFC_i - \overline{HFC})^2}{n}}$$

$$T = \frac{1}{n}\sum\left[\left(\frac{x_i}{\overline{x}}\right)\ln\left(\frac{x_i}{\overline{x}}\right)\right]$$

The Theil index and *MLD* belong to the generalized entropy family of inequality measures which derive from the notion of entropy in information theory.

$$MLD = \frac{1}{n}\sum \ln\left(\frac{\overline{x}}{x_i}\right)$$

The Atkinson index is derived by making additional assumptions about the function form of the social welfare function, welfare weights and hence relationships between

$$A = 1 - \left[\frac{1}{n}\sum\left(\frac{x_i}{\overline{x}}\right)^{1-e}\right]^{\frac{1}{1-e}}$$

transfers and changes in inequality. The distinguishing feature of the Atkinson index is its ability to gauge movements in different segments of the distribution. The

parameter epsilon (*e*) in the formula, bound by the limits of 0 and 1, determines the level of inequality aversion.

Since all the indices are originally used to measure inequality of income, they are negative indices which means the smaller the less inequality. In order to keep the consistence with the definition of each index, we set $x_i = 1 - HFC_i$ in the formula.

It is important to note that the percent of households facing catastrophic payment, defined as greater than 40% of their capacity to pay, is not a true summary measure of the distribution of *HFC*. Rather it is more akin to a poverty line measure as it records the fraction of the distribution above a certain threshold.

Given the equal disutility argument developed earlier, one could argue that the distribution of *HFC* should not be compared to the mean *HFC* across households but rather the equal disutility *HFC* which is defined to be:

$$HFC_o = \frac{\sum HE_i}{\sum CTP_i}$$

Many of the summary measures just described can be modified by replacing the mean *HFC* with the HFC_0. For all these possibilities, we have calculated the Spearman rank correlation coefficient. The rank order correlation coefficient is extremely high across all the summary measures (table 2).

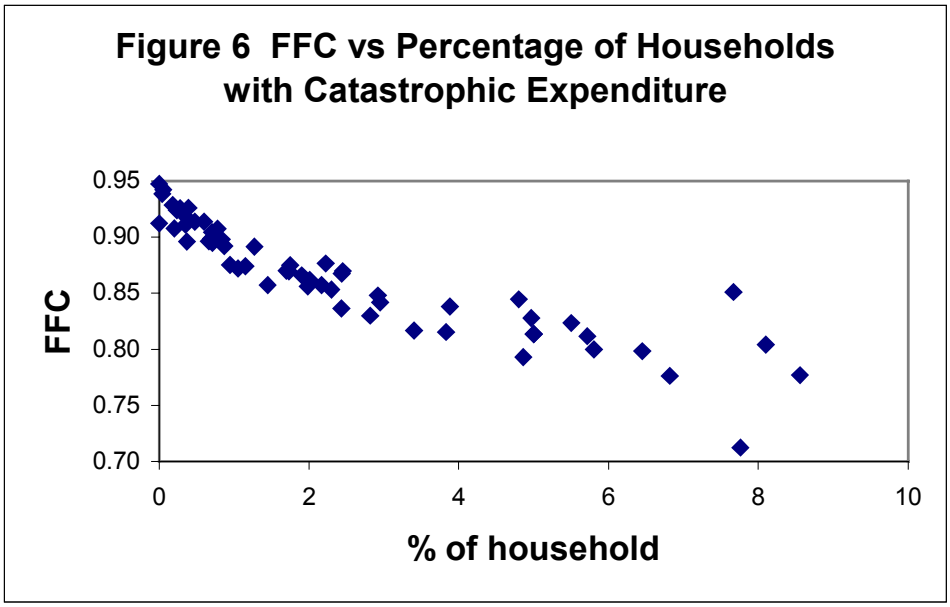
Table 2 The Rank Correlation Coefficient of Different Inequality Measures

	Based on mean HFC									Based on sum mean HFC		
	FFC(m)	**FFCo(m)**	**Std(m)**	**MLD(m)**	**Theil(m)**	**A1(m)**	**A2(m)**	**A3(m)**	**A4(m)**	**FFC(s)**	**FFCo(s)**	**Std(s)**
FFC(m)	1											
FFCo(m)	1	1										
Std(m)	0.9662	0.9662	1									
MLD(m)	0.9537	0.9537	0.975	1								
Theil(m)	0.9604	0.9604	0.9975	0.9732	1							
A_1(m)	0.9653	0.9653	0.9977	0.9748	0.9992	1						
A_2(m)	0.9680	0.968	0.9977	0.9753	0.9987	0.9998	1					
A_3(m)	0.9698	0.9698	0.9978	0.9753	0.9983	0.9994	0.9998	1				
A_4(m)	0.9702	0.9702	0.9976	0.9753	0.9981	0.9992	0.9996	0.9999	1			
FFC(s)	0.9795	0.9795	0.9628	0.9552	0.9581	0.9628	0.9652	0.9657	0.9659	1		
FFCo(s)	0.9795	0.9795	0.9628	0.9552	0.9581	0.9628	0.9652	0.9657	0.9659	1	1	
Std(s)	0.9153	0.9153	0.9688	0.9492	0.9679	0.9666	0.9655	0.9649	0.9639	0.951	0.951	1
Catastrophic	0.9602	0.9602	0.9557	0.949	0.9554	0.9585	0.9599	0.9596	0.9602	0.957	0.957	0.9176

A_1 Atkinson index (e=0.20)
A_2 Atkinson index (e=0.25)
A_3 Atkinson index (e=0.30)
A_4 Atkinson index (e=0.35)

If a single summary measure is to be primarily used in making comparisons then several criteria are worth considering. First, the summary measure should be designed to have a meaningful and interpretable scale. Second, the measure should have interval scaling properties if it is to be used in certain types of quantitative analysis. Third, the summary measure should be chosen to give the normatively appropriate weight to different parts of the distribution. In other words, if society is very concerned about catastrophic expenditure, the measure should be designed to emphasis catastrophic expenditure (figure 6).

Figure 6 FFC vs Percentage of Households with Catastrophic Expenditure



2.5. Decomposition of the FFC index

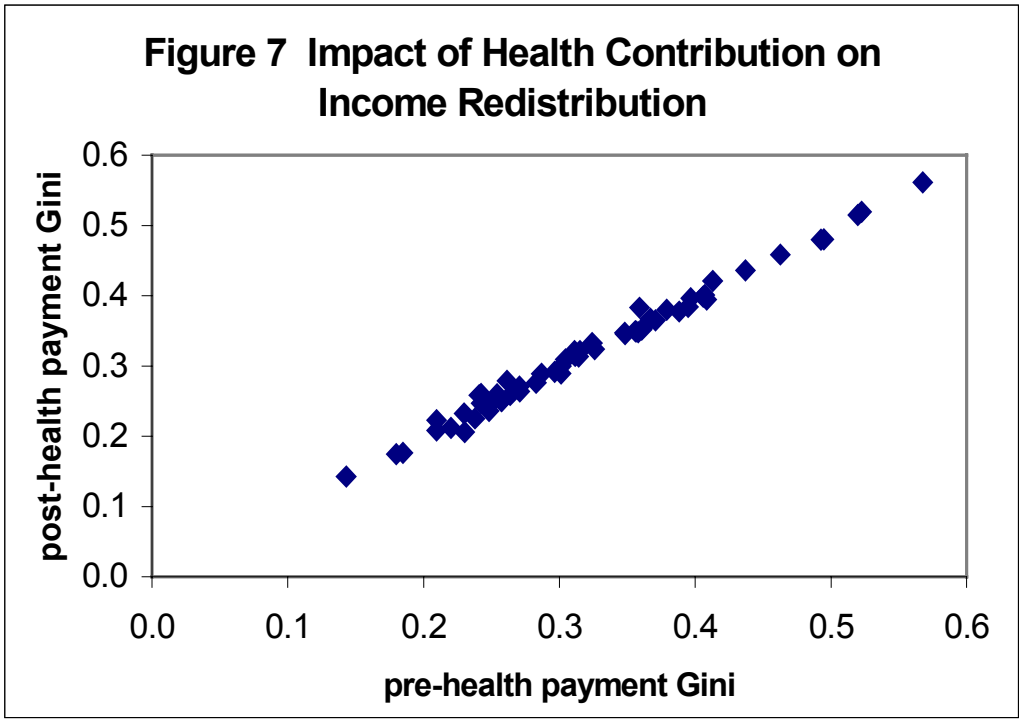
2.5.1. Impact of health system contribution on income redistribution

The most extensively debated issue concerning the fairness in financial contribution is the relationship between the distribution of *HFC* and the progressivity of payment (Wagstaff A. 2001).(Shaw R.Paul 2001) Most of this criticism has been founded on the notion that a central purpose of health system contributions is to redistribute income. Three factors in this regard are worth considering.

First, the impact of health system financing on income redistribution is not large. The total redistributive effect of health systems can be captured as the difference between Gini coefficients of income (or expenditure) before and after contributions to the health system. Figure 7 illustrates the relatively small impact of health system contributions on income distribution.

Second, it can be argued that consideration of the redistributive effect of the health system in isolation of the redistributive effect of the totality of public finance is irrelevant. A society may have an explicit objective of redistributing income that is carried out through the totality of the instruments of public finance. Why would the redistributive effect of a sub-component be interesting?

Third, the WHO construct for the assessment of the fairness in financial contribution takes as its starting point the efforts a society has undertaken to redistribute income. In other words, the question is whether there are further issues of fairness such as the avoidance of catastrophic payment above and beyond an overall social goal of income redistribution. We believe the answer is yes.



2.5.2. Separation of vertical effect from the FFC index

Taking the societies' efforts to redistribute income as a given, there are still some important issues for fairness in financial contributions to health system: catastrophic expenditure (extreme horizontal inequality), moderate horizontal inequality and vertical inequality. Any of the three conditions could make the distribution of *HFC* unequal. To further explore the impact of these factors on the distribution of *HFC*, in this section we explore methods to decompose the distribution of *HFC* and the *FFC* summary measure into the contribution of vertical, moderate horizontal and extreme horizontal inequality.

The first step to decompose the *FFC* index is to estimate a counter-factual distribution of *HFC* where differences in *HFC* that are a function of total expenditure are removed. The horizontal effect is the residuals (ε_i in the following equation) between the share a household should pay (HFC_i hat) and the share of its actual payment (HFC_i). The HFC_i can be written as:

$$HFC_i = f(\exp_i) + \varepsilon_i$$

$$\varepsilon_i = HFC_i - f(\exp_i)$$

We define $HFCa_i$ as the contribution of household i after dropping the vertical effect, which can be written as:

$$HFCa_i = \overline{HFC} + \varepsilon_i$$

where *HFC* bar is mean *HFC* of all households.

To estimate ε for each household, we applied piecewise linear functions, a function composed of linear segments. Piecewise linear functions can be used to approximate true non-linear relationships in data with the advantage that the shape is data driven and it will not be an artifact of functional-form assumptions. The function we are going to estimate is:

$$(1) \quad HFC = \begin{cases} \alpha^0 + \beta^0 \exp & \text{if } \exp < t_1 \\ \alpha^1 + \beta^1 \exp & \text{if } t_1 \le \exp < t_2 \\ \alpha^2 + \beta^2 \exp & \text{if } t_2 \le \exp < t_3 \\ \alpha^3 + \beta^3 \exp & \text{if } t_3 \le \exp \end{cases}$$

In this case, we set the four knots from t_1 to t_4 at the four quartiles of the household per capita expenditure. Let

$d_1=1$ if $\exp \ge t_1$
$d_2=1$ if $\exp \ge t_2$
$d_3=1$ if $\exp \ge t_3$

To combine all three equations, equation (1) can be simply written as

(2) $HFC = \beta_1 + \beta_2 \exp + \gamma_1 d_1 + \delta_1 d_1 \exp + \gamma_2 d_2 + \delta_2 d_2 \exp + \gamma_3 d_3 + \delta_3 d_3 \exp + \varepsilon$

The slopes of the four segments are β_2, $\beta_2+\delta_1$, $\beta_2+\delta_1+\delta_2$ and $\beta_2+\delta_1+\delta_2+\delta_3$. To make the function continuous, we require that the segments join at the knots. The linear restrictions on the coefficients are

(3) $\beta_1 + \beta_2 t_1 = (\beta_1 + \gamma_1) + (\beta_2 + \delta_1) t_1$

(4) $(\beta_1 + \gamma_1) + (\beta_2 + \delta_1) t_2 = (\beta_1 + \gamma_1 + \gamma_2) + (\beta_2 + \delta_1 + \delta_2) t_2$

(5) $(\beta_1 + \gamma_1 + \gamma_2) + (\beta_2 + \delta_1 + \delta_3) t_3 = (\beta_1 + \gamma_1 + \gamma_2 + \gamma_3) + (\beta_2 + \delta_1 + \delta + \delta_3) t_3$

From equation (3), (4) and (5) we get

$\gamma_1 = -\delta_1 t_1, \quad \gamma_2 = -\delta_2 t_2, \quad \gamma_3 = -\delta_3 t_3$

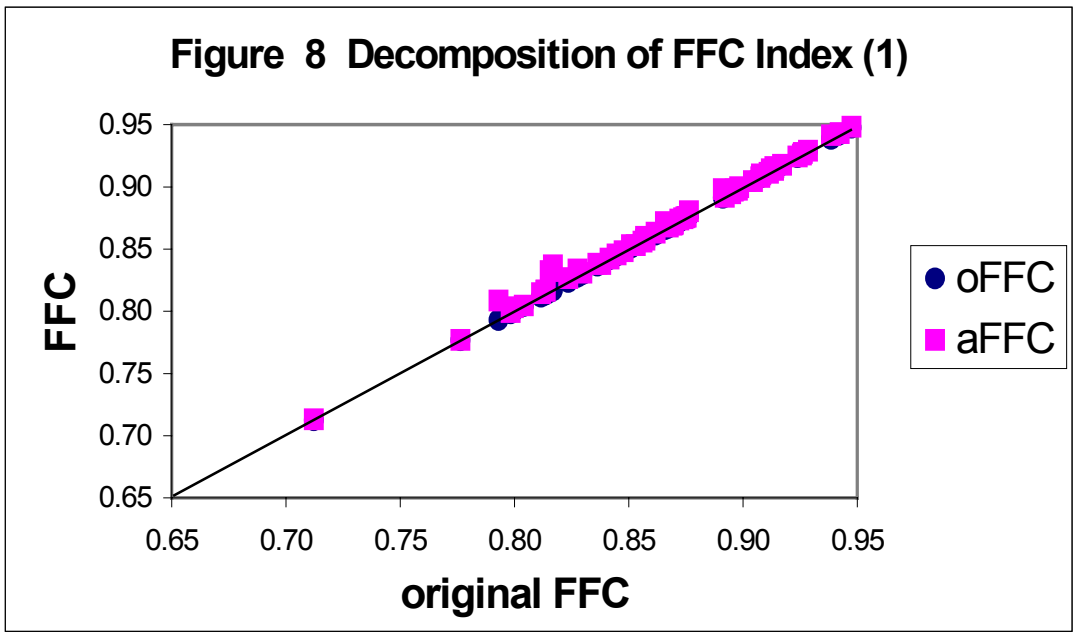
Inserting these collecting terms in equation (2), we obtain

(6) $HFC = \beta_1 + \beta_2 \exp + \delta_1 d_1 (\exp - t_1) + \delta_2 d_2 (\exp - t_2) + \delta_3 d_3 (\exp - t_3) + \varepsilon$

From multiple regression we can obtain constrained least squares estimation. The variables used in the regression are:

$Exp_1 = exp$
$Exp_2 = exp - t_1$ *if* $exp \geq t_1$, *otherwise* $exp_2 = 0$
$Exp_3 = exp - t_2$ *if* $exp \geq t_2$, *otherwise* $exp_3 = 0$
$Exp_4 = exp - t_3$ *if* $exp \geq t_3$, *otherwise* $exp_4 = 0$

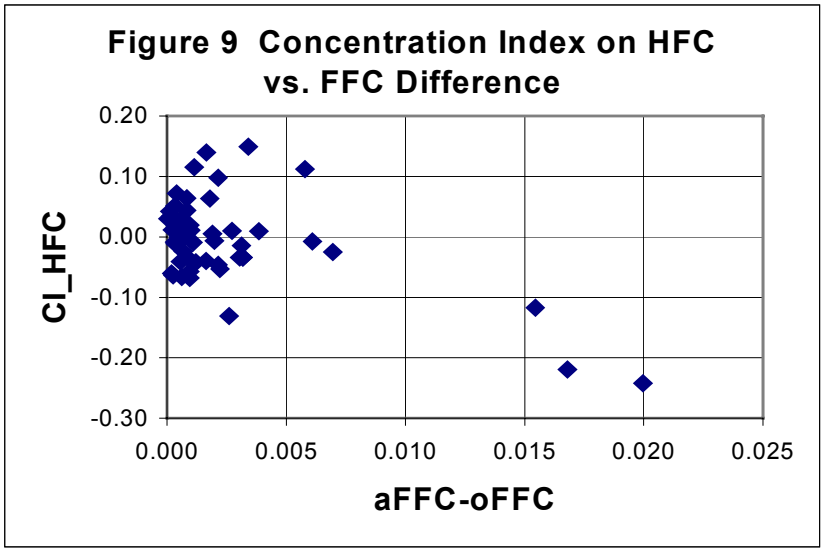
The estimations were made and residuals were obtained for each household using STATA. The *FFC* index was re-calculated as *aFFC* based on the new *HFC* for each household (*HFCa*, as defined before). Comparing the index of *aFFC* with the original



FFC (oFFC), we found that the removing all vertical inequality effects has little effect on the *FFC* index (Figure 8). Based on the sample of countries, nearly all of the changes are less than 10% of the *FFC*.

For rank order correlation coefficient across countries for the *oFFC* and the *aFFC* is 0.996.

We can assess if a country has a 'too progressive' health system contribution by examining the *HFC* concentration index. 24 countries have a positive concentration index for *HFC*. In other words, there are 24 countries in which the distribution of *HFC* may look more unequal because the health system contributions are progressive. Figure 9, however, shows a scatterplot of the *HFC* concentration index and the change in the *FFC* index when all vertical inequality is removed. In only one country with a positive *HFC* concentration index is there a change in the index greater than



0.005, namely India. In other words, empirically when the index is decomposed, the vertical equity effect is small. In this sample of countries, the concern raised by Wagstaff and Shaw appears to have little or no effect on the *FFC* index.

2.5.3. Separation of extreme horizontal effect from the FFC index

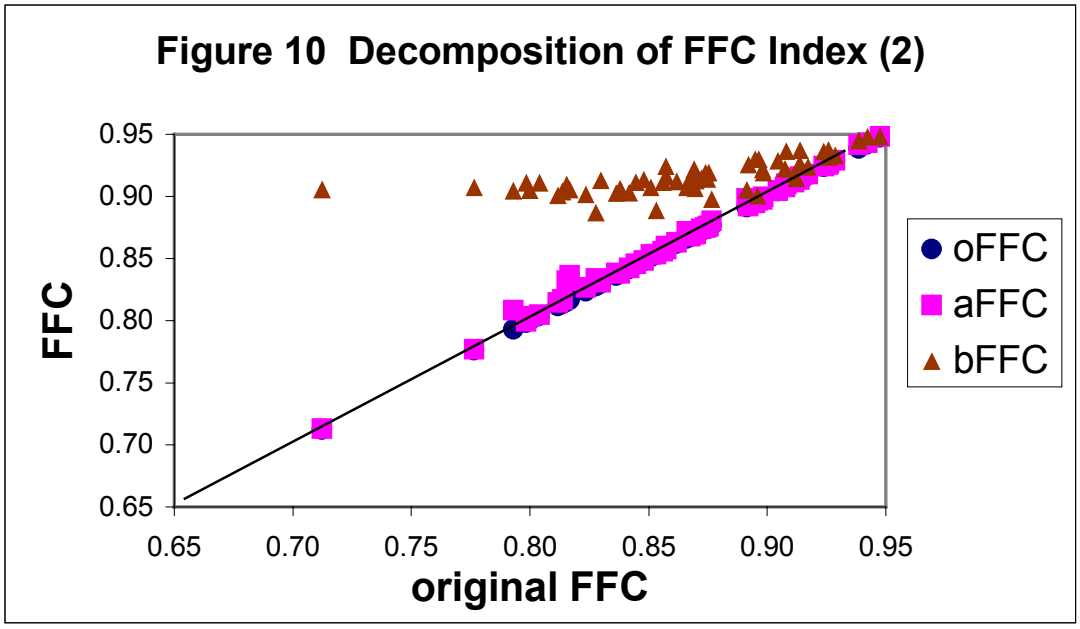
After eliminating the impact regressivity or progressivity on the index, the second step of the decomposition is to remove the effect of catastrophic expenditure by estimating the counterfactual distribution of *HFC* in the absence of catastrophic spending. The *HFC* threshold used to define catastrophic health expenditure is arbitrary. To facilitate comparison, we define catastrophic expenditure at 40% of household non-subsistence effective income (capacity to pay).

Using the criteria of catastrophic expenditure defined above, we replaced the household financial contribution (*HFC*) with the mean *HFC* for the households who

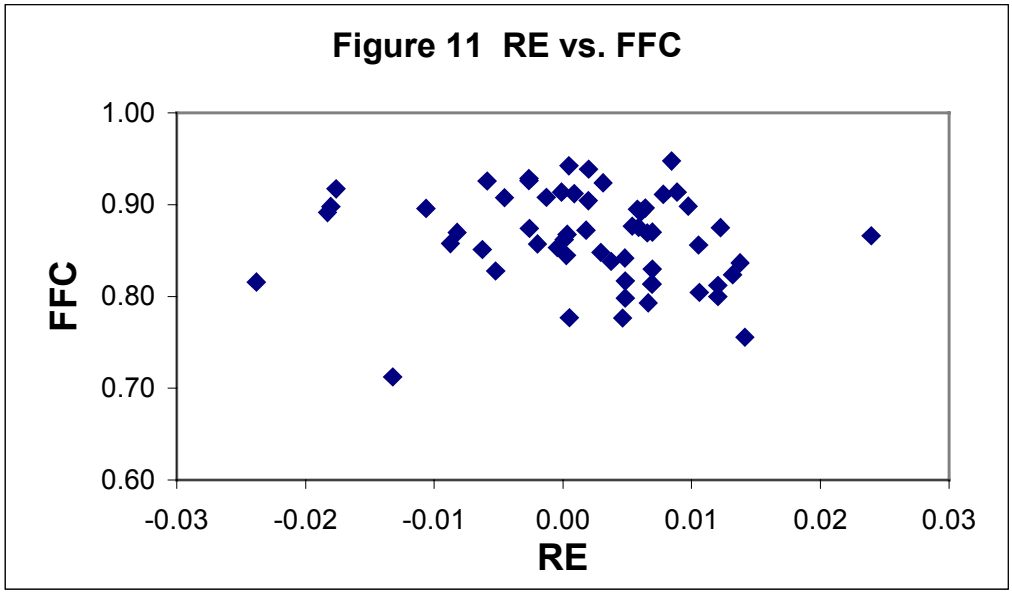
paid catastrophic shares of their capacity to pay. Consistent with basic insurance theory of risk pooling, we then summed all of the catastrophic payment and compared it with the total capacity to pay among the whole population to get a ratio. The ratio was added to all the households whose contribution is under 40% of capacity to pay. Now we get the new *HFC* for each household. The new *FFC* index (*FFCb*) was computed.

$$FFCb = 1 - \sqrt[3]{\frac{\left|HFCb_i - \overline{HFCb_i}\right|^3}{n}}$$

Figure 10 compares the original *FFC* compared with the *FFC* for the distribution of *HFC* after removing vertical inequality and catastrophic payment *(FFCb*). Introduction of catastrophic health insurance has dramatically improved the distribution of *HFC* in all countries. After removing the effect of catastrophic payment there is little variation in *FFC* in those countries that began with an *FFC* less than 0.875. Above that threshold there is still some variation in *FFC* that is presumably due to differences in moderate horizontal inequality.



The dominant effect of catastrophic payment on the distribution of *HFC* was already demonstrated earlier where the percentage of households with catastrophic payment was very highly correlated with various distribution summary measures including the *FFC* (table 2). The importance of horizontal inequality not vertical in determining the distribution of *HFC* is also reinforced by the lack of a relationship between the total redistributive effect (*RE*) and the *FFC* (figure 11).



3. Further steps & challenges

In this section, we discuss further components of our work plan.

3.1. Refining the methodology

As more and more countries undertake the *FFC* analysis, new issues pertaining to one or a group of countries arise. We seek to address them and some of them are described below.

3.1.1. Distribution of government non-tax revenue, oil, etc.

In estimating government spending on health from each household, we assume that most government revenue is from general tax which is true for majority of the member states. Where other sources of revenue such as oil or state-owned enterprises are substantial, issues arise as to how or whether to assign such revenue back to the household.

The FFC working group has looked at two approaches. The first approach is to treat government investment revenue the same as international or domestic donations since it doesn't come from households. Government spending on health through government revenue from households would not include such revenue. The other approach is to assign such revenue equally back to each household, for example 0.3% or 0.5% of the household capacity to pay for all households. With this approach the *HFC* captures all government spending.

Regarding the first approach, if we ignore this revenue in the *HFC*, will the role of government spending on health be fully captured in the index? The answer is yes. It will be reflected in the distribution of out of pocket payment across households. The

effect of this extra government input will be to reduce catastrophic spending among the population, especially for the poor if the government fund is used properly.

3.1.2. Distribution of employers' contribution to private health insurance.

As we defined, the household financial contribution to health system should include all the components paid directly or indirectly by the household. In principal, private health insurance premiums paid by both employer and employee should be included in the calculation. However, employer's contribution to private health insurance on behalf of employee is very difficult to obtain from household income and expenditure data. For countries where private insurance is substantial and employers are involved in premium contribution, like the United States, the *HFC* could be underestimated.

3.1.3. Medical saving account

The medical saving account is a compulsory individual or family savings account used for specified health expenditure and has been mainly applied in Singapore. There is considerable debate on the function of the medical saving account on financial risk protection. Nevertheless, other countries have chosen it as one of their health financing sources. In the current methodology, we treat it in a similar way to social security contribution on health. The amount that the household actually spent on health from the medical saving account goes to both numerator and denominator.

3.2. Data issues

3.2.1. Low cost survey data

Currently, the household survey data used include Living Standard Measurement Survey, Household Budgetary Survey, Income and Consumption survey, socio-economic survey and other surveys including income and expenditure information required for the *FFC* calculation. All of these surveys are high cost multipurpose surveys and not every country has such surveys. Lower cost surveys are being considered and efforts are being made to identify the minimum information required by the *FFC* measure that could be collected in the World Health Survey. For example, could information on health expenditure and assets be used to approximate households with catastrophic payments?

3.2.2. Techniques of FFC estimation from incomplete data sets

A certain percentage of surveys include incomplete information. For example, income or total household expenditure may be missing. To make full use of this micro level information we need techniques to estimate income from expenditure or vice versa.

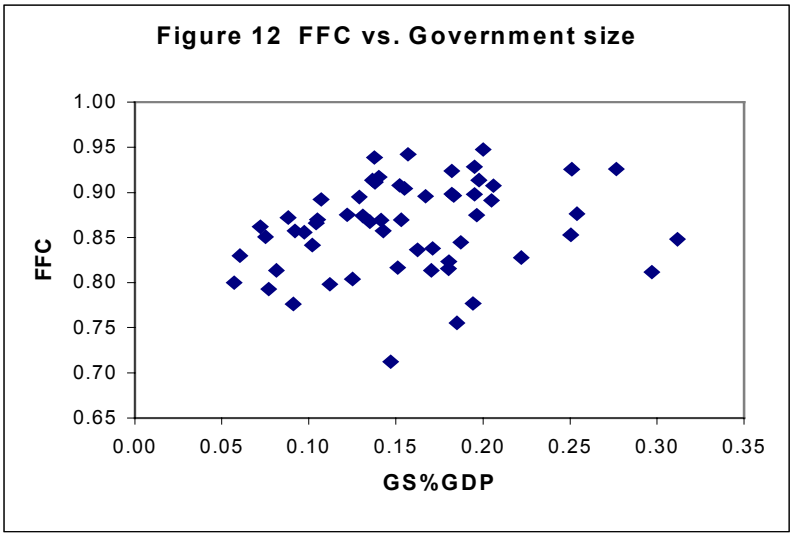
Another kind of incomplete information problem is that for some countries, especially developed countries, the direct tax information come from a registration system and is linked with the household survey data for a particular year. The tax payment and the tax refund (based on the previous year's tax payment) are in a different time reference although they are both reported in the same time point. If we use the household tax

payment net of refund as the actual tax contribution, we might have a small portion of households with negative direct tax.

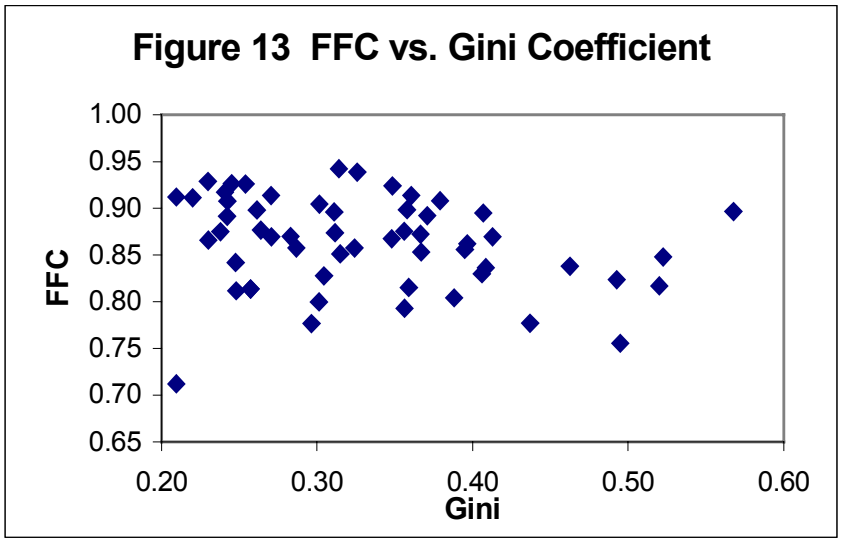
Similarly, the time lag problem also creates negative out of pocket payment for the countries where the insurance program requires the patient to pay the full charges at the point of service yet he/she is reimbursed later. This results in some households with negative net out of pocket payment.

3.3. Understanding the macro determinants of FFC

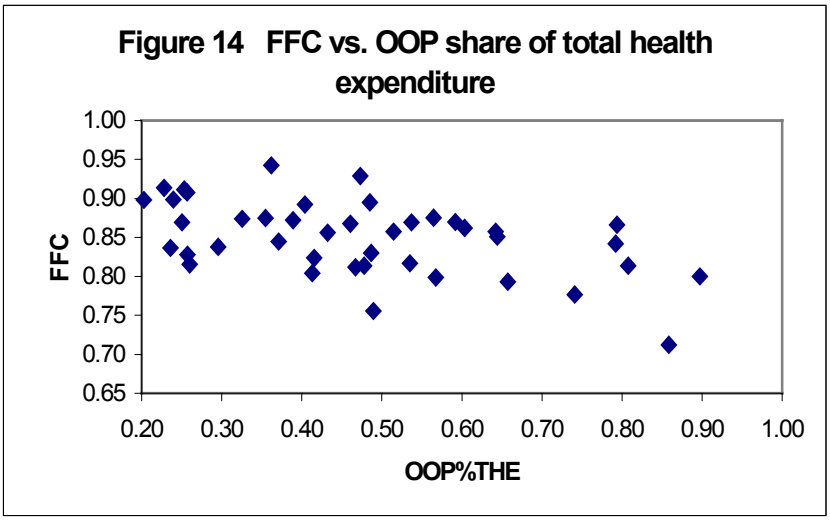
We are exploring factors that may explain variation in the distribution of HFC across countries. In nearly every country government plays an important role in the health financing system. Government size is an indication of the tax base and thus of the capacity of the government to provide financial risk protection. We us Government spending (*GS*) as a percentage of GDP as a proxy for government size. Figure illustrates that there is some relationship.



Income inequality may also be an important factor correlated with inequality in household financing contribution.



The third candidate variable is the out of pocket payment share of total health expenditure.



The structures of the health system are also potential explanatory variables. We temporarily classified the health financing system into three groups according to the risk sharing level. The first group is universal coverage with advanced risk sharing. The second group is medium risk sharing which includes social health insurance and other employment-related health insurance. The third group is the low level of risk sharing where there are no insurance schemes. Based on these three group we created two dummy variables for the advanced and medium risk sharing.

The results of a linear regression of *FFC* on these five variables is given in table 3. It appears that all these factors are significant. Much further work is needed to explore the factors that can explain the presence of inequality in *HFC*.

Table 3 Regression Results

	Coef.	Std.	t	P
GS%GDP	-0.3166	0.1042	-3.04	0.004
Gini	-0.1529	0.0668	-2.29	0.026
OOP%THE	-0.1627	0.0309	-5.27	0.000
Advance risk sharing	0.0391	0.0154	2.54	0.014
Medium risk sharing	0.0294	0.0134	2.20	0.032
Constant	0.9961	0.0369	26.98	0.000

F	13.65	Prob > F	0
R-squared	0.5629	Adj R-squared	0.5217
Root MSE	0.0347		

3.4. Policy oriented in-depth analysis and capacity-building for member states

Micro-data on household contributions can provide a rich basis for in-depth policy analyses.

3.4.1. In-depth analysis on catastrophic expenditure

Since catastrophic expenditure is a primary concern in assessing a health financing system, analysis of household risk factors for catastrophic expenditure may be useful. These factors include: who may potentially be impoverished by paying for health services, what kind of services cause people to face the catastrophic payment, inpatient services, outpatient services, purchasing medicine and so on. This type of analysis is illustrated using data from Lebanon.

Lebanon is a middle income country with per capita GDP $4500. The total population is 3.578 million. The Life expectancy is 69 for males and 74 for females. The health service provision system is mixed public and private. Health funds come from government, social security, mutual funds, private insurance and out of pocket payment. Out of pocket payment represents about 50% of total health expenditure. There are different health insurance schemes, mostly employment-related. The government is planning to expand insurance coverage by introducing universal coverage for the basic health service.

Data used in this example is National Household Health Expenditure and Use of Service for the year 1999. Sample size is 6544 households. Logistic regression was used where the dependent variable is 1 for catastrophic spending. The catastrophic expenditure was set, as we mentioned above, at above 40% of household's total consumption expenditure minus food poverty line which is 85,000 Lebanese pounds based on our first round estimation. The survey data showed that about 5% of households had catastrophic health expenditure.

Table 4 illustrates that chronic disease, handicapped status and presence of senior members in the household are the risk factors that will increase the probability of the catastrophic health expenditure. On the other hand, insurance coverage, higher income, bigger family, household head with higher education level, and native Lebanese are protective factors.

Table 4 Results of Logistic Regression

	Coef.	Std. Err.	z	P>z
Chronic disease	0.357	0.045	8.02	0.000
Education	-1.035	0.422	-2.45	0.014
Senior members	0.437	0.069	6.33	0.000
Insurance coverage	-1.002	0.157	-6.40	0.000
Handicapped members	0.386	0.119	3.25	0.001
Per capita income	-0.001	0.000	-3.55	0.000
Household size	-0.108	0.027	-3.94	0.000
Nationality	-0.512	0.218	-2.34	0.019
_cons	-2.326	0.253	-9.20	0.000

Log likelihood =-1,177.94 Pseudo R^2=0.1129

From the results, we could predict a household's risk of facing catastrophic expenditure based on these characteristics. Suppose there are two households. The

first one has per capita income of 500 thousand Lebanese pounds, 5 members and one person is covered by health insurance, the household head had university education, and is a Lebanese. The second family has lower income, 100 thousand Lebanese pounds per person, 4 family members, and no one is covered by health insurance, there are 2 persons in this family over 60 years old and 2 have chronic disease, one person is handicapped, the household head didn't have an university degree and is non-Lebanese.

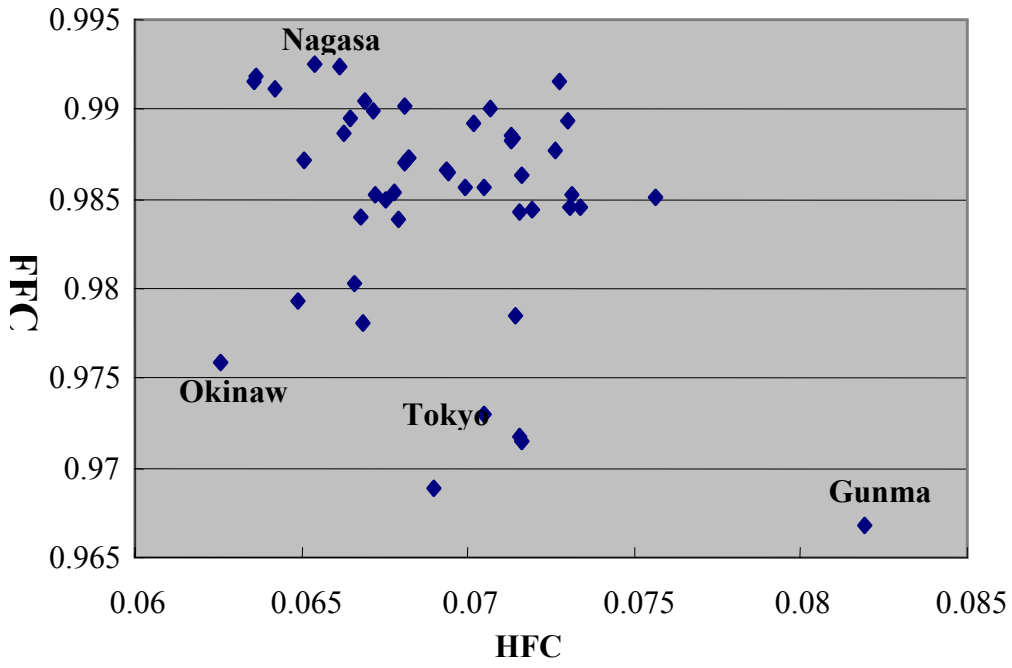
Using the equation we obtain form the Logistic regression, we can calculate that the risk of facing catastrophic health expenditure is 0.22% for the first family and 28.42% for the second family.

3.4.2. The Sub-national analysis

The FFC analysis can also be made at a sub-national level. Depending on data availability, analysis by geographic areas, urban/rural, sub-systems (it is argued that decentralization gives local governments more flexibility to arrange their own health financing system) and ethnic groups within a population could also be interesting.

Figure 15 shows the preliminary results for sub-region analysis on *HFC* and *FFC* done by (Hasegawa T. 2001) based on 1994 Japanese household survey data.

Figure 15 FFC and HFC: 47 Prefecture Distribution (Household Survey 1994, Japan)



3.4.3. The time series analysis

The time series analysis requires household surveys from different years. When the data is available, the analysis could be highly valuable to look at trends in the fairness of health financing system over time. It also can be used to evaluate the impact of

certain health financing reforms by comparing before and after reform changes in distribution.

3.4.4. Local capacity building

A very important purpose for developing the measure is to make it a useful policy tool for member states. Local capacity building is critical for this purpose. We have been providing various forms of technical support to countries making the assessment by themselves. Workshops at regional and national levels have been organized to familiarize both technocrats and other stakeholders in response to requests from the Ministries of Health. More requests for technical help from member states may be continue to come in.

Appendix table 1: Data Collection-country List

Region	Country	year	Survey name	Food poverty line Per person/month
1 AFRO	Burundi	1998	Enquete Nationale sur les conditions de vie des populations	5955.21
2 AFRO	Comorros	1995	Enquête exploratoire budget-consommation	---
3 AFRO	Côte d'ivoire	1995	Enquête prioritaire sur les dimensions sociales et l'ajustement culturel	---
4 AFRO	Gambia	1998	Household Poverty Survey	---
5 AFRO	Ghana	1994 & 1998	Ghana Living Standard Survey	31774.49
6 AFRO	Mauritius	1996/97	Household Budget Survey	419.41
7 AFRO	Namibia	1994	Household Income and Expenditure Survey	77.88
8 AFRO	South Africa	1995	South Africa Income Expenditure Survey	90.27
9 AFRO	Tanzania	1993	Human Resource Development Survey	7473.45
10 AFRO	Zambia	1996	Living Conditions Monitory Survey	33492.75
1 AMRO	Argentina	1996/97	Encuesta Nacional de Gasto de los Hogares	43.36
2 AMRO	Belize	1996	Poverty Assessment	66.15
3 AMRO	Brazil	1996	LSMS	39.31
4 AMRO	Canada	1997	Survey of Household Spending	58.65
5 AMRO	Colombia	1997	National Quality of Life Survey	29418.33
6 AMRO	Costa Rica	1997	Encuesta Nacional de los Hogares	2880.43
7 AMRO	Ecuador	1998	Indicadores de condiciones de vida	154920.49
8 AMRO	Guyana	1992	LSMS	1105.01
9 AMRO	Jamaica	1997	Survey of Living Condition	962.20
10 AMRO	Mexico	1996	National Income Expenditure Survey	212.80
11 AMRO	Nicaragua	1993	LSMS	73.80
12 AMRO	Panama	1997	Encuesta National de Niveles de Vida	31.98
13 AMRO	Paraguay	1996	Household survey	47215.26
14 AMRO	Peru	1994 & 2000	Encuesta National de Niveles de Vida	68.00*
15 AMRO	USA	From 1983 to 1998	Consumer Ependiture Survey	43.36*
1 EMRO	Egypt	1997	Egypt Integrated Household Survey	82.65

2 EMRO	Lebanon	1999	National Household Health Expenditure and Use of Services (NHHEUS)	85051.19
3 EMRO	Morocco	1991	Enquêtes sur les conditions de vie des méanges	173.11
4 EMRO	Pakistan	1991	Pakistan Integrated Household Survey	345.36
5 EMRO	Yemen	1998	Household Budget Survey	---
1 EURO	Albania	1996	Employment & welfare survey	1849.06
2 EURO	Armenia	1996	Armenian Household Living Standards Survey	6028.27
3 EURO	Azerbaijan	1995	The Azerbaijan Survey of Living Condition	50504.86
4 EURO	Bulgaria	1995 & 1997 & 2000	Bulgarian Integrated Household Survey	39.67*
5 EURO	Belgium	1997/1998	Household Budget Survey	1569.6
6 EURO	Croatia	1998 & 1999	Household Budget Survey	242.93
7 EURO	Czech	1999	Household Budget Survey	742.99
8 EURO	Denmark	1997	Danish Household Budget Survey	399.74
9 EURO	Estonia	1995	Household Budget Survey	321.36
10 EURO	Finland	1998	Consumption Expenditure Survey (CES98)	310.34
11 EURO	France	1995	Household Budget Survey	341.27
12 EURO	Germany	1988 & 1993	Income and Consumption Survey	91.40*
13 EURO	Greece	1998-1999	Household Survey	13305.42
14 EURO	Hungary	1993	Household Budget Survey	2229.72
15 EURO	Iceland	1995	Household Budget Survey	38.5689
16 EURO	Kazahkastan	1996	LSMS	1289.88
17 EURO	Kyrgyz	1998	Poverty Monitory Survey	215.13
18 EURO	Latvia	1995	Household Budget Survey	12.76
19 EURO	Lithuania	1999	National Household Budget Survey	93.54
20 EURO	Norway	1996-1998	Household Expenditure Survey	528.6
21 EURO	Poland	1993	Household Budget Survey	38.36
22 EURO	Portugal	1995	Income and Expenditure Survey	5854.73
23 EURO	Romania	1994	Integrated Household Survey	20463.27

24	EURO	Russia	1996 & 1998	Russian Longitudinal Monitory Survey	130.73 *
25	EURO	Slovak Rep	1993	Family expenditure survey	544.09
26	EURO	Slovenia	1997	Anual Household Budget Survey	5400.14
27	EURO	Spain	1996	Encuesta Continua de Horgares	6541.84
28	EURO	Sweden	1996	Household Expenditure Survey	514.12
29	EURO	Tajikistan	1999	Living Conditions Survey	13269.35
30	EURO	The Former Yug. Rep. Of Macedonia	1997	Macedonian Household Budget Survey (HBS)	---
31	EURO	UK	1999/2000	Family Expenditure Survey	34.78
32	EURO	Ukraine	1996	Income Expenditure survey	41.29
1	SEARO	Bangladesh	1996	Household expenditure Survey	535.15
2	SEARO	India	1995	Socia-Economic Survey	364.10
3	SEARO	Indonesia	1999	National Socioeconomic Survey	117420.64
4	SEARO	Maldives	1998	Maldives Vulnerability and Poverty Assessment	---
5	SEARO	Nepal	1997	LSMS	594.89
6	SEARO	Sri Lanka	1995/1996	Household Income and Expenditure Survey	746.98*
7	SEARO	Thailand	1994 & 1996 & 1998	Thaniland Socio-Economic Survey	668.90*
1	WPRO	Cambodia	1999	Cambodia Socioeconomic Survey 1999	41797.02
2	WPRO	Korea	1999	Household Income and Expenditure Survey	43707.52
3	WPRO	Papua New Guinea	1996	PNG 1996 Household Survey	---
4	WPRO	Philippines	1997	1997 Family Income and Expenditures Survey	585.92
5	WPRO	Vietnam	1997	Vietnam Living Standard Survey	148476.19

*

Germany	1993	USA	1998
Bulgaria	1997	Peru	1994
Russia	1996	Thailand	1998

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