DEFINING AND MEASURING FAIRNESS IN FINANCIAL CONTRIBUTION TO THE HEALTH SYSTEM[1]*

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I. Introduction

One of the challenges common to all social systems is to achieve fairness in the distribution of the financing burden, and protection from the risk of financial loss. For health systems, this goal is of particular importance and especially difficult to achieve due to the catastrophic and unpredictable nature of some expenditures. Societies have long demonstrated a special concern about how health systems are financed.(Behrman 1995;Londoño & Frenk 1997;World Health Organization 2000)Much of the public discourse in countries undertaking health sector reform is focused on the design of health system financing and its fairness.(Londoño & Frenk 1997;Wagstaff A & Van Doorslaer E 1998)

The purpose of this paper is to present a definition, a measure and an index of fairness in financial contribution to the health system. Our notion of fairness is *not* a concern about the extent to which contributions to the cost of the health system across households redistribute income. Starting from a society's efforts to redistribute income, there are, nevertheless, important considerations of fairness that we try to define and quantify. Three issues are critical to this concept of fairness: avoiding catastrophic payments by households, horizontal equity and (to some extent) progressivity of contribution. Further, our approach separates financing from utilisation, so that fairness in financial contribution is determined independently of the health status of the individual or household or the use of health services.

Our definition, measure and index of fairness in financial contribution are designed and developed to be applicable across and within countries with varying types of health systems and at different stages of development and of the health transition. The index can be used as a tool to analyse changes over time within countries such as the results of health reform, economic crises, or policies such as decentralisation. Some empirical applications considering differences across countries and relating these to the organisation of health systems are discussed in companion publications.(World Health Organization 2000;Xu et al. 2000)

The paper is divided into eight sections. The second section describes the overall WHO Framework for Measuring Health System Performance, for which the measure of fair finance was designed. The third section provides some background information on health system financing arrangements. The fourth section is a brief review of the literature on equity in health finance. Section five discusses the conceptual and theoretical aspects of our measure of fairness of health financing. Section six explores the properties of the measure and index using simulation analysis. The seventh section gives detailed information on the construction of the measure. The final section provides a summary, conclusions and a discussion of future applications.

II. WHO Framework for Assessing Health System Performance

The measure of fairness of financing presented here is part of a framework being applied by the World Health Organisation to assist countries to assess the overall performance of their health systems. The framework sets out three intrinsic goals: improving health, enhancing the responsiveness of the system to the legitimate expectations of the population; and assuring fairness in financial contribution. For the first two goals, we are concerned both with raising their level and improving their distribution. . Health and responsiveness are addressed in more detail in other papers. (Murray CJL & Frenk J 1999;World Health Organization 2000)

For financing, we consider only the distribution, not the level, as there is no consensus on what the level of health spending should be. The intrinsic goals of the WHO framework do not include either increasing or decreasing the amount spent on health. While the level of health spending is clearly an important determinant of the outcomes of a health system on all three intrinsic goals, it is not an intrinsic goal in and of itself. Societies must choose the appropriate level of financing for the health system. Given a level of spending, however, every society will want the greatest amount of the socially desired mix of health, responsiveness and fairness in financial contribution possible; this is the concept of performance or efficiency. The choice of the level of total financing is a very important policy choice but unlike health, responsiveness, and fairness in financial contribution, more consumption of healthcare is not unequivocally better.

Fairness in financial contribution is an intrinsic goal of a health system because it is a desired outcome in and of itself. Fairness in financial contribution may also improve access to health care and health outcomes, but this instrumental role of fair financing is a separate issue. Consider two systems, both having exactly the same level of health, the same distribution of health, the same responsiveness and the same distribution of responsiveness. But in one, many households pay catastrophic shares of their effective non-subsistence income for health and in the other no household makes catastrophic payments. Most would agree that the system that protects households from catastrophic payment is more fair and to be preferred.

The goal of fairness in financial contribution is nested within a framework of overall health system performance in which it is not the only intrinsic goal. A system in which all households contribute 0% of their income to health is fairly financed, but would do very poorly in the goals of producing health and responsiveness. Similarly, a system financed entirely through out-of-pocket payments where the poor pay very little because healthcare is unaffordable may score relatively well on financial fairness but will do poorly on the level and distribution of health and responsiveness.

The inclusion of fairness in financing as an intrinsic goal is mirrored by general preferences regarding the goals of health systems. In a survey where respondents were asked to weight the relative importance of all five aspects of health system performance, fairness in financial contribution is considered by respondents to be as important as achieving higher levels of health and greater equality in the distribution of health. Each of these goals received a weight of 20-25%.(Gakidou, Frenk, & Murray 2000)

III. Diversity of Health Financing Systems

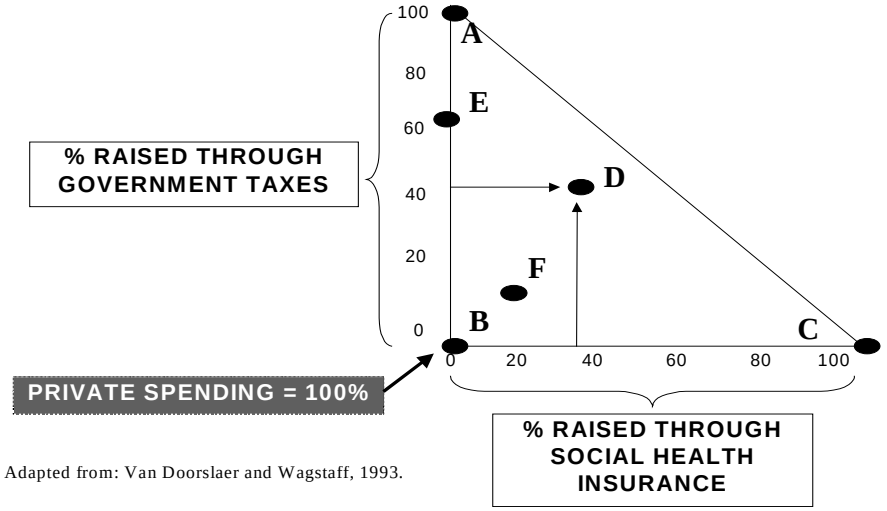
The household is the basic unit of analysis for this and many other studies of financing. While funds for health services may flow from households, employers and governments, it is households or individuals who ultimately own the productive resources in a society. (Fuchs V.R. 1988;Iglehart J.K. 1999)Funds for health services are extracted from households through such means as payroll deductions, income taxes, value-added taxes incorporated into the purchase price of goods and services, out of pocket payments for health care, and private insurance premiums. As Fuchs (Fuchs V.R. 1988) writes: “The most basic point, often obscured in public discussions, is that the public must pay for care under any system of finance. …the ultimate cost falls on families and individuals even when the payment mechanism makes it appear that the bills are being sent elsewhere.”

There are four main types of financing for health: government-raised (through general and specific taxes); social insurance contributions (often levied through payroll and other taxes, as well as other contributions); private insurance contributions; and out-of-pocket payments. The first three types of finance are pre-paid, involve a substantial degree of risk pooling and can protect both rich and poor from catastrophic and impoverishing health expenditures. Contributions are often a function of income. It is important to emphasize that government-financed and social insurance schemes *can*, but *do not necessarily*, protect all citizens. Particular groups are often excluded such as the poor, recent immigrants or informal workers.

Within the categories of government-raised and social insurance, there is also substantial variation across countries. Most countries rely on a mix of value-added, income, excise and other taxes. The structure of each tax system reflects the preferences of each country for solidarity and progressivity, as well as the economic structure and wealth of the economy. Some countries rely heavily on general taxation as compared to a social insurance or social security scheme. Further, countries vary in the proportion of the population covered by social security through payroll taxes, depending on the size of the formal labour market. Social security may be financed from general or payroll taxes, and there may be redistribution away from, or toward, those individuals that are insured. In most cases, social insurance is paid for by dedicated payroll taxes where a fixed proportion goes to finance health care for workers and their families. Some countries supplement this with funds collected through general taxes, while others use funds from payroll collections to finance public health programs that also cover the informal population.

Private payments are of two types: private insurance premiums and out-of-pocket payments. Private insurance can protect individuals from catastrophic expenditures, but coverage, access and risk pooling are often limited. Private insurance is typically a good available only to the rich in poor countries, the healthy and those that live in urban areas. Out of pocket payments are typically made at point-of-service and the individual consumers choose, as a function of income, how much they are willing and able to purchase. Catastrophic, and potentially impoverishing, expenditures arise because households will sell assets and borrow from future potential earnings in order to purchase care. The financing of out of pocket payments is, in fact, often severely constrained by the individual or household access to credit and borrowing. Necessary care is forgone and expenditures are zero if the cost of care exceeds the ability to pay at the time of service. Further, out of pocket payments are the most fragmented across individual consumers, with no possibility of pooling risks. Out of pocket financing of health is the most likely reason that would characterize unfair distributions of health financing, and to generate severe financial losses and risk of impoverishment for some families. This is particularly evident in countries where other financing options are restricted to the rich, and out of pocket payments are the only option for the poor.

By Source of Revenue



Adapted from: Van Doorslaer and Wagstaff, 1993.

The health finance mix tends to vary substantially across countries. The degree to which governments rely on each of the four sources of funds – government raised, social health insurance, private insurance and out-of-pocket spending -- varies substantially. A variety of combinations are illustrated in Figure 1. In this diagram, the closer the point is to the line A-C, the less the reliance on private spending. A country that relied entirely on private out-of-pocket spending would be found in the bottom left-hand corner (point B). Systems financed (almost) entirely from one source-- such as at points A, B and C in Figure 1 – are rare. Most wealthier and some developing countries rely on some combination of sources (point D), with certain countries leaning less heavily on out-of-pocket payments (Point D as compared to Point F). Many countries are close to points E or F with a heavy reliance on private funding, most of which is out of pocket in poor countries, to supplement public and social insurance-based finance. In only a few countries is private insurance (point G) important.(Van Doorslaer E & Wagstaff A 1999)

IV. Equity in Health Finance

Before presenting our framework on fairness in financial contribution a useful starting point is to review the rich literature on equity in health finance .(Wagstaff A & Van Doorslaer E 1998) This has grown out of the public finance literature that analyzes the extent to which the tax system achieves one of society's goals, that of redistribution of income and wealth. In transferring this concept to the health system, equity in health finance has been formulated as the extent to which all forms of health payments (taxes, social insurance payments, private insurance and out-of-pocket payments) contribute to the redistribution of income. (Deaton A & Muellbauer J 1980)[2]

This view of equity in health finance has been justified using two types of arguments. First, it is claimed that the health system should be considered as one of many mechanisms to redistribute income and should thus be evaluated in terms of how well

[2] There is good evidence that policy-makers in the OECD countries are concerned about the effects of health care financing arrangements on the distribution of income as well as on who receives health care (cf. E.g., OECD,1992).

it achieves this intrinsic goal. The second argument is instrumental: health systems that redistribute income are likely to give more access to the poor and thus lead to better health outcomes. This latter view leads naturally to a related set of analyses on the distribution of the benefits of health services.

As Van Doorslaer, Wagstaff *et al.(Van Doorslaer E & Wagstaff A 1999)* note, the most inclusive measure of equity in health finance is the total effect of health financing contributions on the redistribution of income. One way to capture this net effect is to compare the Gini coefficient of household income prior to health system payments with the Gini coefficient of household income after health system contributions. The total re-distributive effect can be conceptually and quantitatively divided into the contributions of vertical equity and horizontal equity.[3] Vertical equity is the extent to which the rich pay more for the health system than the poor. Horizontal equity is the extent to which households with the same income pay the same amount to the health system.

The extent to which health system contributions redistribute income is dominated by the progressivity of the contributions, with the progressivity of each mode of financing weighted by its importance relative to other sources.[4] Several authors have applied the well-developed methods for evaluating the progressivity of tax payments to payments for health care.(Aronson JR, Johnson P, & Lambert PJ 1994;Kakwani K 1977;Kakwani K, Wagstaff A, & Van Doorslaer E 1997;Kakwani N. 1997;Rasell E, Bernstein J, & Tang K 1994;Wagstaff A & Van Doorslaer E 1992;Wagstaff A & Van Doorslaer E 1993;Wagstaff A & Van Doorslaer E 1999;Wagstaff A., Van Doorslaer E, & Paci P 1989;Aronson JR, Johnson P, & Lambert PJ 1994;Aronson JR, Johnson P, & Lambert PJ 1994;Aronson JR, Johnson P, & Lambert PJ 1994;Aronson JR, Johnson P, & Lambert PJ 1994;Aronson JR, Johnson P, & Lambert PJ 1994) Many of these studies have used the Kakwani index, which considers the degree to which a payment (for tax or health care) departs from proportionality, where proportionality is measured against the distribution of pre-payment income in the population. The method involves plotting ranked pre-payment income against the cumulative proportion of health care payments. The area between the two distributions provides a measure of the extent of regressivity or progressivity in health care payments relative to that of income (Figure 2).[5] When health system contributions are progressive the Kakwani index will be positive and when health system contributions are regressive the Kakwani index will be negative.

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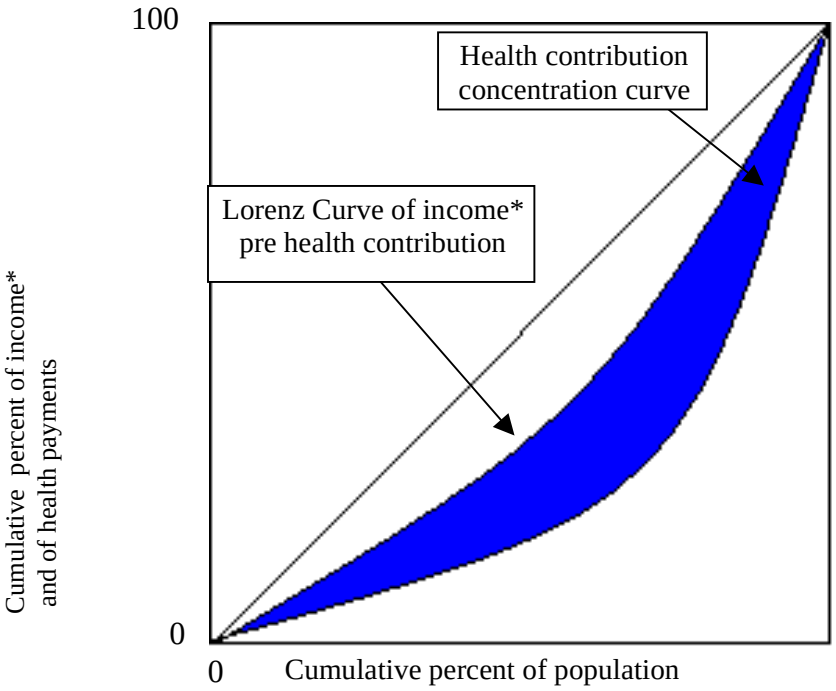
[3] Unequal treatment of households with the same income by the tax system or the health system can be further divided into two components: the extent to which the ranking of households by income changes after payments for the health system, and the extent to which there is inequality in payments to the health system when households are ranked within bands of similar post-payment income. For most purposes this distinction may not be that informative.

[4] A progressive system of payments means that richer households pay a larger share of their income than poorer households. In a regressive system, the richer households pay a smaller share of income than poorer households.

[5] The Kakwani index is formulated as the difference between the Gini coefficient for pre-payment income, and the concentration index for health care payments.

Figure 2: Kakwani Index of Progressivity



Adapted from: Van Doorslaer and Wagstaff, 1993.
*May be income, expenditure, or some other measure of capacity to pay.

The analysis of progressivity using the Kakwani index has been applied to a number of OECD countries.(Rasell E, Bernstein J, & Tang K 1994;Wagstaff A & Van Doorslaer E 1993;Wagstaff A & Van Doorslaer E 1999;Wagstaff A., Van Doorslaer E, & Paci P 1989;Wagstaff A., Van Doorslaer E, & Paci P 1989) These studies find that direct taxes are progressive in all developed countries, while indirect taxes are generally regressive. Social insurance is progressive in countries where coverage is universal, and regressive in those that exclude the higher income groups. Private insurance is regressive in countries such as the United States and Switzerland, because premiums are not related to income but are constant or related to risks. For those who purchase it, private insurance is often the sole source of coverage. Even when the poor do not buy insurance, the distribution can be regressive among those who do buy, because of the large differences in income.

A common finding of these studies is that out-of-pocket payment is regressive. It is particularly so in countries where pre-paid health care does not cover the low-income groups. The overall findings show that in countries where health financing is predominantly private, either via insurance or out-of-pocket payments, the system is most regressive. Social insurance-based countries are mixed, depending on whether the higher income groups are permitted to opt out of the system. Tax-financed systems are proportional or mildly progressive.

Several authors have analysed changes over time, the impact of reforms or proposed changes in health financing within countries such as the United States, the Netherlands and Australia. These studies have measured the extent to which changes in financing have generated or would generate more or less progressive health financing regimes.(Holahan J & Zedlewski S 2000;Lairson DR, Hindson P, & Hauquitz A 1995;Wagstaff A & Van Doorslaer E 1998)

Information on vertical equity in developing countries is scarce. Several studies have shown that in some countries, all families, including the poor, spend a high share of their budget on out of pocket health spending.(Hotchkiss DR et al. 1998) In Thailand and Mexico, the poor spend a higher proportion of their income on out-of-pocket health spending than the rich. Further, the regressivity of out-of-pocket spending is related to the degree to which populations are covered by pre-paid insurance schemes. (Frenk J, Lozano R, & González Block MA. 1994;Pannarunothai & Mills 1997)A study of Jamaica, Ghana, Côte d'Ivoire, Peru and Bolivia using Living Standard Measurement Surveys, concluded that health financing channelled through the public sector did little to ameliorate inequalities in spending and access to health care.(Baker JL & van der Gaag J 1993) Efforts are under-way to extend the work on the progressivity of health financing in OECD countries to the developing world, particularly to Latin America and the Caribbean. Some early results from these studies have shown a heavy reliance on out-of-pocket payment that varies from 30 to 60% of health finance. Further, out-of-pocket payments are regressive in a number of countries, and exacerbate the existing inequalities in the distribution of income. (Gonzalez Pier E & Parker S 1999;Lasprilla E, ObandoC, & Encalad E Lasprilla C 1999;Suarez RM 1999;Valladares R & Barillas E 1999)A recent study of health financing in Mexico using Kakwani indices found that overall the system is close to neutral, out of pocket spending is regressive and other sources of finance tend to be somewhat progressive.(Gonzalez Pier E & Parker S 1999)

When health system payments differ for households with the same income, the impact on income redistribution is less than if households of the same income paid the same amount. This is a central issue in studies of horizontal equity within the context of the total re-distributive effect. Empirical studies of this effect in OECD countries show it to be relatively small. There are few studies of the effect of horizontal equity on income redistribution in developing countries.

Although not part of the equity in health finance literature, another type of study that is relevant to fairness of financial contribution attempts to quantify the extent of catastrophic or impoverishing payments for healthcare.(Frenk J, Lozano R, & González Block MA. 1994) While few such studies exist, impoverishment has been recognized as a critical dimension for policy.

In summary, work to date relevant to evaluating the fairness of financial contribution has proceeded in three main directions. First, the dominant conceptual framework is to analyze equity of the health financing system by its contribution to income redistribution. In practice, this means a focus on progressivity. This work has clearly been important, useful and influential, but the concept of fairness is much broader than this concern for income redistribution. For example, most would agree that when households face catastrophic payments to purchase needed healthcare that this is undesirable and unfair. Yet, catastrophic payments for rich households might actually improve the distribution of income and catastrophic payments for a small number of poor households would have a negligible effect on overall income distribution. Second, most of the empirical work has been on developed country systems. Third, the recent trend in the literature is to link analyses of payments to the health system to the analysis of the distribution of the benefits of the health system. In the WHO Framework for Health Systems Performance Assessment, the ultimate impact of the distribution of healthcare resources should be captured in the

measure of fairness in financial contribution.

V. Concepts and Theory

In this section, we define our concept of fairness, operationalize this definition and propose a summary measure or index to compare the fairness of financial contribution in two different populations.

A. Conceptual Framework

Let us explore the concept of a fair distribution of contributions to the health system across households with a completely different point of reference. 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.

We begin this discussion of the conceptual basis for measuring fairness of financial contribution with the question: what is a maximally fair distribution of financial contribution to the health system? This normative discussion is a useful basis for making sure that any measure captures the critical dimensions of fairness and provides some basis for establishing meaningful endpoints for any scale. Ultimately, the measure of fairness may be used only to describe the state of affairs in different populations. Nevertheless, starting from some explicit normative discussion will help clarify the meaning of the measurements. The following discussion will lead us to a more inclusive formulation of fairness than has been the focus of much of the literature in developed countries reviewed above.

To explore notions of fairness in financial contribution, we can start by identifying what is *unfair*. 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 related to the core concept of fairness. Fairness in the philosophical literature is often associated with the concept of impartiality . One way to think about impartiality is using the device of the original position. If you do not know who you are in society, what would be a fair way to organize the financing of the health system? We argue that from such an impartial point of view, we want households or individuals to contribute equal shares of their *capacity to pay* for the health system. The debate about defining fairness in financial contribution then becomes a debate over the meaning of capacity to pay. Is a household's capacity to pay simply its income? Households face unavoidable costs to maintain subsistence, such as expenditures required for food, minimal clothing and shelter. Surely a household's capacity to pay should exclude expenditure required for these basic needs.

Capacity to pay could then be defined as to equal a household's income minus subsistence expenditure. But a household's capacity to pay may not simply be a function of current income. Households may have assets, and they may also have access to their future earnings through formal and informal financial mechanisms. Current income, assets and future earnings may all contribute to the effective income of a household. We believe that capacity to pay needs to be defined in terms of *effective income* (see below for a more formal definition) rather than current income. Effective income may be higher or lower than current income; it can be considered as the income that households would behave as if they have when making consumption decisions. In that respect it is akin to permanent income (Friedman M 1957), but with at least one important differences. Permanent income is a positive theory of consumer behaviour which will reflect among other factors the discount rate that individuals use in decision-making. For a normative concept to compare to health expenditure, effective income must be defined independent of variation in individuals subjective discount rate. This is discussed more fully below.

Although we do not argue that empirical ethics is the solution to all normative choices[6], measurements of population preferences can be informative. WHO undertook a survey of 1007 respondents of their preferences for health systems, including preferences for the financing arrangements in the health system. The sample was a convenience sample of health professionals and those with a special interest in health from over 100 countries, but was not a representative sample. This survey was distributed to the world-wide staff of WHO and then placed on the WHO web site in order to elicit responses from a broad range of interested individuals. The results of the survey strongly indicate preferences for a system in which everyone contributes an equal share of capacity to pay into a health system (Table 1A). For ease of explanation, in the survey "disposable income" was defined to be equal to "capacity to pay". More than 70% of the WHO staff and more than 60% of internet respondents voted for this option as their preferred method for achieving a fair system of health financing.

[6] Well-known problems with abhorrent preferences limit the scope for using empirical ethics (Hausman Daniel M 2000). Perhaps even more problematic is that many of these choices require considerable deliberation, the time for which is rarely available in surveys.

Table 1: Preferences for Fairness of Health Financing based on the WHO Survey of Preferences on Health System Performance Assessment (percentages of respondents)

Table 1A: Preferred financing mechanism for a health system

	WHO staff	Internet respondents	All respondents
Everyone pays the same amount	0.21	1.8	1.0
Everyone pays for what they receive	5.4	6.8	6.1
Everyone pays an equal share of their income	19.8	25.3	22.5
Everyone pays an equal share of their disposable income	71.7	61.2	66.6
The richest 10% pay for everyone	2.9	4.9	3.9

Table 1B: Choice between one household paying 50% of disposable income and two households each paying 25% of disposable income

	WHO staff	Internet respondents	All respondents
One household more fair	3.0	4.6	3.8
Two households more fair	72.6	74.8	73.7
Equally fair	12.2	9.6	10.9
Don’t know	12.2	11.0	11.6

Table 1C: Choice between one household paying 100% of disposable income and two households each paying 50% of disposable income

	WHO staff	Internet respondents	All respondents
One household more fair	3.5	3.9	3.7
Two households more fair	73.8	75.1	74.4
Equally fair	11.5	10.1	10.8
Don’t know	11.3	11.0	11.1

Table 1D: Choice between one household paying 200% of disposable income and two households each paying 100% of disposable income

	WHO staff	Internet respondents	All respondents
One household more fair	3.7	3.7	3.7
Two households more fair	68.3	73.2	70.7
Equally fair	10.2	7.8	9.2
Don’t know	17.8	15.3	16.6

To summarize, we make the normative claim that: *A health system is fairly financed if the ratio of total health system contribution of each household through all payment mechanisms to that households capacity to pay (effective non-subsistence income) is identical for all households, independent of the households health status or use of the health system.* This is a plausible normative claim that may appeal to many. Nevertheless, we recognize that there may be a long and lively debate as to the ideal conception of fairness of financing for the health system.

Not everyone will agree with this normative claim, but the measure derived from looking at the share of non-subsistence effective income that goes for the health system across households can be still be used for comparisons, just as the Gini coefficient can be used without endorsing complete equality of income across households as a social goal. In practice, those who prefer want a health financing system that is even more progressive than that implied by this measure should not be concerned, as no country we have studied comes even close to equal shares of non-subsistence permanent income. We expect and hope that this approach to examining the fairness of health system financing through shares of household non-subsistence effective income will spark debate. But we believe it captures the three key issues: a special concern of for those households facing catastrophic spending for health, for unequal contributions for equivalent households and for the overall progressivity of the system.

B. Operationalization of HFC

The definition of fairness developed above is an equal distribution of shares of capacity to pay across households. Capacity to pay for a household has been defined as effective income minus subsistence expenditure. We begin by formulating the quantity of interest at the household level as the health financing contribution (HFC):

$$HFC_i = \frac{HE_i}{ENSY_i} \quad (1)$$

where HFC_i is the health system financing contribution of the household i, HE_i is the per capita expenditure on health of household i, and $ENSY_i$ is the per capita effective income minus subsistence expenditure of household i. HFC is ideally defined over a period of one year for a household. One year has been chosen because for most households it is a natural unit of time that encompasses many predictable fluctuations in income and expenditure. It is also the interval over which the World Health Organization intends regularly to evaluate health systems.[7] In practice, HFC has been estimated using shorter period data, typically referring to one month, because survey data seldom refers to an entire year.

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[7] The period of evaluation of health expenditure and permanent non-subsistence income is important. Depending on the availability of various formal and informal mechanisms to borrow and save, households may behave as if they average their income over longer periods. In the extreme, the life cycle consumption hypothesis argues that households smooth consumption over the stream of all future income. (Ando A & Modigliani F 1963)In practice, in different societies the period over which permanent income is defined will vary, being generally longer at higher incomes.

The numerator (HE_i) includes all financial contributions to the health system attributable to the household through taxes, social security contributions, private insurance, and direct, out-of-pocket payments. These include financial outlays that the household itself is not necessarily aware of paying, such as the share of sales or value-added taxes that governments then devote to health. For taxes that are not earmarked and for social security contributions, total household payments must be multiplied by the share of these revenues that ultimately goes to finance the health system. [8]

To operationalize the denominator of HFC, we need to define effective income and subsistence expenditure. Our notion of effective income is meant to reflect household tendencies to smooth consumption over time, taking account of expected variations in income over the course of the year, their assets (allowing for saving or non-saving) and their future earnings potential. There is a rich literature in economics offering different theories of how households make consumption decisions. For example, in the life cycle income hypothesis, households are assumed to smooth their consumption over the life cycle, such that expected consumption is equal in all subsequent time periods. One formulisation of this theory of consumption behaviour that is adapted to the circumstances of health is:

$$C_0 = \frac{Y_0 + A_0 + \sum_{t=1}^{l} Y_t P_t \delta^t}{1 + \sum_{t=1}^{l} P_t \delta^t} \qquad (2)$$

Where C_0 is the consumption of a household at time t = 0, given complete access to mechanisms to smooth consumption and consume assets, Y_t is the income at time $t \geq 0$, P_t is the probability of being alive in each future year, A_o is the net value of assets (savings or debts) at time t = 0, and δ is 1/(1+r), where r is the market interest or discount rate, equal for all households .

The life cycle hypothesis is a positive theory of consumer behaviour. In this context, the discount rate must be the discount rate of the individual or household. However, for the purposes of defining the capacity to pay of a household, we do not want to use the subjective present value of future consumption, but rather the financial present value. In other words, the discount rate should be the market rate of interest. The life cycle income hypothesis is particularly important for three sets of circumstances: when households face predictable fluctuations in income during the course of the year, when their income in future years is expected to change and when they have positive assets or negative assets (debts). A household is likely to consume in a year, more or less, than it earns, in all of these circumstances.

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[8] Two potentially important sources of finance for the health system in some countries, donor assistance and government non-tax revenue through the sale of assets such as oil, need further discussion. Donor assistance is paid for by households in other countries through voluntary contributions or taxes; therefore, we do not include donor assistance in the definition of household health expenditure in the recipient country. Oil revenue or the sale of any other national asset is a more difficult issue. One argument holds that national assets are owned equally by all households. Thus government revenues from their sale should be attributed in equal amounts to all households. Such financing would appear to be extremely regressive because the same dollar value of sales for a poor household would be a much larger share of income than for a rich household. Alternatively, it can be argued that sale of assets should be treated in the same way as donor assistance and not attributed to households in the analysis of fairness in financial contribution, so that it has no effect on the measure. A third possibility is to attribute in proportion to the capacity to pay, so the effect is neutral.

For households to succeed in smoothing consumption over long periods of time, effective formal or informal mechanisms must exist to allow borrowing on the basis of the present value of their future earnings or saving earnings in a form of assets that can be subsequently sold as needed. If households possess assets, in most settings these can be sold and converted into effective income although temporary problems may exist that impede the sale of assets and create liquidity problems for households. A more important problem is that in many countries mechanisms may not be available to allow households to increase consumption by borrowing on the basis of future earnings.

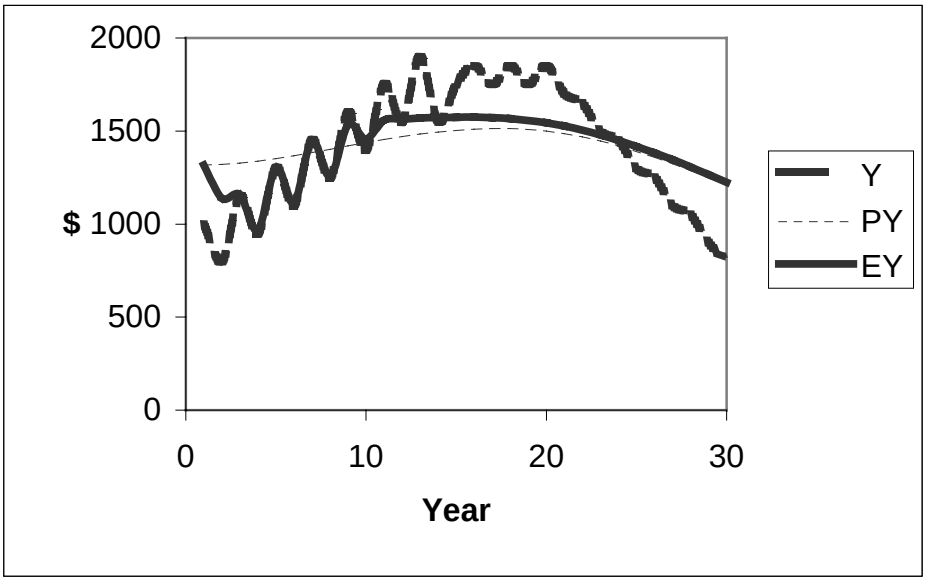
Because of the imperfections of formal and informal mechanisms to smooth consumption, the income that a household is able to consume and would seek to consume accordingly given its current income, assets and access to future earnings could differ from that predicted by the life cycle hypothesis. Where no mechanisms exist to borrow or save, effective income equals income at that time; where imperfect mechanisms exist, consumption would be somewhere between current income and expression 2.*(Behrman 1995)* One of the many ways to model the effects of the limited access of mechanisms to borrow is:

$$(3) \qquad C_0 = Min\left[\frac{Y_o + A_0 + \sum_{t=1}^{L} Y_t P_t \delta^t}{1 + \sum_{t=1}^{L} P_t \delta^t}, Y_o + A_0 F_0 + \sum_{t=1}^{L} Y_t P_t F_t \delta^t\right]$$

Where F_t is a measure of the access a household has currently to future earnings at time t. The *Min* expression means that a household would like to consume at the level suggested by the life cycle hypothesis, but when its access to borrowing is less than what is required it is forced to consume less. When all F_t are zero, but $F_0 > 0$, households cannot draw on future income, but are limited in their consumption to current income and current assets.

At first pass, the notion of consumption smoothing may be confusing. Figure 3 shows a simple illustrative example. Annual income for the household shown is expected to increase irregularly for the next 15 years and then steadily decrease. If the household has access to mechanisms to smooth consumption, then we would expect the household to consume the amounts shown by the pink line. In the absence of effective mechanisms to smooth consumption, consumption may be as shown in the dashed line.

Figure 3:



Considerations of fairness in financial contribution are normative and the denominator in HFC needs to be defined in terms of some meaningful comparable standard across households. Reflecting the desire of households to smooth consumption over time and the limitations to consumption smoothing in many environments, we define effective income as the level of consumption that a household would seek and is able to consume, based on a life cycle perspective assuming that all households share a standard discount rate. To avoid all ambiguity, we are argue that effective income is as defined in equation 3 with the added constraint that all households use the market interest rate as the discount rate.

Because we define capacity to pay in terms of effective income, it leads naturally to certain conclusions about what should be included in the denominator. For example, subsidies raise a household's net income and therefore its effective income. Likewise, tax payments generally lower income and effective income. [9] Because F_t cannot be easily observed, estimating effective income presents a number of challenges that are addressed in the section on implementation.

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[9]Medical savings accounts are an interesting illustration of how the measure depends on the nature of an asset. In Singapore, Medisave is a mandatory savings account of a certain percentage of income that can only be used to pay for health services. When a household pays for healthcare from a medical savings account, the expenditure is clearly to be included in HE, the numerator of HFC. But how does the medical savings account affect effective income? Because a medical savings account can only be used to pay for health care, it has a different effect on effective income than regular assets. When it is used, it increases effective income by the same amount that is used in the numerator.

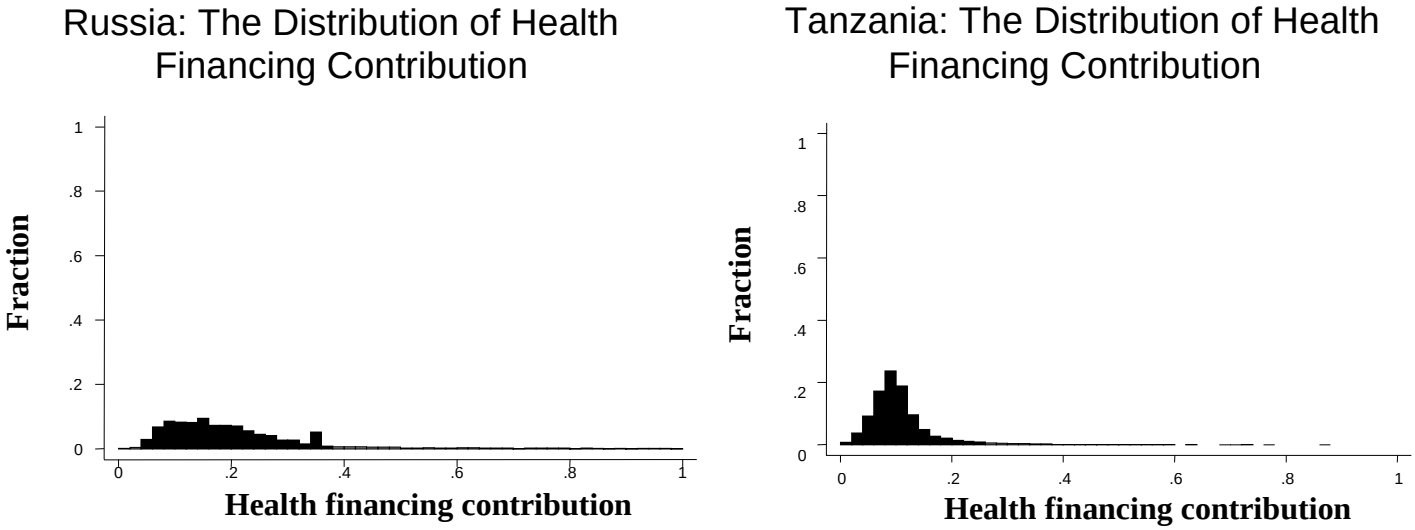
The second step in defining capacity to pay is to define expenditure required for subsistence. There is an extensive literature on basic needs which addresses this question .(Sen A 1981;Sen A 1984;Sen A 1985;Streeten P et al. 1981)Clearly, subsistence expenditure for the purposes of defining HFC should not include expenditure on health even if it is seen as essential. Subsistence minimally includes expenditure on food, basic shelter and minimal clothing. Implementation of the definition of subsistence will address the important problem of using definitions that are comparable across populations.

Household composition will have an important effect on total subsistence expenditure. The capacity to pay and thus HFC will, therefore, reflect differences across households in their composition. In principle, it will be important to develop estimates of actual subsistence requirements for different households that reflect the composition of households and their circumstances. Expenditure required for subsistence can vary with local events. For example, during a famine the fraction of income required to purchase subsistence needs may increase dramatically. The conceptualization of HFC as effective non-subsistence income (ENSY) captures these effects.

C. Summarizing the distribution of HFC

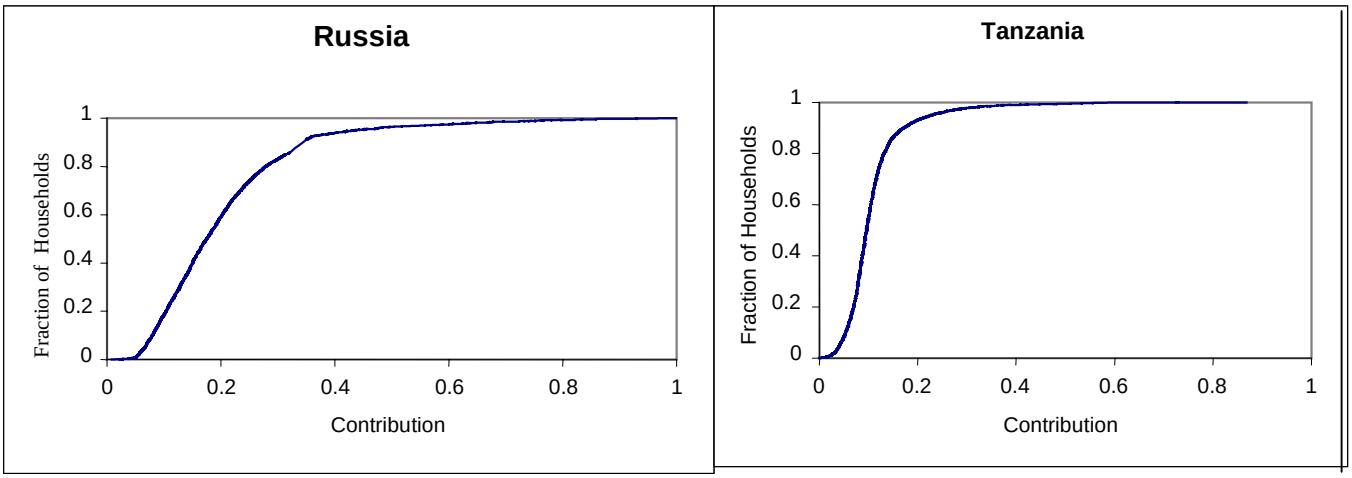
We have formally defined HFC so that for each country one could with the appropriate information on health expenditure, effective income and subsistence expenditure, estimate the household distribution of HFC. Figure 4 shows the distribution for two countries (the Russian Federation and the United Republic of Tanzania) based on the analysis of household survey data.

Figure 4:



The distribution of HFC in the Russian Federation is much broader than for the United Republic of Tanzania; there are more households contributing catastrophic shares of their capacity to pay to the health system than in the United Republic of Tanzania. Even in the lower ranges of capacity to pay, there is much more inequality in the Russian Federation than in the United Republic of Tanzania.

Cumulative Distribution of Households Health Financial Contribution



Distributions of Households According to Health Expenditure as a Fraction of Effective Non-Subsistence Income

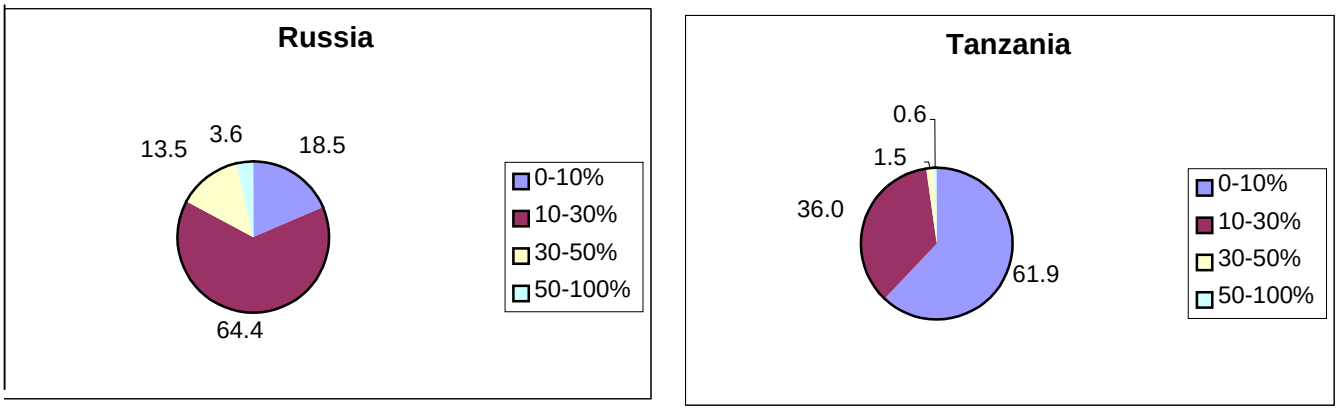


Figure 4 also shows the information contained in the distribution of HFC in two other ways: a pie chart emphasizing the percentage of households with very high shares of their capacity to pay spent on health and a line chart representing the cumulative distribution across households of HFC. Such graphical representations of the distribution of HFC are all informative in different ways. But when we want to compare many such distributions across countries, it is necessary to develop an index that can summarize the extent of inequality in the distribution of HFC. This is analogous to the problem of comparing distributions of income where measures such as the Gini coefficient are commonly used to represent distributions as a single index.

While there is a vast literature on indexes of inequality to summarize distributions, the development of this index should take into account the special concern we have about catastrophic spending. This means that the right hand tail of the distribution should be heavily weighted.

Preference measurement through the survey of health systems preferences discussed above is also informative. When faced with a choice between distributing the burden of health finance among two households as opposed to concentrating the burden in a single household, more than 70% of respondents favoured distributing the burden across the households (Tables 1B, 1C, 1D). This preference for a shared burden is robust to varying the magnitude of the financing burden from 25 to 100 percent of household disposable income. This is consistent with a strong preference for protecting individual households from catastrophic expenditures and for sharing the burden of health financing across households.

One family of inequality measures that can be designed to give special weight to the tail of the distribution, compares the quantity of interest, in this case each individual's financial contribution, to the mean of the population. The general form of such individual-mean difference (IMD) measures is:

$$(4) \qquad IMD(\alpha,\beta) = \frac{\sum_{i=1}^{n} \left| HFC_i - \mu \right|^{\alpha}}{n\mu^{\beta}}$$

where HFC_i is the financial contribution of household i, μ is the mean financial contribution of the population, and n is the number of households in the population. The choice of the parameter α determines the significance attached to differences in the health financial contribution observed at the tails of the distribution, compared to differences observed close to the mean of the distribution. The parameter β determines the extent to which the measure is relative to the mean as opposed to measuring absolute differences. If β=1, the measure is strictly relative and when β=0 the measure is restricted to absolute deviations from the mean. β can take any value between 0 or 1, reflecting some mix of concern for relative and absolute individual-mean differences. Variance is a measure of individual-mean difference where α = 2 and β=0, and the coefficient of variation corresponds to α = 2 and β=1.

We argue that to give appropriate emphasis to households spending catastrophic shares of their capacity to pay, α should be greater than 2. We have selected a value of 3 for simplicity. So that the index is not affected by the level of spending we have set β equal to zero. This means that the index has translation independence, namely that a fixed quantity added to every household will not affect the extent of inequality.

Finally in constructing an index of Fairness of Financial Contributions to Health (IFFC), we have rescaled the measure so that it has unit value when all households pay the same fraction of their capacity to pay; in other words, 1.0 means complete equality of HFC. A constant has been added to the index so that the minimum value represents a maximum distribution of inequality that is not exceeded in any empirical example studied:

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

We have compared results for a number of countries using some alternative values of α. For example, there is little impact of changing α from 2 to 3. We expect to continue work in this area in order to explore the properties of other indexes to summarize the distribution of HFC. We also intend to investigate individual preferences further as a basis for guiding the selection of the parameters and rescaling of the index.

D. Other aspects of the distribution of HFC

As with any measure, there are some issues that are not captured in the distribution of HFC or in the IFFC. It is important to note that the distribution of HFC will not show if a poor household chooses not to purchase healthcare because it is unaffordable. In this sense, a fair distribution of HFC may mask a situation where poor households have opted out of the system and are not receiving needed health services. This lack of financial access to needed services will reduce overall health of the population and increase health inequality. It is also likely to reduce responsiveness and increase responsiveness inequality. This simply emphasizes the importance of judging the overall equity of a health system in terms of the distribution of health, responsiveness and financial contribution.

The relation between the distribution of HFC and the extent of financial risk protection in a population is important. Measures of financial risk protection such as the coverage of insurance are difficult to interpret because the benefits packages, co-payments and premiums for insurance vary so much within and across populations. The ex post distribution of health expenditure across households is a good estimator of the average ex ante distribution of financial risk in the population. In other words, in a very large sample, the distribution of health expenditure last year (the ex post distribution) will equal the average ex ante distribution of financial risk across households. Because health expenditure is in the numerator of HFC, changes in the ex ante distribution of financial risk will be reflected in changes in the distribution of HFC. Nevertheless, it is important to recognize that the distribution of HFC may not capture all the inequality in the distribution of ex ante financial risk protection. However, if average ex ante financial risk is correlated with effective income or subsistence payments then the distribution of HFC will reflect these differences. We conclude that because the ex post distribution of expenditure can be measured through household surveys and the ex ante distribution of financial risk is extremely difficult to measure, the distribution of HFC is a convenient and feasible measure of fairness in financial contribution and of ex ante financial risk protection.

VI. Measurement Properties of the IFFC

In this section, we will use a hypothetical population to illustrate the properties of the IFFC: the distributions of income per capita, ex ante health expenditure risk, and food expenditure per capita are based on real populations. We use simulations that are explained in more detail below to show how the distribution of HFC across households would change as prepayment mechanisms are introduced in a population

and as the progressivity of the fees or prepayments is increased. These simulations also allow us to explore the phenomenon of opting out and to contrast the measurement properties of the IFFC and the widely used measure of vertical equity, the Kakwani index.

To calculate the distribution of HFC across households in a population, we need information on income, subsistence expenditure, and the risk of health expenditure. Health expenditure risk is a function of the available technology and its cost and the risk of illness. We have developed the simulations for a population of 2000 households, which can be considered equivalent to monitoring fairness of financial contribution in a larger population using a random sample survey of 2000 households. The assumed distributions of the key quantities have been developed from averaged results from selected households surveys to make sure they are realistic.[10],[11]

One important phenomenon that we want to present in these simulations is that households may need to borrow in order to pay for healthcare, because health expenditure exceeds the capacity of a household to pay. In the simulations, we have assumed that households faced with a health expenditure that is three times greater than capacity to pay will choose to not pay and not to receive care.

Table 2 summarizes the base case when there is no prepayment to allow risk pooling. In the base case, 5.7% of households are spending more than 50% of their capacity to pay for health. Four households in a thousand (0.4%) are choosing not to purchase care because it is unaffordable. The IFFC is 0.347 and the Kakwani index is –0.3, showing how out-of-pocket payment is highly regressive. The figure of 5.7% of households facing catastrophic payment is high, but lower than that found in a number of countries in real survey results.(Xu et al. 2000)

[10]Per capita income is simulated using a log normal distribution with quartiles at $US 562, 838 (median) and 1251, corresponding to a mean of $US1000 and a standard deviation of $US650. The subsistence share is a decreasing share of total household expenditure and the parameters are drawn from the household survey data mentioned above. The formula for subsistence expenditure (percentage spent on food) is :

$$(6)\quad pctfd_i = \exp(\alpha + \beta * \ln(income_i)$$

Where $\alpha = 2.24$ and $\beta = -0.5$

Health expenditure risk is simulated using a log normal distribution with quartiles at $US 14, 25 (median) and 67, corresponding to a mean of $US60 and a standard deviation of $US100. The mean corresponds to an average of 6% health expenditure across countries. Again, the distribution is parameterised using survey data for out of pocket expenditure. Using realised expenditure as a proxy for ex ante health expenditure risk has certain caveats. These two variables will tend to coincide, at least ex post, when there is risk pooling. Still, using the realised expenditure from survey data does not provide information on the risk from health *needs*, but only the distribution of those needs that actually resulted in expenditure. The risk associated with actual health need may be either less or more that realised expenditure. In the absence of independent data on medical needs, we draw a distribution from the survey data

[11]In this simulation, we assume that the distribution of ex ante health expenditure risk is the same for all households. In fact, the distribution may be shifted to the right for poorer households because they have worse health status. This covariance between the ex ante distribution of health expenditure risk and income per capita is not included in this illustration.

To illustrate the properties of the IFFC, we introduce into this population two policy changes. First, we introduce risk pooling through some form of universal insurance coverage. Figure 5 illustrates a form of risk pooling that begins by covering the highest cost healthcare risks. Risk pooling of 10% means that the highest costs are pooled and charged in a uniform premium to all households up to the point that 10% of total expenditure is covered. This assumption corresponds to an insurance that is ideally suited to protect against catastrophic costs, far more than any country's actual financing arrangements, but is regressive because premiums are not related to capacity to pay (the index of progressivity is zero).Expanding risk pooling means that the universal insurance covers lower and lower health care costs. Individual households still face the full cost of non-pooled risks. When risk pooling reaches 100% there are no out-of-pocket payments and all health expenditure is through pre-payment.

Figure 5:
Distribution of health expenditure risk

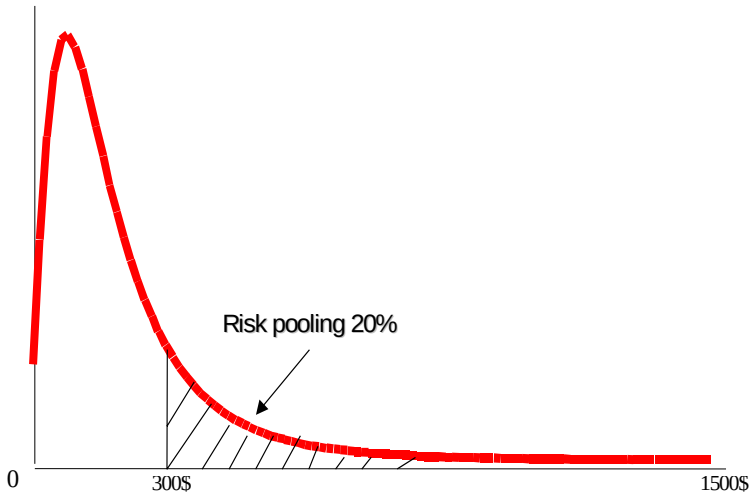


Figure 6:

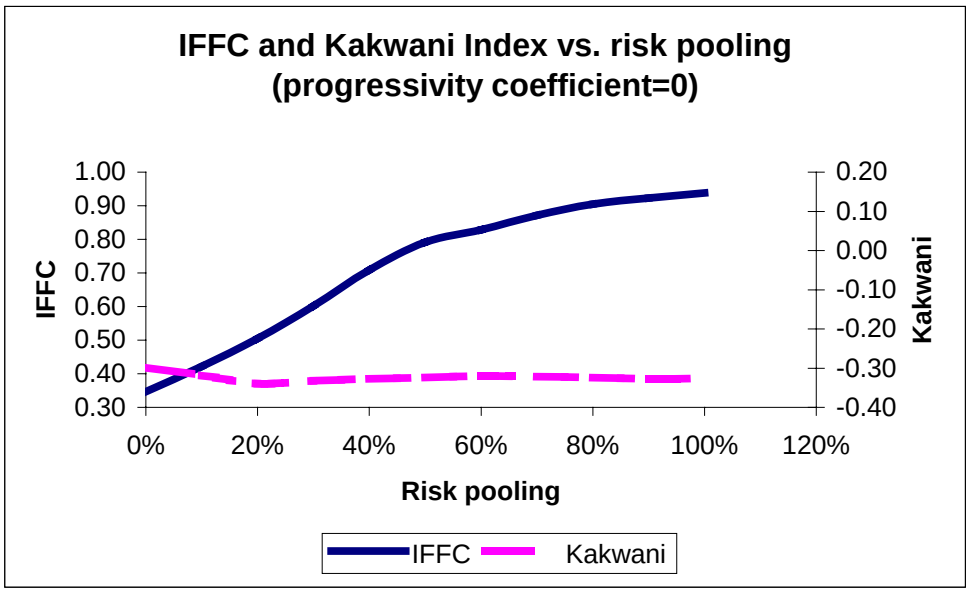


Figure 6 shows the IFFC and the Kakwani index as a function of risk pooling. Increasing risk pooling protects more and more households from catastrophic health expenditures and thus makes the distribution of HFC more equal and the IFFC closer to one. Figure 6 also indicates that increasing risk pooling has had little or no beneficial effect on the overall progressivity of payment according to the Kakwani measure.[12]

In fact, the initial expansion of risk pooling makes the Kakwani index more negative because access to prepayment means that fewer poor households will opt out of receiving care, so that the total contribution of the poor to the financing of the health system increases. Clearly, a concern about fairness that includes avoiding catastrophic payment is captured in the IFFC but not in the Kakwani index.

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[12] We present the results for both the IFFC and the Kakwani index for each simulation exercise. The Kakwani index has the following formula:

(7) Kakwani Index = Concentration Index – Gini Coefficient

where the

$$Concentration\ Index = 1 + \frac{1}{n} + \frac{2}{n^2 mu}(HE_1 + HE_2 + HE_3 + ... + HE_n)$$

n= Sample size

HE= Health expenditure, $HE_1 > HE_2 > ..... HE_n$

mu= Mean

and the Gini coefficient is calculated with respect to total household expenditure or income.

The second policy option that we use to explore the properties of the IFFC is the progressivity of payments. If we make the out-of-pocket payments (and the prepayments, as risk pooling is introduced) a function of income, we can test how the IFFC changes with the introduction of more and more progressive contributions. . To capture progressivity, we define a single parameter β such that :

(8) $$AHER_i = HER_i * Z * Y_i^{\beta}$$

Where $AHER_i$ is the adjusted health expenditure risk, HER_i is the health expenditure risk for a household, Y is income, and Z is a constant such that under any regime of progressivity total revenue collected is constant. When β equals zero, fees and prepayment are not a function of income. When β equals one, then fees and prepayments are neutral with respect to income that is they are defined in terms of shares of income. When β is greater than one, fees and prepayment are progressive. A plausible range of 0 to 1.4 for β, based on country experience, has been used in the simulations. Figure 7 shows the IFFC and Kakwani index or a population with no risk pooling as a function of β. Both the Kakwani index and the IFFC increase as progressivity is increased.

Figure 7:

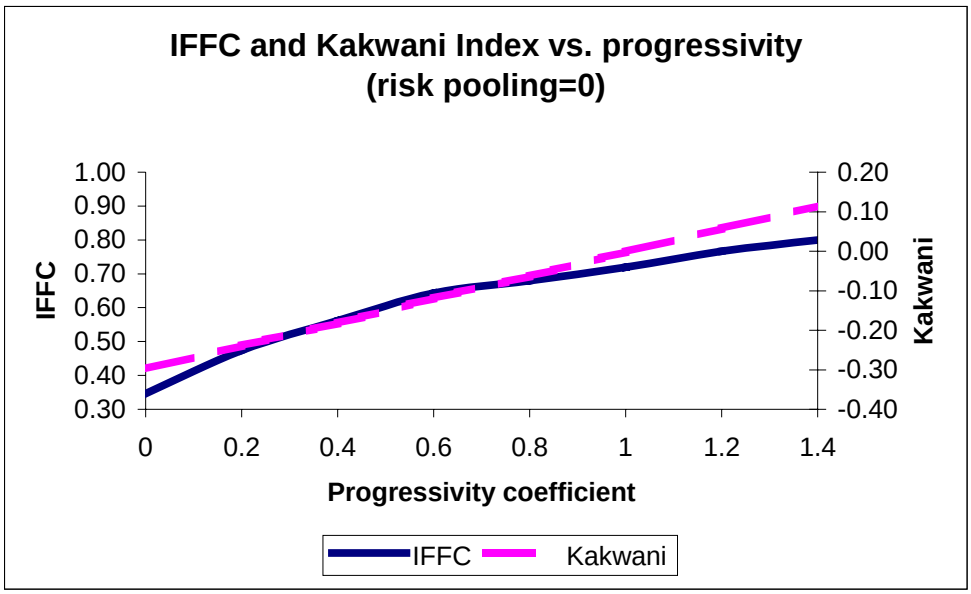


Table 2A and Figure 8 illustrate the combined effect on IFFC of extending risk pooling and introducing progressivity into the fee schedules. IFFC clearly captures both the extension of financial risk protection and progressivity. In other words, the distribution of HFC as summarized by the IFFC captures at least two of the initial considerations that we set out for its development. In contrast, the Kakwani index is largely insensitive to the extension of financial risk protection (Table 2C and Figure 9), for a given degree of progressivity.

Figure 8: IFFC as a function of risk pooling and

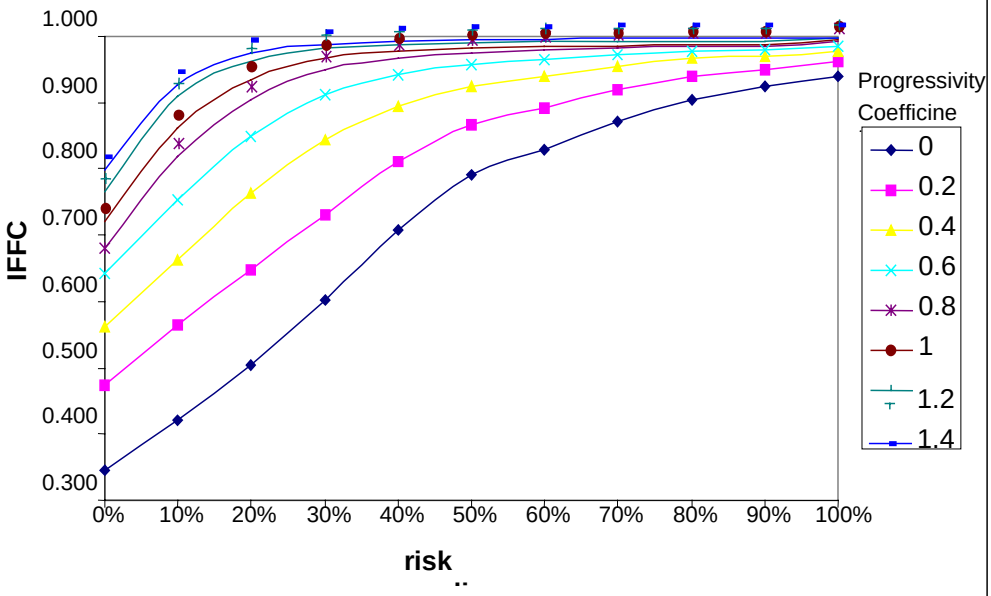
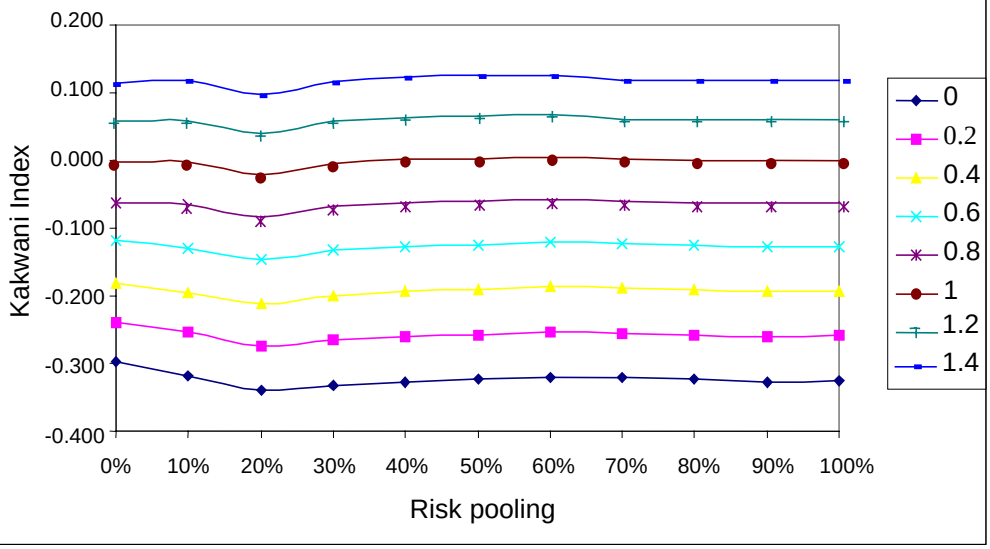


Figure 9: Kakwani Index and risk pooling, varying the degree of progressivity



Tables 2A, 2B, 2C and 2D: Simulation of IFFC, Catastrophic Health Expenditure, Kakwani Index and Health Expenditure Risk Exceeding the Borrowing Constraint, varying the degree of progressivity and risk pooling and applying universal population coverage

Table 2A: IFFC Index of Fairness of Financial Contribution

		Progressivity							
Risk	Threshold	0	0.2	0.4	0.6	0.8	1	1.2	1.4
0%	1500	0.347	0.474	0.562	0.643	0.680	0.720	0.767	0.800
10%	504	0.422	0.565	0.662	0.752	0.817	0.862	0.909	0.928
20%	304	0.505	0.648	0.763	0.849	0.904	0.935	0.963	0.976
30%	211	0.601	0.731	0.843	0.912	0.949	0.966	0.981	0.988
40%	155	0.708	0.810	0.894	0.941	0.966	0.977	0.988	0.993
50%	116	0.791	0.865	0.925	0.958	0.975	0.982	0.991	0.995
60%	87	0.829	0.891	0.940	0.965	0.979	0.984	0.992	0.996
70%	63	0.872	0.919	0.955	0.972	0.982	0.986	0.992	0.996
80%	44	0.905	0.941	0.966	0.977	0.984	0.987	0.992	0.996
90%	27	0.923	0.950	0.971	0.979	0.985	0.987	0.992	0.996
100%	0	0.939	0.961	0.977	0.986	0.991	0.995	0.997	0.999

Table 2B: Proportion of Households with Catastrophic Health Expenditure

	Threshold	Progressivity							
Risk	($)	0	0.2	0.4	0.6	0.8	1	1.2	1.4
0%	1500	5.65	4.75	4.35	3.50	2.45	2.15	1.80	1.60
10%	504	5.35	4.40	3.85	2.90	1.70	1.45	1.05	0.90
20%	304	4.75	3.95	2.85	1.95	0.80	0.30	0.10	0.00
30%	211	3.70	2.90	1.90	1.05	0.30	0.05	0.05	0.05
40%	155	3.00	2.25	1.15	0.60	0.05	0.05	0.05	0.05
50%	116	2.10	1.55	0.75	0.25	0.10	0.05	0.05	0.05
60%	87	1.70	1.05	0.60	0.20	0.10	0.05	0.05	0.05
70%	63	1.10	0.65	0.50	0.15	0.05	0.05	0.05	0.05
80%	44	1.00	0.30	0.30	0.10	0.05	0.05	0.05	0.05
90%	27	0.90	0.35	0.15	0.10	0.10	0.05	0.05	0.05
100%	0	0.60	0.25	0.15	0.05	0.05	0.05	0.05	0.05

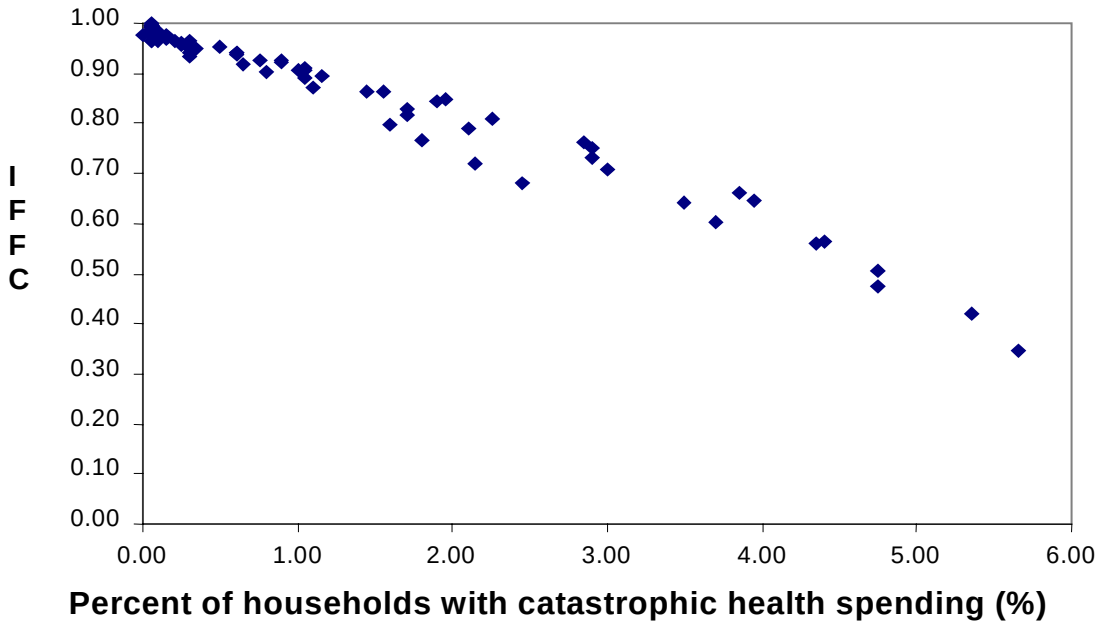
Table 2C: 'Kakwani Index

	Threshold	Progressivity							
Risk	($)	0	0.2	0.4	0.6	0.8	1	1.2	1.4
0%	1500	-0.298	-0.239	-0.182	-0.119	-0.063	-0.002	0.058	0.115
10%	504	-0.319	-0.254	-0.195	-0.129	-0.065	-0.002	0.059	0.117
20%	304	-0.339	-0.275	-0.212	-0.148	-0.084	-0.022	0.039	0.099
30%	211	-0.332	-0.266	-0.199	-0.133	-0.068	-0.005	0.057	0.117
40%	155	-0.328	-0.261	-0.194	-0.128	-0.063	0.001	0.063	0.123
50%	116	-0.324	-0.258	-0.191	-0.125	-0.060	0.003	0.065	0.125
60%	87	-0.320	-0.253	-0.187	-0.121	-0.057	0.005	0.066	0.125
70%	63	-0.321	-0.255	-0.189	-0.124	-0.060	0.002	0.061	0.118
80%	44	-0.324	-0.257	-0.191	-0.126	-0.062	0.000	0.060	0.118
90%	27	-0.327	-0.260	-0.194	-0.128	-0.064	-0.001	0.060	0.119
100%	0	-0.326	-0.259	-0.193	-0.127	-0.063	0.000	0.061	0.119

Table 2D: Proportion of Households that Cannot Afford Health Care (Health Expenditure Risk Exceeds the Borrowing Constraint of 3 Times Capacity to Pay)

	Threshold	Progressivity							
Risk	($)	0	0.2	0.4	0.6	0.8	1	1.2	1.4
0%	1500	0.35	0.3	0.15	0.1	0	0	0	0
10%	504	0	0	0	0	0	0	0	0

Figure 10: IFFC vs. Catastrophic health spending



In developing HFC and the IFFC, avoidance of catastrophic spending by households was identified as an important component of fairness in financial contribution. Table 2B and Figure 10 illustrate that regardless of the level of risk pooling or progressivity in the simulations, IFFC is closely related to the fraction of households facing catastrophic spending on health. Here we have defined catastrophic spending as households that actually spend more than 50% of their effective income after paying for subsistence needs. Estimates of the number of households which would forego health care because the cost would exceed three times their capacity to pay are given in Table 2D. With the assumption about risk pooling starting at the highest costs, even a very low degree of pooling, or a modest degree of progressivity, is enough to eliminate the likelihood of facing such high costs. The close mapping of the IFFC to the percentage of households with catastrophic health spending (correlation of –0.987) means that the IFFC values capture this component of fairness. For the same set of simulations, the correlation between the Kakwani index and the percentage of households facing catastrophic spending was much lower, only –0.558. The IFFC is also highly sensitive to the progressivity of finance, as is the Kakwani measure.

These findings—that the IFFC is more closely related to both the degree of risk pooling and the share of households facing catastrophic expenditures than the Kakwani index is—also emerge from simulations with other assumptions about risk pooling, such as random coverage of the population or coverage that starts with the richest households and is extended toward the poorest. All these simulations are drawn from the same distributions of capacity to pay and of household ex ante financial risk, so they all have essentially the same mean HFC. If two populations have the same mean, to which all households are compared, then any increase in the variance or higher moments of the distribution will increase the number of households facing catastrophic risks and also lower the index of fairness as households are spread farther from the mean and are more unequal among themselves.

When populations with different means are compared, the association between IFFC and the risk of catastrophic expenditure is naturally weakened, because if all households are tightly clustered around a high mean value of HFC there will be little inequality but there can still be a large number facing high expenditure risks. Simulations in which all values of HFC are doubled, continue to show a strong correlation as progressivity and risk pooling are varied, but there is less correlation when simulations with high and low means are compared. Nonetheless, the index of fairness is related to catastrophic risk even over a range of mean HFC from under four percent to over 20 percent, when 21 countries are compared .(Xu et al. 2000) High average contributions, as a share of capacity to pay, tend to be associated empirically with high variance in the distribution, so that both IFFC and catastrophic risk are greater than for distributions with lower means and less variation among households.

Further analyses and policy simulations for particular populations will be helpful in delineating the measurement properties of HFC and the summary across households, the IFFC.

This discussion has contrasted the IFFC with the Kakwani index, because health system financing is often judged by the degree of progressivity alone and because progressivity is usually the dominant component of the total re-distributive effect of health care financing .(Van Doorslaer E & Wagstaff A 1999) The full re-distributive effect can be written as:

(9) $$RE = V - H - R \qquad V = \frac{gk}{(1-g)}$$

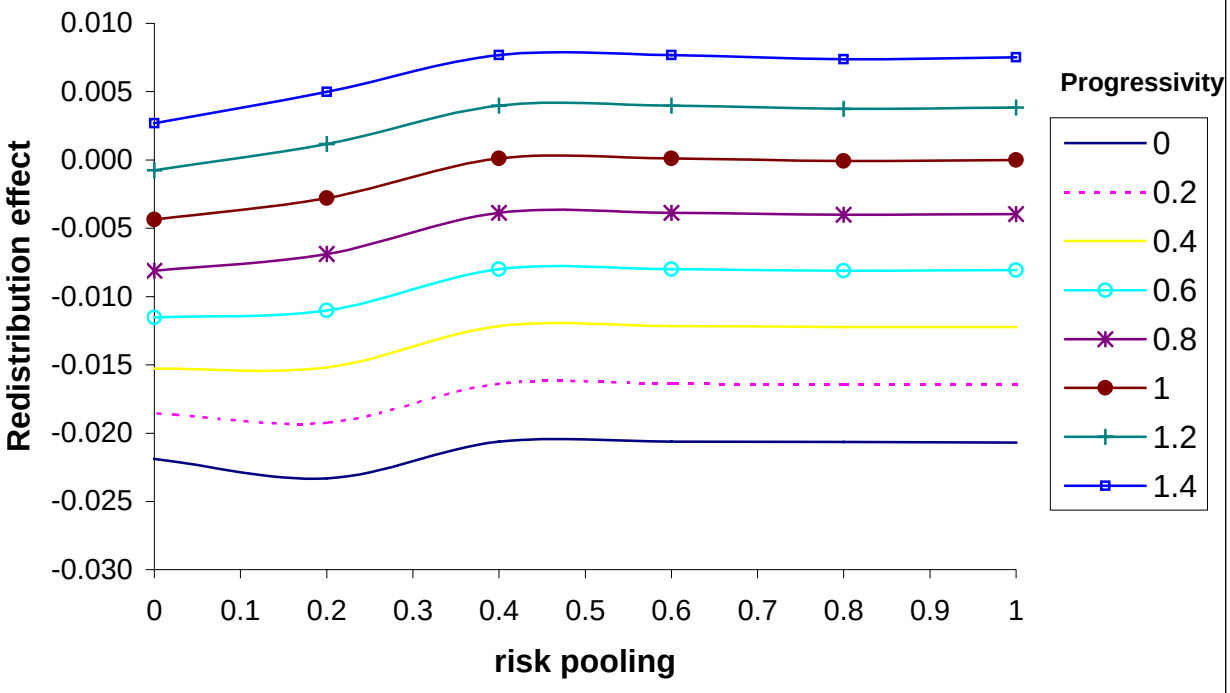
where K is the Kakwani index, g is the mean share of health spending in total household expenditure, equivalent to HFC except for the adjustment for subsistence spending, H is the effect of horizontal inequity and R is the effect of re-ordering households, compared to the distribution prior to paying for health care (zero if no such re-ranking occurs). The re-distributive effect can be computed for each source of finance separately as well as for the total. In the simulations reported here, only the total effect is considered, but since out-of-pocket payments have a large negative re-distributive effect (worsening inequality of HFC) while risk pooling has a positive effect (reducing inequality), the overall effect depends on the degree of risk pooling as well as on the progressivity of both modes of finance.

Table 3 and Figure 11 show the results of the simulation: the total income re-distributive effect is strongly related to progressivity, but is largely insensitive to the degree of risk pooling, even when risk pooling is assumed to cover the largest expenditures preferentially. The pattern in Figure 11 resembles that for the Kakwani index alone, in Figure 9, except that for degrees of progressivity greater than 0.2, the re-distributive effect always improves at risk pooling is extended. In contrast, the Kakwani index always worsens as pooling increases from zero to 20 percent because more households become able to spend on health. As with the Kakwani index, the total re-distributive effect bears little relation to the risk of catastrophic spending when risk pooling starts with the highest expenditures, and no relation at all if risk pooling is random or favors the rich over the poor.

Table 3: Total redistribution effect as a function of risk pooling and progressivity

	Risk Pooling					
Progressivity	**0%**	**20%**	**40%**	**60%**	**80%**	**100%**
0	-0.0219	-0.0233	-0.0216	-0.0206	-0.0206	-0.0207
0.2	-0.0185	-0.0192	-0.0173	-0.0164	-0.0164	-0.0165
0.4	-0.0153	-0.0152	-0.0130	-0.0122	-0.0122	-0.0122
0.6	-0.0115	-0.0110	-0.0088	-0.0080	-0.0081	-0.0081
0.8	-0.0081	-0.0069	-0.0046	-0.0039	-0.0040	-0.0040
1.0	-0.0044	-0.0028	-0.0005	0.0001	-0.0001	0.0000
1.2	-0.0008	0.0012	0.0035	0.0040	0.0037	0.0038
1.4	0.0027	0.0050	0.0073	0.0077	0.0074	0.0075

Figure 11: Total redistribution effect as a function of risk pooling, varying the degree of progressivity



In summary, we have demonstrated that the IFFC reflects the extent of catastrophic spending in the population, the progressivity of payments and the extent of financial risk pooling. One set of simulations is not sufficient to demonstrate all the properties of the distribution of HFC and the IFFC. Further analyses and policy simulations for particular populations will be helpful in delineating their measurement properties

VII. Estimating the Distribution of Health Financing Contribution

In order to measure HFC, particularly across countries, a number of data sources and several simplifying assumptions are required. This section first discusses data requirements and then provides detailed information on the mechanics of calculating HFC using survey data. These reflect the empirical work that is presented elsewhere.(Xu et al. 2000) The final part of this section discusses some of the data limitations.

A. Data Requirements

HFC is based primarily on information gathered through national household surveys, combined with detailed information on the rules governing taxation and social security payments for health, and National Health Accounts (NHA) estimates .(Van Doorslaer E & Wagstaff A 1999) National household surveys are required that include household or individual-level data on income, total expenditure, and expenditure on specific goods and services (especially food, out of pocket expenditure on health, and private health insurance premiums). These data are usually available from particular classes of surveys:

National Income and Expenditure Surveys (IES) undertaken by most countries on a sporadic basis often with the primary purpose of measuring income inequality and basic expenditure patterns(Poullier JP & Hernandez P 2000);

- multipurpose, multilevel surveys such as Living Standard Measurement Surveys (LSMS) or the Surveys of Quality of Life undertaken by many developing countries on a sporadic basis, often with the support of a multilateral agency such as the World Bank;

- National Health Surveys or Demographic and Health Surveys (DHS) undertaken regularly by many developed and developing countries and designed to measure health status, but sometimes also including measures of health spending; and

- Specific surveys of health expenditure that are available for only a few countries.

These surveys sometimes report spending on direct (but not indirect) taxes. Where they do not, government tax documents and other published material is consulted and the tax schedule is used to estimate taxes paid by a household on the basis of its reported income, wealth and consumption. This is complemented with information regarding social security and health insurance laws that provide information on premiums and other contributions to the health system. NHA figures (compiled by WHO for all countries) provide estimates of various components of health expenditure from private and public sources.(Van Doorslaer E & Wagstaff A 1999) NHA estimates also provide a benchmark to check the reliability of the survey data on health expenditures by comparing them to national aggregates. Health Systems Profiles that describe the structure and financing of the health system are also necessary.

B. Estimating HFC

Health expenditure, the numerator of HFC, can be estimated with data from household surveys, tax and social insurance schedules and national health accounts. The denominator of HFC requires estimates of effective income and subsistence expenditure. The simplest way to estimate effective income is to assume that households do not have access to any mechanisms to smooth consumption. In the terms of equation (3), F_a and all F_t are assumed to be zero. Expenditure is then the best estimate of effective income. For simplicity in the first round of estimation we have adopted this approach; more refined approaches will be adopted in the future. In a similar fashion, we have estimated subsistence expenditure as simply equal to food expenditure.

In summary, as an interim strategy to estimate HFC, we have adopted the following formula for the contribution of household *i:*

$$(9) \qquad HFCi = \frac{Total\ health\ spending_i}{Capacity\ to\ pay_i} = \frac{HS_i}{(EXP + aTax - Food)_i}$$

The term *aTax* in the denominator represents taxes paid by the family that are not included in expenditure, plus social security contributions; the calculation is explained in detail below. In the formulas that follow, the subscript *i* refers to information at the household level and *N* refers to information at the national level. All figure are monthly, and where other periods are reported, these are simply scaled. If the survey is conducted over more than one month and the inflation rate is high over these months, all expenditures are deflated to a common month according to the Consumer Price Index (CPI).

The ***numerator*** of HFC, *total household health spending* (HS_i), is the sum of prepayment and out of pocket payment to the health system. There are three components in the calculation of prepayment:

$$(10) \qquad prepay_i = TGSH_i + (SSH_i * scalar(W)) + PRV_i$$

The first component of prepayment ($TGSH_i$), is the share of *total government spending which is used for health* at the national level, which is estimated as the ratio of *total public spending on health* (PSH_N) to *total government spending* (TGS_N), both net of *social security payments to health* (SSH_N). This is then multiplied by total government revenue derived from the individual household, to give an estimate of the *household's contribution to government spending on health.* The full expression for TGSHi is formalised as:

$$(11) \qquad TGSH_i = \left(\frac{PSH - SSH}{TGS - SSH}\right)_N * (Scalar(X) * (INCTAX + VAT + other)_i)$$

where (*INCTAX + VAT + other)* is the estimate of the household's contribution to total government revenue. This is adjusted by a scalar, *X*, to take account of the fact that the sum of estimated revenues from all households in the survey may not match the national accounts estimates of public revenues, just as the survey may not provide accurate estimates of total private consumption or GDP. The calculation of *X* is described below.

Total government revenue incorporates all payments towards the financing of the health system through tax revenue (mainly income tax, sales and value-added tax and other taxes) and non-tax revenue. The estimation of each component depends on the amount of household-level data available from the household survey. Usually *income tax* ($INCTAX_i$) and *value-added tax* (including sales taxes, VAT) contributions from households can be calculated directly from the survey. Excise and property tax payments ($other_i$) are sometimes provided.

Whenever income tax ($INCTAX_i$) was not available directly from the survey, it was estimated from reported income from all sources including salaries and non-salary earnings (in-kind benefits) from all employment (including second job if relevant), combined with the country's tax schedule information. Not all individuals who are subject actually pay income tax. A reasonable assumption is that only the formal sector employees pay income tax, and that they can be identified using job classification questions from the survey. Evasion cannot be estimated but is assumed to be difficult for formal sector salaries. VAT and excise taxes are easier to assign to the various categories of good and services purchased by the household, by applying the corresponding tax rates to each family's expenditure pattern using the survey data. Other taxes (such as corporate tax, import taxes or property tax), excise and property tax when not reported in the survey, and non-tax revenue are estimated based on the tax information that is available in the survey.
The scalar X in equation (11) is used to assign non-tax and other tax revenue back to the household, according to the following formula:

$$(12) \qquad Scalar(X) = \frac{((TGS - SSH)_N / GDP_N) \quad * \quad GDPs}{(INCTAX + VAT + other)_i}$$

where GDPs is the estimate of GDP given by the survey. It is calculated as the weighted sum of all household expenditure over the share of total *private consumption* (PC) to GDP (at the national level). When household surveys do not provide weights, the ratio of sample population to total population is used to inflate the survey expenditure data to the country level.

$$(13) \qquad GDP_s = \frac{EXP_i}{(PC/GDP)_N}$$

We assume that total household consumption is equivalent to total private consumption. Strictly speaking, this is not the case since private consumption is the market value of all goods and services purchased, or received as income in-kind, by households and non-profit institutions (NGOs). The latter part not being captured in the household survey, we may underestimate total private consumption at the national level if the non-profit institution component is large.

Substituting from equation (13) into equation (12) shows that the numerator of (12) is just

$$(14) \qquad (TGS - SSH)_N * SUM_i \, EXP_i/PC_N$$

that is, total government non-social security revenue adjusted for the discrepancy between survey and national accounts estimates of private consumption. Substituting

from equation (12) into equation (11) then shows that the estimate of a household's tax contribution to financing health is just that household's share of reported total tax payments in the survey, adjusted for the discrepancy with national accounts, multiplied by the share of total public spending on health to total government spending, both net of social security spending on health.

The second component of prepayment in equation (10), is the total adjusted social health insurance premium of the household:

(15) $$SSH_i * Scalar(W)$$

The *household social health insurance premium* (SSH_i) is computed using the same algorithm as for the income tax calculation. Survey data are used if available. When this is not the case, the contribution rate (provided in social security/social health insurance laws) is applied to individual-level data on salaries. The assumption is that only formal sector employees, or full-time permanent workers, pay social health insurance. We assume that the employer's contribution is borne by the employees in the form of reduced salaries. For the computation, this implies that the employer's contribution rate should be added to that of that of the employee. While this assumption is strong, it simplifies the analysis and the comparison across countries and has been used in previous research (Wagstaff A & Van Doorslaer E 1999). It is important to stress that only the portion of social security contributions attributable to health is incorporated in the calculations. As with income tax, the social health insurance premium is assigned back to the household by summing over all individuals in the household who pay social health insurance premiums.

Survey data on social insurance contributions do not always coincide with NHA data. These discrepancies are essentially the result of under- or over-reporting of social security contributions in the survey data. Where this type of reporting bias arises it must be corrected. We use a scalar adjustment to ensure consistency between these two sources. The scalar is computed using the same adjustment as in *X* for discrepancies between survey and national accounts estimates of GDP. The share of social security on health at the national level ($(SSH/GDP)_N$), is divided by the sum of estimated social security contributions to health at the household level (SSH_i):

(16) $$Scalar(W) = \frac{GDP_s * (SSH / GDP)_N}{SSH_i}$$

The third component of prepayment s the total *private health insurance premium of the household* (PRV_i). Household contributions to private health insurance are often available from the household survey.

In some countries, employers also contribute to the private health insurance on behalf of their employees. In such cases we include the employer's contribution if the information is available. Where this information is not available, a bias is introduced, particularly in some developed countries where private health insurance is a dominant form of health service financing and the employer subsidises a share of the premium. Where this information is missing, we underestimate this component of prepayment. To avoid introducing an upward bias in private health insurance premiums, refunds or credits granted by insurance companies in the period prior to the survey should be deducted from household private health insurance premiums for the same period. Unfortunately, since the reimbursement may refer to payments in an earlier period not covered by the survey,

this adjustment can lead to negative estimates of insurance payments and is still difficult to implement with short-period data.

We now discuss the estimation of *out of pocket spending on health* (OOP_i) in the HFC numerator. Out of pocket payment includes all categories of health-related expenses recorded at the time the household received the service. Typically these include doctor's consultation fees, purchases of medication and hospital bills. Although spending on alternative and/or traditional medicine is included in the computation of out of pocket spending when it is available from the survey, expenditure on transport to receive health care services is excluded[13]. Tax deductions for health expenditures are incorporated implicitly where household survey data are available on total income taxes. In other cases, this requires a refinement of the calculations that is typically very difficult given available data and due to the fact that deductions are often applicable over a period of time that spans more than a calendar year.

The HFC ***denominator*** is a measure of the household's effective income minus subsistence expenditure. The proxy that we use to calculate capacity to pay is *total, household per capita expenditure* (EXP_i) net of *household per capita food expenditure* ($Food_i$). The denominator excludes tax payments except for general tax and social insurance payments that can be attributed to the household as contributions for health. Total household expenditure is the amount spent on all goods and services by the household, including in-kind spending and the consumption of household-made products. This information is available directly from the household survey and is aggregated to a monthly value.

$Food_i$ is the amount spend on all foodstuffs by the household, including the family's own food production. Food expenditure was computed by summing all the items considered to be non-luxury goods. The definition excludes expenditure on alcoholic beverages, tobacco, and eating outside of the household (restaurants).

The household's adjusted tax payment and its contribution to social security on health ($aTax_i$) is calculated using the following formula:

(17)

$$aTax_i = \left[(VAT_i + EXCISE_i) * (Scalar(X) - 1) + (INCTAX_i + other_i) * Scalar(X)\right] * \left(\frac{PSH - SSH}{TGS - SSH}\right) + SSH_i * Scalar(W)$$

Adjustments are made for household tax payment and social security contributions. To avoid double-counting VAT and excise tax which is already included in reported expenditure, these values are adjusted by the *X scalar* (defined above). Income tax and other relevant taxes not integrated in expenditure are also adjusted using the *X scalar* for the same reasons as those discussed above for the numerator. Likewise, social security contribution for health is adjusted with the *W scalar*. [14]

[13] This assumption is consistent with the National Health Accounts method of calculating out of pocket payments.

[14] Note that only social security on health is included in *aTax* as the total payment to social security was not available for some countries.

C. Data Limitations

Available data present several limitations, of which the most serious are related to the recall period for out of pocket health spending and for expenditure. Most surveys provide this information on a monthly basis, which does not give an adequately long period over which to measure the risk of health expenditure. It is impossible to discern from a one-month period, if high health expenditure is a repeated incident or an isolated event. Further, without repeated and longer-run measures, it is impossible to apply an adequate time horizon to expenditures across all households as we only have data on households that actually spent in a particular month. If the sample is large enough, and expenditure patterns do not display seasonally (an unlikely assumption), then this will not be an issue. What is required to answer these questions better are surveys that ask about both monthly expenditures, which will tend to minimise recall bias, and longer periods such as a year.

Another important point is that our calculations do not include subsidies. This is because very few countries have household-level information on subsidies in the surveys that include information on health spending. The exclusion of subsidies could generate biases in both the numerator and the denominator of HFC. In future analyses, using particular countries for which the necessary data are available, we will explore the issue of subsidies in greater detail.

VIII. Discussion

How the health system is financed can have a profound effect on individuals' access to healthcare and thus on health, health inequalities, responsiveness and responsiveness inequalities. Beyond this instrumental role of how a health system is financed, we argue that that fairness in financial contribution is an intrinsic goal of the health system. Fairness in financial contribution is a different construct that the traditional focus of the literature on equity in health finance, which measures the extent to which payments for the health system redistribute income. Taking as given society's efforts to redistribute income, some systems are still financed more fairly than others. This notion of fairness should capture the extent to which the system avoids households making catastrophic payments for health, the extent to which individuals in similar circumstances contribute the same amount and the extent to which the rich bear some of the costs of the poor.

These elements of fairness are captured by examining each household's contribution to the health system through taxes, social insurance, private insurance and out-of-pocket payments as a share of its capacity to pay. Capacity to pay is a household's effective income minus expenditure required for subsistence needs. We argue that when shares of capacity to pay are equalized across households then a system achieves fairness in financial contribution. The distribution of HFC across households can be summarized using an index, the IFFC.

The distribution of HFC and the summary index, the IFFC, have been calculated for a number of countries.(Xu et al. 2000)This empirical application of the concepts in this paper demonstrates the feasibility and utility of this measurement. Nevertheless, a number of issues remain that will benefit from further work and refinement. These fall naturally into three types of issues: estimating HFC from survey data; alternative summary indexes of the distribution of HFC; and sub-national application of the analysis of fairness in financial contribution.

Several estimation issues need to be addressed. First, the working assumption that households have no access, in any country, to their future earnings so that expenditure is a good estimate of effective income needs to be relaxed. As a first step, the bounds of effective income could be estimated by calculating consumption as if the permanent income hypothesis applied. The sensitivity of the distribution of HFC to using the permanent income hypothesis estimates could be examined. Second, subsidies, which can be an important component of household income in some countries. e.g. housing subsidies, should be estimated if possible. Third, inconsistencies between household surveys and national health accounts need to be investigated and solutions standardized.

The IFFC has been designed as a summary of the distribution of HFC across households to emphasize the right-hand tail of the distribution – households facing catastrophic payments. Further work to inform the selection of the parameters in the IFFC should include measurement of key population preferences. In addition to strengthening the empirical basis for selecting the parameters in the IFFC, the communicability of the measure to the general public, media and policy makers needs to be explored. For example, the IFFC is closely related to the fraction of households facing catastrophic spending, so simpler variants of the IFFC may be adequate for some policy uses.

Future research will include a number of new empirical applications, as well extensions of existing work to additional countries. Using before and after measures, we will apply the IFFC to analyse the success of health financing reforms in achieving greater fairness. IFFC is also highly applicable to the study of particular components of health systems, such as: the comparison of fairness of the portion of finance that comes from general taxes or social insurance to out of pocket payments; drug spending as compared to hospitalisation or other sub-sectors; and, geographic variation. Another interesting avenue for future research is to consider the level of fairness *de jure* (based on legislation or constitutional rights) versus *de facto* given the actual distribution of health payments, where the latter do not depend on assuming that *de jure* provisions actually determine households' contributions.

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