

# 18

## *Catastrophic Payments for Health Care*

Health care finance in low-income countries is still characterized by the dominance of out-of-pocket payments and the relative lack of prepayment mechanisms, such as tax and health insurance. Households without full health insurance coverage face a risk of incurring large medical care expenditures should they fall ill. This uninsured risk reduces welfare. Further, should a household member fall ill, the out-of-pocket purchase of medical care would disrupt the material living standards of the household. If the health care expenses are large relative to the resources available to the household, this disruption to living standards may be considered catastrophic. One conception of fairness in health finance is that households should be protected against such catastrophic medical expenses (World Health Organization 2000).

Ideally, longitudinal data would be used to estimate the extent to which living standards are seriously disrupted by the purchase of medical care in response to illness shocks. That would allow one to identify how spending on nonmedical goods and services changes following some health shock (Gertler and Gruber 2002; Wagstaff 2006). But often only cross-section data are available. Some approximation to the disruptive effect of health expenditures on material living standards must then be made. A popular approach has been to define medical spending as “catastrophic” if it exceeds some fraction of household income or total expenditure in a given period, usually one year (Berki 1986; Russell 2004; Wagstaff and van Doorslaer 2003; Wyszewianski 1986; Xu et al. 2003). The idea is that spending a large fraction of the household budget on health care must be at the expense of the consumption of other goods and services. This opportunity cost may be incurred in the short term if health care is financed by cutting back on current consumption or in the long term if it is financed through savings, the sale of assets, or credit. With cross-section data, it is difficult to distinguish between the two. Besides this, there are other limitations of the approach. First, it identifies only the households that incur catastrophic medical expenditures and ignores those that cannot meet these expenses and so forgo treatment. Through the subsequent deterioration of health, such households probably suffer a greater welfare loss than those incurring catastrophic payments. Recognizing this, Pradhan and Prescott (2002) estimate exposure to, rather than incurrence of, catastrophic payments. Second, in addition to medical spending, illness shocks have catastrophic economic consequences through lost earnings. Gertler and Gruber (2002) find that in Indonesia earnings losses are more important than medical spending in disrupting household living

standards following a health shock. Notwithstanding these limitations, medical spending in excess of a substantial fraction of the household budget is informative of at least part of the catastrophic economic consequences of illness, without fully identifying the welfare loss from lack of financing protection against health shocks. In this chapter, we describe measures of catastrophic health payments based on this approach.

### Catastrophic payments—a definition

The two key variables underlying the approach are total household out-of-pocket (OOP) payments for health care and a measure of household resources. Income, expenditure, or consumption could be used for the latter. Of these, only income is not directly responsive to medical spending. That may be considered an advantage. However, the health payments-to-income ratio is not responsive to the means of financing health care, and that may be considered a disadvantage. Consider two households with the same income and health payments. Say one household has savings and finances health care from their savings, whereas the other has no savings and must cut back on current consumption to pay for health care. This difference is not reflected in the ratio of health payments to income, which is the same for both households. But the ratio of health payments to total household expenditure will be larger for the household without savings. Assuming that the opportunity cost of current consumption is greater, the “catastrophic impact” is greater for the household without savings and, to an extent, this will be reflected if expenditure, but not if income, is used as the denominator in the definition of catastrophic payments.

If total household expenditure is used as the denominator, the catastrophic payments are defined in relation to the health payments budget share. A potential problem is that this budget share may be low for poor households in low-income countries. The severity of the budget constraint means that most resources are absorbed by items essential to sustenance, such as food, leaving little to spend on health care. This derives from the first limitation of the catastrophic payments approach identified above. Households that cannot afford to meet catastrophic payments are ignored. A partial solution is to define catastrophic payments not with respect to the health payments budget share but with respect to health payments as a share of expenditure net of spending on basic necessities. The latter has been referred to as “nondiscretionary expenditure” (Wagstaff and van Doorslaer 2003) or “capacity to pay” (Xu et al. 2003). The difficulty lies in the definition of expenditure that is nondiscretionary. A common approach is to use household expenditure net of food spending as an indicator of living standards. Of course, not all food purchases are nondiscretionary. But nonfood expenditure may better distinguish between the rich and the poor than does total expenditure.

Let  $T$  be OOP payments for health care,  $x$  be total household expenditure, and  $f(x)$  be food expenditure, or nondiscretionary expenditure more generally. Then, a household is said to have incurred catastrophic payments if  $T/x$ , or  $T/[x-f(x)]$ , exceeds a specified threshold,  $z$ . The value of  $z$  represents the point at which the absorption of household resources by spending on health care is considered to impose a severe disruption to living standards. That is obviously a matter of judgment. Researchers should not impose their own judgment but rather should pres-

ent results for a range of values of  $z$  and let the reader choose where to give more weight. The value of  $z$  will depend on whether the denominator is total expenditure or nondiscretionary expenditure. Spending 10 percent of total expenditure on health care might be considered catastrophic, but 10 percent of nondiscretionary expenditure probably would not. In the literature, when total expenditure is used as the denominator, the most common threshold that has been used is 10 percent (Pradhan and Prescott 2002; Ranson 2002; Wagstaff and van Doorslaer 2003), with the rationale that this represents an approximate threshold at which the household is forced to sacrifice other basic needs, sell productive assets, incur debt, or become impoverished (Russell 2004). World Health Organization researchers have used 40 percent (Xu et al. 2003) when “capacity to pay” (roughly, nonfood expenditure) is used as the denominator.

### Measuring incidence and intensity of catastrophic payments

Measures of the incidence and intensity of catastrophic payments can be defined analogous to those for poverty. The incidence of catastrophic payments can be estimated from the fraction of a sample with health care costs as a share of total (or nonfood) expenditure exceeding the chosen threshold. The horizontal axis in figure 18.1 shows the cumulative fraction of households ordered by the ratio  $T/x$  from largest to smallest.<sup>1</sup> Reading off this graph at the threshold  $z$ , one obtains the fraction  $H$  of households with health care budget shares that exceed the threshold  $z$ . This is the catastrophic payment head count. Define an indicator,  $E$ , which equals 1 if  $T_i/x_i > z$  and zero otherwise. Then an estimate of the head count is given by

$$(18.1) \quad H = \frac{1}{N} \sum_{i=1}^N E_i,$$

where  $N$  is the sample size.

This measure does not reflect the amount by which households exceed the threshold. Another measure, the catastrophic payment overshoot, captures the average degree by which payments (as a proportion of total expenditure) exceed the threshold  $z$ . Define the household overshoot as  $O_i = E_i((T_i/x_i) - z)$ . Then the overshoot is simply the average:

$$(18.2) \quad O = \frac{1}{N} \sum_{i=1}^N O_i.$$

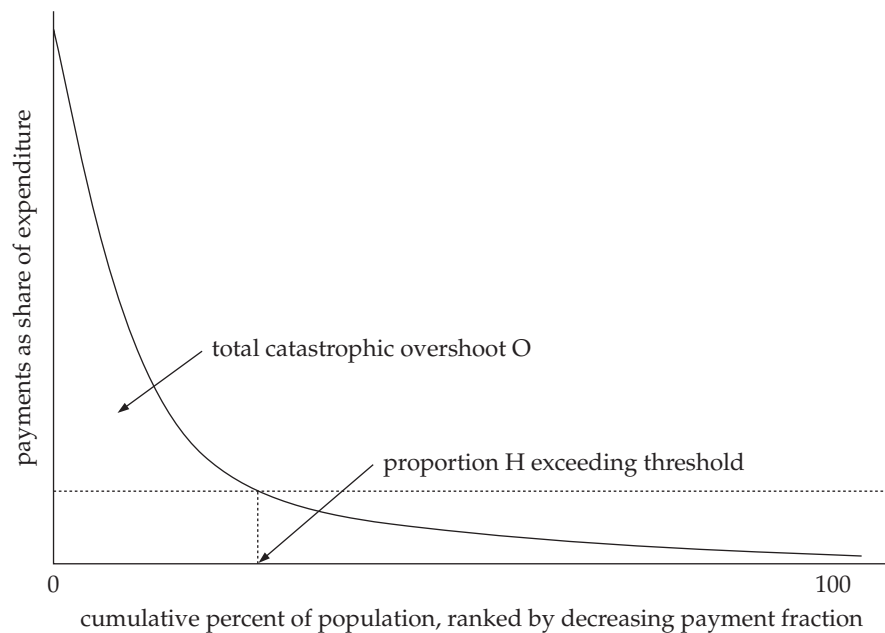
In figure 18.1,  $O$  is indicated by the area under the payment share curve but above the threshold level. It is clear that although  $H$  captures only the incidence of any catastrophes occurring,  $O$  captures the intensity of the occurrence as well. They are related through the mean positive overshoot, which is defined as follows:

$$(18.3) \quad MPO = \frac{O}{H}.$$

Because this implies that  $O = H \times MPO$ , it means that the catastrophic overshoot equals the fraction with catastrophic payments times the mean positive overshoot—the incidence times the intensity. Obviously, all of the measures above can also be defined with  $x-f(x)$  as denominator.

<sup>1</sup>The figure is basically the cumulative density function for the reciprocal of the health payments budget share with the axes reversed.

**Figure 18.1** Health Payments Budget Share against Cumulative Percent of Households Ranked by Decreasing Budget Share



Source: Authors.

**Box 18.1** Catastrophic Health Care Payments in Vietnam, 1993

The table below presents measures of the incidence and intensity of catastrophic payments for health care in Vietnam estimated from the 1998 Vietnam Living Standards Survey. Catastrophic payments are defined for health payments as a share of both total household expenditure and nonfood expenditure, using various threshold budget shares. As the threshold is raised from 5 percent to 25 percent of total expenditure, the estimate of the incidence of catastrophic payments ( $H$ ) falls from 33.8 percent to 2.9 percent, and the mean overshoot drops from 2.5 percent of expenditure to only 0.3 percent. Standard errors are small relative to the point estimates, which is to be expected for a reasonable sample size (5,999 in this case). Unlike the head count and the overshoot, the mean overshoot among those exceeding the threshold (MPO) need not decline as the threshold is raised. Those spending more than 5 percent of total expenditure on health care, on average spent 12.5 percent (5% + 7.48%). Those spending more than 25 percent of the household budget on health care, on average spent 35.5 percent.

For a given threshold, both the head count and the overshoot are higher, as they must be, when catastrophic payments are defined with respect to health payment relative to nonfood expenditure. This is also illustrated graphically in the figure, which shows the health budget share curves for both definitions. For any budget share, the OOP/[nonfood exp.] curve is always to the right of the OOP/[total exp.] curve. For instance, for more than 15 percent of households, health spending was at least a quarter of nonfood expenditure, but health spending was a quarter of total expenditure for only 3 percent of households.

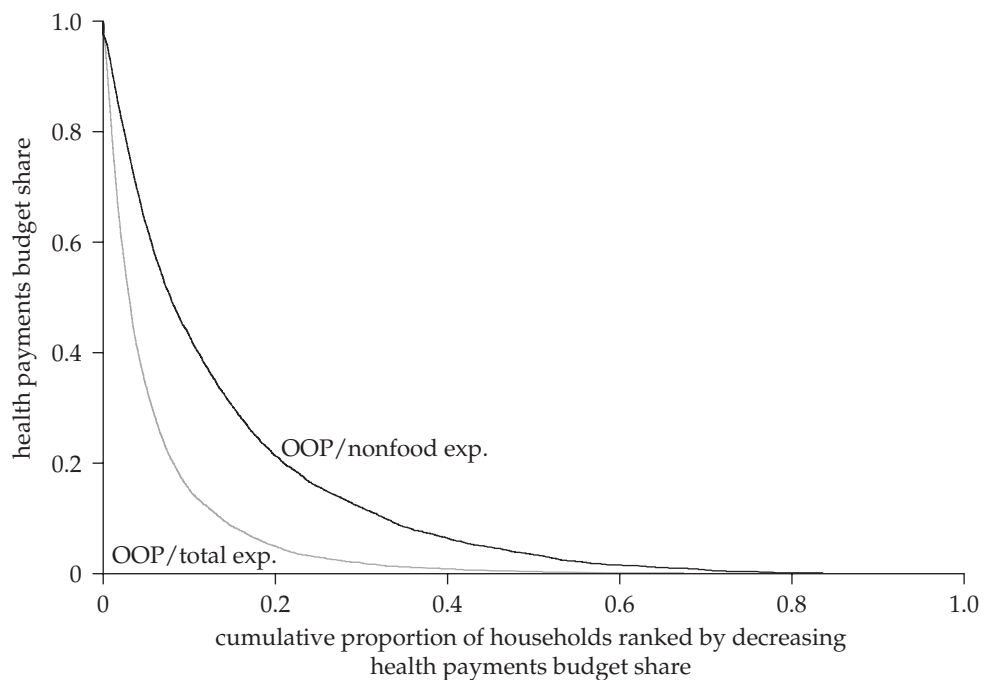
Estimates of the incidence and intensity of catastrophic payments in 14 Asian countries are given by van Doorslaer et al. (forthcoming).

**Box 18.1** (continued)

*Incidence and Intensity of Catastrophic Health Payments, Vietnam 1998  
Defined with Respect to Total and Nonfood Expenditure, Various Thresholds*

Catastrophic payments measures	Threshold budget share, $z$				
<i>Out-of-pocket health spending as share of total expenditure</i>	5%	10%	15%	25%	40%
Head count ( $H$ )	33.77%	15.11%	8.47%	2.89%	—
standard error	0.61%	0.46%	0.36%	0.22%	
Overshoot ( $O$ )	2.53%	1.39%	0.81%	0.30%	—
standard error	0.08%	0.06%	0.05%	0.03%	
Mean positive overshoot (MPO)	7.48%	9.18%	9.58%	10.46%	—
<i>As share of nonfood expenditure</i>					
Head count ( $H$ )	—	—	29.37%	15.10%	5.97%
standard error			0.59%	0.46%	0.31%
Overshoot ( $O$ )	—	—	4.35%	2.24%	0.76%
standard error			0.13%	0.09%	0.05%
Mean positive overshoot (MPO)	—	—	14.81%	14.83%	12.66%

*Health Payments Total and Nonfood Budget Share against Cumulative Percentage  
of Households Ranked by Decreasing Budget Share, Vietnam 1998*



Source: Authors.

### Distribution-sensitive measures of catastrophic payments

As noted above, if health spending is income elastic, nonfood expenditure may be preferred for the denominator of the budget share to better detect catastrophic payments among the poor. But the measures introduced in the previous section are insensitive to the distribution of catastrophic payments. In the head count, all households exceeding the threshold are counted equally. The overshoot counts all dollars spent on health care in excess of the threshold equally, irrespective of whether they are made by the poor or by the rich. If there is diminishing marginal utility of income, the opportunity cost of health spending by the poor will be greater than that by the rich. If one wishes to place a social welfare interpretation on measures of catastrophic payments, then it might be argued that they should be weighted to reflect this differential opportunity cost.

The distribution of catastrophic payments in relation to income could be measured by concentration indices for  $E_i$  and  $O_i$ . Label these indices  $C_E$  and  $C_O$ . A positive value of  $C_E$  indicates a greater tendency for the better-off to exceed the payment threshold; a negative value indicates that the worse-off are more likely to exceed the threshold. Similarly, a positive value of  $C_O$  indicates that the overshoot tends to be greater among the better-off. One way of adjusting the head count and overshoot measures of catastrophic payments to take into account the distribution of the payments is to multiply each measure by the complement of the respective concentration index (Wagstaff and van Doorslaer 2003). That is, the following weighted head count and overshoot measures are computed:

$$(18.4) \quad H^W = H \cdot (1 - C_E) \quad \text{and}$$

$$(18.5) \quad O^W = O \cdot (1 - C_O).$$

The measures imply value judgments about how catastrophic payments incurred by the poor are weighted relative to those incurred by the better-off. The imposition of value judgments is unavoidable in producing any distribution-sensitive measure. In fact, it could be argued that a distribution-insensitive measure itself imposes a value judgment—catastrophic payments are weighed equally irrespective of who incurs them. The particular weighting scheme imposed by equation 18.4 is that the household with the lowest income receives a weight of two, and the weight declines linearly with rank in the income distributions so that the richest household receives a weight of zero. So, if the poorest household incurs catastrophic payments, it is counted twice in the construction of  $H^W$ ; whereas if the richest household incurs catastrophic payments, it is not counted at all. A similar interpretation holds for equation 18.5. Obviously, different weighting schemes could be proposed to construct alternatives to these rank-dependent weighted head count and overshoot indices.

If those who exceed the catastrophic payments threshold tend to be poorer, the concentration index  $C_E$  will be negative, and this will make  $H^W$  greater than  $H$ . From a social welfare perspective and given the distributional judgments imposed, the catastrophic payment problem is worse than it appears simply by looking at the fraction of the population exceeding the threshold because it overlooks the fact that it tends to be the poor who exceed the threshold. However, if it is the better-off individuals who tend to exceed the threshold,  $C_E$  will be positive, and  $H$  will overstate

**Box 18.2** *Distribution-Sensitive Measures of Catastrophic Payments in Vietnam, 1998*

In the table below we present the concentration indices and the rank-weighted head count and overshoot measures for the same example of Vietnam. The distribution of catastrophic payments clearly depends on whether health payments are expressed as a share of total expenditure or of nonfood expenditure. In the former case, catastrophic payments rise with total expenditure, with the exception only of the head count at the 5 percent threshold. This reflects the fact that the OOP health payments budget share tends to rise with total household resources in low-income countries (van Doorslaer et al. 2007). As a result, the rank-weighted head count and overshoot are smaller than the unweighted indices given in the table in box 18.1. But when health payments are assessed relative to nonfood expenditure, the concentration indices are negative, with one exception, indicating that the households with low nonfood expenditures are more likely to incur catastrophic payments defined in this way. As a consequence, the weighted indices are larger than the unweighted indices in the table in box 18.1. The difference between the total and nonfood expenditure results is due to the income inelasticity of food expenditures.

*Distribution-Sensitive Catastrophic Payments Measures, Vietnam 1998*

<i>Out-of-pocket health spending as share of total expenditure</i>	<i>Threshold budget share, z</i>				
	5%	10%	15%	25%	40%
Concentration index, $C^E$	-0.0315	0.0270	0.0971	0.2955	—
Rank-weighted head count, $H^W$	34.84%	14.70%	7.65%	2.03%	—
Concentration index, $C^O$	0.0960	0.1845	0.2821	0.4594	—
Rank-weighted overshoot, $O^W$	2.28%	1.13%	0.58%	0.16%	—
<i>As share of nonfood expenditure</i>					
Concentration index, $C^E$	—	—	-0.1299	-0.1020	-0.0116
Rank-weighted head count, $H^W$	—	—	33.19%	16.64%	6.04%
Concentration index, $C^O$	—	—	-0.0681	-0.0197	0.0809
Rank-weighted overshoot, $O^W$	—	—	4.65%	2.28%	0.69%

*Source:* Authors.

the problem of the catastrophic payments as measured by  $H^W$ . A similar interpretation holds for comparisons between  $O$  and  $O^W$ .

### Computation

Computation of the catastrophic payments measures introduced above is straightforward with standard statistical packages such as Stata or SPSS. Here we present the appropriate Stata code. Let `oop` be the household OOP health payments variable. The total household expenditure variable is `x` and nonfood expenditure, or some other definition of nondiscretionary expenditure, `xnf`. Besides variables indicating the sample design parameters where they exist, these are the only variables required for the analysis.



Create a variable for the health payments budget share (`oopshare`) and subsequently the indicator of catastrophic payments,  $E_i$  (count#), and the overshoot,  $O_i$  (over#), for each of the desired threshold values,  $z$ ,

```
gen oopshare=oop/x
forvalues i = 5 10 to 25 {
    gen count`i'=(oopshare>(`i'/100))
    gen over`i'=count`i'*(oopshare-(`i'/100))
}
```

The head count,  $H$ , and the mean overshoot,  $O$ , are simply the means of count# and over#. In the case that the sample has a complex design, the appropriate estimates of the population means and their standard errors would be obtained from the following:

```
svyset psu [pw=wt], strata(strata)
svy: mean count* over*
```

where `psu` is the variable indicating the primary sampling unit, `wt` is the sample weight, and `strata` is the variable indicating the characteristic on which the sample is stratified (see chapter 2). The mean positive overshoot (MPO) is obtained from the following:

```
forvalues i = 5 10 to 25 {
    svy, subpop(count`i'): mean over`i'
}
```

Measures of catastrophic payments defined with respect to nonfood expenditure can easily be obtained by simply replacing `x` with `xnf` in the denominator of the OOP budget share. One may also want to change the threshold values in this case.

Concentration indices for the variables count# and over# can be computed by the convenient regression or covariance methods presented in chapter 8. To facilitate computation of the rank-weighted head count,  $H^W$ , and mean overshoot,  $O^W$ , one may store the concentration indices for the various threshold values in matrices. For example, a matrix of concentration indices (`ci`) for the count variables could be produced as follows:

```
sum r [aw=wt]
sca v_rank=r(Var)
foreach var of varlist count* {
    sum `var' [aw=wt]
    sca m_`var'=r(mean)
    gen d_`var'=(2*v_rank)*(`var'/m_`var')
    quietly {
        regr d_`var' rank
        matrix coefs=get(_b)
        gen ci_`var'=coefs[1,1]
        if "`var'"=="count5" {
            matrix ci=coefs[1,1]
        }
        if "`var'"!="count5" {
            matrix ci=(ci, coefs[1,1])
        }
    }
}
```



where the variable `r` is the weighted fractional rank computed as in chapter 8. A matrix of concentration indices for the overshoot variable at various thresholds could be produced by repeating the loop with `count*` replaced by `over*` following `varlist` and `count5` replaced by `over5`.

A matrix containing the weighted head counts (`wh`) could then be created with the following:

```
qui svy: mean count*
matrix h=e(b)
matrix wh=(h[1,1]*(1-ci[1,1]),h[1,2]*(1-ci[1,2]), h[1,3]*
(1-ci[1,3]),h[1,4]*(1-ci[1,4]),h[1,5]*(1-ci[1,5]))
```

The unweighted head counts, concentration indices, and weighted head counts can then be displayed.

```
matrix list h
matrix colnames ci = ci5 ci10 ci15 ci20 ci25
matrix list ci
matrix colnames wh = wh5 wh10 wh15 wh20 wh25
matrix list wh
```

To produce a graph such as that in box 18.1, create the complement of the OOP budget share (`compshare`), then use this as the `sortvar()` in a `glcurve` command to generate the weighted fractional rank (`p`) for households sorted in decreasing order of the OOP budget share. Then do a connected scatter plot of the budget share against this rank. This can be done for both the share of total and nonfood expenditure as follows:

```
gen compshare = 1-oopshare
glcurve oopshare [aw=wt], pvar(p) sortvar(compshare) nograph
label variable p "OOP/total exp."
gen compshare1 = 1-oopshare1
glcurve oopshare1 [aw=wt], pvar(p1) sortvar(compshare1)
nograph
label variable p1 "OOP/non-food exp."
#delimit ;
twoway (connected p oopshare, sort msize(tiny)) (connected p1
oopshare1, sort msize(tiny)),
ytitle(health payments budget share)
xtitle(cumulative proportion of population ranked by
decreasing health payments budget share) ;
```

### Further reading

Going beyond measurement, one would want to know what characteristics make a household vulnerable to incurring catastrophic payments. An analysis of the correlates of catastrophic payments in six Asian countries is presented in O'Donnell (2005).

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