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Explaining the incidence of catastrophic expenditures on health care: Comparative evidence from Asia

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Abstract

Out-of-pocket (OOP) financing of health care leaves households exposed to the risk of unforeseen expenditures that absorb a large share of the household budget. We explain variation in the incidence of catastrophic medical expenditures across households in six Asian countries/territories. Except in India and Sri Lanka, larger households are more likely to incur catastrophic payments. The incidence is higher in rural areas and lower among households with a sanitary toilet and safe drinking water. Household total consumption is positively correlated with the incidence of catastrophic payments. We distinguish between effects through the mean and the variance of the OOP budget share by estimating a linear regression model with multiplicative heteroscedasticity. Total consumption is positively correlated with the variance of the OOP budget share. The direction of the mean effect differs across countries. We consistently reject exogeneity of total consumption. Correcting for endogeneity generally reduces the magnitude of the coefficient on total consumption and leaves it insignificant. One interpretation is that households finance health payments from savings, borrowing and assets sales resulting in a rise both in total household expenditure and its health care share.

Keywords: health care financing, out-of-pocket payments, catastrophic payments, Asia

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1. Introduction

Heavy reliance on out-of-pocket (OOP) financing of health care in most developing countries leaves households exposed to the risk of unforeseen medical expenditures. Illness can bring a difficult choice between diverting resources towards medical care or foregoing treatment with the risk of long-term deterioration in health and earnings capacity. Responding to medical needs can absorb a large share of the household budget, which may be considered catastrophic in view of the required sacrifice of current consumption and/or the long-term consequences for household welfare of borrowing or depleting assets to pay for health care (Berki 1986; Wyszewianski 1986; Russell 2004). Exposure to such catastrophic medical expenditure risk is a major disadvantage of OOP financing and an important motivation for the movement to some sort of pre-payment mechanism (World Health Organisation 2005). Previous research has documented the scale of the catastrophic medical expenditures that households are exposed to (Pradhan and Prescott 2002) and those actually incurred (Wagstaff and Van Doorslaer 2003; Xu, Evans et al. 2003; Van Doorslaer, O'Donnell et al. 2005). There is less evidence on the sources of variation in the incidence of catastrophic payments. At a national level, the share of OOP in health financing plays a predictably large role (Xu, Evans et al. 2003; Van Doorslaer, O'Donnell et al. 2005). This does not tell us how catastrophic expenditures are distributed across households, which should be related to insurance coverage. But among the many without adequate insurance, it is important to know whether it is the better off or the poor that are most likely to incur such expenditures, the old or the young, large households or small households, urban or rural dwellers. Identification of the sources of variation in the incidence of catastrophic payments tells us which groups are most in need of protection against catastrophic risks. It also helps formulate the appropriate policy response to evidence of catastrophic payments. A greater likelihood of catastrophic payments among rural households suggests that this population has the greatest need for the development of risk pooling mechanisms of health financing. If households with sanitary toilets and clean drinking water face a lower risk of catastrophic payments, it might mean that public health measures can be an effective indirect method of addressing the problem.

The purpose of this paper is to identify sources of variation across households in the incidence of catastrophic expenditures on health care. The correlation of

catastrophic payments with risk factors might vary with levels of development and the nature of health financing. To explore this possibility, we examine evidence from six Asian countries/territories (Bangladesh, Hong Kong, India, Sri Lanka, Thailand and Vietnam) that differ in income levels, degree of reliance on OOP financing and the incidence of catastrophic payments (Van Doorslaer, O'Donnell et al. 2005). Consistent with most of the literature, we define catastrophic payments as OOP expenditures on health care in excess of a given share of the total household budget.[1] We concentrate on a 10% threshold, which is common in the literature (Pradhan and Prescott 2002; Ranson 2002; Wagstaff and Van Doorslaer 2003) and has been argued to approximate the burden at which a household is forced to sacrifice other basic needs, deplete productive assets, incur debt, or be impoverished (Russell 2004).

Our approach is to begin by describing the association between household characteristics and the probability of incurring catastrophic payments and then to explore the nature of the associations that are uncovered. In the next section, probit analysis is used to examine how the probability of medical expenditures exceeding the 10% threshold varies with household characteristics. A factor can affect this probability through the mean and/or the variance of the OOP health payments budget share. From a policy perspective, it is important to make the distinction between household characteristics that raise the expected value of health payments and those that increase exposure to risk. In section 3, we distinguish between mean and variance effects by estimating linear regression models with multiplicative heteroscedasticity. A variance effect implies parameter heterogeneity across the conditional distribution. We examine this directly, in the second part of section 3, by estimating regressions at different quantiles of the OOP budget share distribution. It is the unpredictability of OOP payments for health care that, in addition to their magnitude, evokes the adjective catastrophic. Defining catastrophic payments as those incurred at the upper tail of the conditional OOP budget share distribution captures this uncertainty. Quantile regression is used to examine the association between household characteristics and such a definition of catastrophic payments.

Across all countries, we consistently find that the probability of incurring catastrophic payments is increasing with total household expenditure. This may reflect the capacity of better-off households to respond to medical needs by diverting resources from expendable consumption while poor households are constrained in the extent to which they can divert resources away from food and shelter. But this is not

the only possible interpretation in the instance that households can use savings, credit or asset sales to finance health care. In this case, the total budget of the household should be treated as endogenous. The positive correlation between catastrophic payments and total household expenditure might reflect causality from health payments to the total budget. Testing the exogeneity of total expenditure then offers a means of examining how OOP payments are financed; through the sacrifice of current consumption or by inter-temporal substitution of consumption? We test and correct for the exogeneity total consumption in section 4. The final section concludes.

2. Explaining incidence of catastrophic expenditures

Which characteristics are associated with the likelihood that a household will incur catastrophic medical expenditures? To answer this question, we use data from household expenditure surveys that document not only OOP payments for health care but also all other items of expenditure, allowing the OOP budget share to be estimated with accuracy. Details of the surveys and the OOP health payments data are provided in Tables A1 and A2 respectively in the Appendix. Catastrophic expenditures are defined at the household level. It is assumed that there is complete pooling of household resources and that the economic impact of OOP payments for health care is spread across the household. There is support for this assumption in a detailed study of strategies for coping with OOP health payments in two villages in Burkina Faso (Sauerbron, Adams et al. 1996).

We examine sources of variation in the incidence of catastrophic payments by simply defining a dummy variable equal to one if OOP payments for health care exceed 10% of the household budget and regressing this on covariates using probit. An alternative approach would be to estimate a linear regression of the OOP budget share and compute partial effects on the probability of exceeding the 10% threshold from the estimated coefficients. This would have the advantage of using more information and of allowing the catastrophic threshold to be re-defined without the need to re-estimate the model. But it would require that both the conditional mean and variance were correctly specified and that observations with zero OOP budget shares were allowed for in the estimation procedure. By using a probit, we avoid these complications at the cost of not being able to distinguish between (although allowing

for) effects on the probability through the mean and the variance. We examine the net effect in this section and distinguish between mean and variance effects in the next.

Health is a potentially important determinant of catastrophic payments. Unfortunately, measures of health status are not usually available in the expenditure surveys required to estimate the OOP budget share. Like Pradhan and Prescott (2002), we rely on the age-sex composition of the household as a proxy for health care needs. In addition to the composition of the household, its size is a possible determinant of catastrophic payments. If economies of scale in the consumption of medical care are limited relative to those of other items, then the household budget share devoted to health care should rise with household size. A household can get by with one cooker whether there are 2 or 10 household members but two sick individuals need twice as many pills as one. Further, the risk that someone in the household will contract illness is increasing with the size of the household and if illness probabilities are dependent, due to contagious disease for example, the proportion of a household that is sick will be greater for larger households. For these reasons, one would expect the probability of catastrophic payments to be a positive function of household size. On the other hand, larger households have a larger supply of informal carers that can substitute for formal medical care and so constrain health costs.

While health determines exposure to risks, income determines health expenditures actually incurred. The poor must devote a large fraction of their limited budgets to food and shelter, possibly leaving little to spend on medicine. They may be forced to absorb illness shocks by forgoing treatment, possibly with long-term consequences for health and earnings. Pradhan and Prescott (2002) simulate the distribution of catastrophic payments that would have arisen in Indonesia if expenditures were made in relation to need, proxied by age and sex, and independent of ability to pay. We concentrate on the relationship between ability to pay and catastrophic expenditures actually incurred, while controlling for proxies for need. Ability to pay is measured by the value of total household consumption per capita, including that derived from household production (see Table A2). For Hong Kong, where household production activities are much less important, we use household expenditure. As noted in the introduction, total consumption will be endogenous if the household can draw on savings, credit or asset sales to finance health payments and, at least in part, smooth consumption of other goods and services. We examine this possibility in section 4.

Location is relevant to expenditures on health care. While proximity to health services may raise utilisation of health care in urban areas, travel costs will raise expenditures in rural areas although such expenses are often not recorded in the data (see Table A2). Lack of health services in rural areas increases reliance on medicines, which usually must be paid for. Location also reflects living conditions that impact on medical expenditures through health. We control for such health determinants directly through indicators of access to sanitary toilets, safe drinking water and solidly built housing, where these are available. Finally, control is made for the age, gender, education, employment status and occupation of the head of household.

The main omission from our empirical model of medical expenditures is the price of medical care. It is not possible to compute prices from expenditure surveys that do not contain utilization data. When the data are available, one must compute average prices across both treatments and individuals within the household and prices cannot be computed for non-users. Attempting to predict prices runs into the usual identification problem of the selection model. The omission of prices means that we cannot interpret the total expenditure coefficients as income elasticities. Prices may vary systematically with income. For example the poor may be exempted from charges and the better-off may purchase higher quality care. We do capture regional variation in prices through region dummies.

In Table 1, we present correlations between household characteristics and the probability that the household has incurred catastrophic medical expenditures defined as at least 10% of total household consumption. The percentage of households exceeding this threshold varies from 3-3.5% in Sri Lanka and Thailand to more than 15% in Bangladesh and Vietnam. It is almost 6% in Hong Kong and almost 11% in India. The estimates are presented as elasticities for household expenditure per capita and household size and composition and as semi-elasticities for the other covariates.[2] Standard errors are computed by the delta-method and are robust to heteroscedasticity and corrected for within cluster correlation where there is a cluster sample design.

Consider first the elasticities with respect to total household consumption per capita. All estimates are positive and significant. A higher level of total expenditure is associated with a higher probability of incurring catastrophic payments for health care. For example, in Bangladesh, a 1% rise in total expenditure is associated with a 1.42% rise in the probability that the OOP budget share will exceed the 10% threshold. These multivariate results support the positive bivariate relationship

between total expenditure and the probability of catastrophic payments that we have reported for a larger number of Asian countries (Van Doorslaer, O'Donnell et al. 2005). The strength of the relationship differs greatly across territories. It is smallest in Hong Kong, which is consistent with the hypothesis that the constraining effect of household resources on catastrophic payments is weakened in high-income economies where there are relatively few poor households that must devote high shares of the household budget to food and shelter. Otherwise, the magnitude of the elasticity does not appear to be related to the level of development, the incidence of catastrophic payments nor the OOP financing share. Bangladesh and Vietnam are broadly similar in relation to each of these factors but catastrophic payments are apparently much more sensitive to household resources in Bangladesh than they are in Vietnam.

The sign of the elasticity of catastrophic payments with respect to household size differs across countries. It is positive and significant in Bangladesh, Thailand and Vietnam. This is consistent with the hypothesis of relatively limited economies of scale in the consumption of medicine. In India and Sri Lanka, however, larger households are significantly less likely to incur catastrophic expenditures. The same two countries differ from the others in the pattern of the household composition effects. In the other countries, the incidence of catastrophic payments is increasing with the proportion of elderly women in the household (the reference group). A greater proportion of children (not infants) and of non-elderly adults reduces the incidence, the reduction being greater for males than for females. In India and Sri Lanka, elderly males raise the incidence of catastrophic payments most although the effect is not significant in Sri Lanka. The age gradients are not as pronounced as they are elsewhere. Cultural determinants of household behaviour and intra-household allocation are the most likely explanation for these cross-country differences.

Education is negatively correlated with the probability of catastrophic payments in all countries. In most cases, the effect is significant. It is also substantial. A head of household with tertiary level education is associated with a 34-60% reduction in the probability of catastrophic payments. It may be that education is acting as a proxy for lifetime income or wealth and reflecting a negative effect of this on health expenditures through better health. This argument holds to the extent that our measure of living standards – current consumption – does not reflect lifetime income due to constraints on the inter-temporal smoothing of consumption. By treating total consumption as exogenous in this section, we are assuming that such constraints are

indeed pervasive. Another interpretation of the negative education effect is that education makes households more efficient in maintaining health (Grossman 1972). An educated household may make more effective use of modern medicine and be less likely to incur large expenditures on self-medication and traditional therapies. In all cases, households with a working head are 14-63% less likely to incur catastrophic payments although the effect is not significant in Bangladesh and Hong Kong. Since we are controlling for total consumption, this is probably attributable to health expenditures incurred where a head of household cannot work due to sickness. In Bangladesh and India, waged labour, as opposed to working in the household farm or business, is associated with a higher incidence of catastrophic payments. The same is true in Vietnam although the relationship is not significant. This may reflect greater opportunities for those with regular employment and a wage to obtain credit to cover health expenses. If this is true, then total consumption is not exogenous. In Thailand, however, the coefficient on paid employment is negative, perhaps reflecting the better insurance coverage of those in the formal labour market, although the effect is not significant and we do control for insurance status.

Households living in urban areas of Bangladesh, India and Vietnam are 31-46% less likely to incur catastrophic payments. It is interesting that the urban effect is much smaller and not significant in both Sri Lanka and Thailand, where health facilities, including hospitals, are less concentrated in cities. Poor rural dwellers in these two countries have better access to health facilities and rely less on medicines that must be paid for out-of-pocket (O'Donnell, van Doorslaer et al. 2005).

There is evidence to suggest that healthy living conditions exert a negative effect on the incidence of catastrophic payments. In Bangladesh, Sri Lanka (not significant) and Vietnam, households with a sanitary toilet are 12-26% less likely to spend in excess of 10% of the household budget on health care. Safe drinking water is associated with a 30% and 26% reduction in the probability in Bangladesh and Sri Lanka respectively. Housing built from solid materials reduces the probability by 19% and 30% in Bangladesh and Vietnam respectively. These estimates are suggestive of an effect of living conditions on exposure to disease and subsequently health expenditures. But it could also be that both health and living conditions reflect lifetime income and the latter is not sufficiently controlled for by current consumption.

Indicators of health insurance cover are available for Hong Kong, Thailand and Vietnam. In Hong Kong, private health insurance cover (*insurance 1)* is not associated with the risk of catastrophic payments. For Thailand, we include dummies to indicate if the head of household is covered by the public sector employees' scheme (CSMBS, 12.7% of households in 2002 – *insurance 1*) and the scheme for formal private sector employees (SSS, 10% of households – *insurance 2*). A third dummy indicates if the head of household has no insurance cover or has purchased private insurance (13% of households – *insurance 3*). The vast majority of this third group had no cover. The reference group is the state Universal Coverage (UC) scheme that was introduced in 2001 and which covered 64.4% of households in 2002. The coefficients on the CSMBS and SSS dummies are negative but not significant. Those without cover were 40% more likely than those with UC cover to incur catastrophic payments. For Vietnam, we distinguish between children, adults and the elderly covered by Vietnam Health Insurance (VHI) since the coverage package for school children is less generous. The coefficients on the number of children and the elderly covered are negative but not significant. However, an extra non-elderly adult covered by VHI is significantly associated with a 24% fall in the probability of OOP payments exceeding 10% of total household expenditure. This is consistent with the finding, from the same data, that medical spending of the uninsured but not the insured increased following a health shock, indicated by a negative change in the body mass index (Wagstaff 2005). Without control for the potential endogeneity of insurance, one must be cautious in interpreting these estimates. They do not necessarily show the causal effect of insurance on reduced exposure to the risk of catastrophic payments. It is difficult to find plausible instruments for health insurance in the available data. On the other hand, in Thailand and Vietnam individual choice with respect to health insurance cover is limited and so exogeneity is not such an untenable assumption. In Thailand, the 13% of households without cover in 2002 were mainly people without national identity cards and immigrants. Since then UC has expanded further and by 2004 the proportion of the population without any cover was very small (Limwattananon, Tangcharoensathien et al. 2005). If we interpret the coefficient on the dummy for no insurance cover as a causal effect, it suggests that the expansion of coverage will have further reduced the incidence of catastrophic payments in Thailand. In Vietnam, most adults covered by VHI obtained coverage by right of being a public sector employee, in the military or a Communist Party member or

working in a formal private sector firm with more than 10 employees. Although voluntary enrolment was possible, at the time of the survey (1998) almost all voluntary cover was of school children and even this was semi-compulsory with schools being enrolled en masse. So, there is limited scope for selection into insurance on unobservables. Even if adverse selection where present, we would expect this to give a positive relationship between cover and medical expenditures. The magnitude of any true negative effect of insurance on catastrophic payments may therefore be underestimated.

TABLE 1

3. Mean versus variance effects and parameter heterogeneity

Association between any factor and the probability of the OOP budget share exceeding a given threshold can arise through the mean and/or the variance of the share. For example, the incidence of catastrophic payments can be greater among the better-off not only because, on average, they spend a larger share of the household budget on health care but also because the variance of the share is larger at higher total expenditures. Mean and variance effects have different implications for the individual welfare and consequently policy. A positive effect on the mean indicates an increase in the expected value of the OOP budget share but a rise in the variance represents a greater degree of risk. An increasing mean may be tackled through measures to constrain user charges across a wide range of health services, while reversing a rise in the variance requires concentrating on payments for expensive but uncommon medical treatments.

We distinguish between mean and variance effects on the OOP share by estimating a linear regression model with multiplicative heteroscedasticity (Harvey 1976). The mean and the log of the variance are each specified as linear functions of regressors. Estimation is by maximum likelihood.[3] Standard errors are robust and corrected for within cluster correlation, where appropriate.

Total household consumption per capita and household size are the only two characteristics consistently correlated with the conditional variance of the OOP share. In Table 2, we present elasticities for these two factors both from a two-part model and from a linear regression model with multiplicative heteroscedasticity estimated

from the observations with non-zero OOP payments. In the latter case, we show the elasticity of the conditional variance with respect to these factors.

TABLE 2

Consider first the two-part model. The elasticity of the probability of non-zero OOP payments with respect to total consumption per capita is consistently positive and of similar magnitude in all countries except Vietnam. The lower magnitude of the elasticity for Vietnam is due to the fact that a very low proportion of the Vietnamese sample reports zero payments (3% rather than around 30-40% in the other samples). This is because medical expenditures are reported for a 12-month reference period in Vietnam, while in most of the other cases such a long reference period is used only for inpatient care and spending on other care is reported for 1 month. A two-part model is not really necessary for the Vietnamese data. It is used simply for consistency with the other countries.

The sign and magnitude of the total consumption elasticities in the second part of the model are less consistent. Conditional on OOP payments being positive, the OOP budget share is falling with the size of the total budget in Hong Kong and Sri Lanka, while it is near constant in Thailand and Vietnam. In India, and even more so in Bangladesh, the OOP share is rising with the budget. Summing the elasticities from the two parts of the model gives the elasticity of the OOP budget share with respect to total consumption. It is close to zero in Hong Kong and Vietnam, which means that OOP payments are proportional to total consumption, and the total consumption elasticity of the *level* of health payments is close to unity. In Bangladesh, India, Sri Lanka and Thailand, the elasticity of the OOP budget share is positive. The share rises with total consumption and the elasticity of the level of health payments exceeds unity. Such large elasticities seem inconsistent with most evidence from micro data that suggests health care is income inelastic. An analysis of Chinese data that, like this paper, uses a two-part model and health expenditure (rather than health care utilisation) as the dependent variable estimates the income elasticity of the level of OOP spending to be 0.3. (Mocan 2004). One reason for the inconsistency is the absence of controls for prices, beyond region dummies, in our estimates. Prices may be expected to rise with household income because the poor are exempted from charges and/or quality differences in the health care consumed. Controlling for prices,

one is examining variation in health care use, as opposed to health care expenditure that we consider here, and this may rise less than proportionately with income. Another potential reason for the discrepancy is that our independent variable is not income but total consumption. If a health shock simultaneously reduces earnings and raises health spending, the income-health relationship will understate the impact of household resources on health spending. (Mocan 2004) find income elasticity rises from 0.3 to 0.52 when the endogeneity of income is corrected. With total consumption as the independent variable, the endogeneity bias will be upward if the household can raise the total budget to accommodate health spending. We examine this possibility in the next section.

The elasticities estimated from the two-part model imply that the probability of incurring catastrophic payments is rising with total consumption in Bangladesh, India, Sri Lanka and Thailand but independent of total expenditure in Hong Kong and Vietnam. This seems inconsistent with the estimates presented in Table 1, which show that the catastrophic probability always rises with total expenditure. Correlation of total expenditure with the conditional variance can explain the apparent inconsistency. Estimates from the linear regression model with multiplicative heteroscedasticity reveal that the variance of the OOP share is indeed rising with total consumption in every country (Table 2). The magnitude of the effects is broadly consistent. A percentage point rise in total consumption per capita is associated with a 0.30-0.42% rise in the conditional variance. India is an exception, with an elasticity of only 0.04%. A positive association between the OOP share and total consumption is expected. Household with very limited budgets are constrained in the degree to which they can respond to stochastic medical needs. This is less true at high incomes. Amongst the better-off, the healthy spend very little on health care while the sick spend a great deal.

In Bangladesh, India and Thailand, the effects of total consumption on the probability of any OOP payments, on mean (non-zero) payments and on the variance of payments are all significantly positive. Consequently, the correlation of total consumption with the probability of catastrophic payments is strongest in these three countries (Table 1). In Vietnam, the mean (non-zero) OOP share is independent of total consumption but the variance is increasing in total consumption. The (non-zero) mean and variance effects of total consumption are in opposite directions in Hong Kong and in Sri Lanka. As total consumption increases, the mean OOP share is falling

but its variance is rising. The variance effect dominates, such that high expenditure households are more likely to incur catastrophic payments.

Besides total consumption, household size is the only other characteristic that is significantly associated with the variance of the OOP budget share in most countries. The direction of the effect differs, however. Only in India is the variance significantly lower in larger households. This, together with the negative effect on the mean results in the lower probability of catastrophic payments in larger households in India (Table 1). In Sri Lanka, the negative effect comes through the mean only. In Bangladesh, Hong Kong and Thailand, a positive impact of household size on the variance dominates a negative effect on the mean such that the risk of catastrophic payments is rising in household size. The negative effect on the mean suggests that (relative) diseconomies of scale in the consumption of medicines are not responsible for the higher incidence of catastrophic payments in larger families. The positive effect on the variance suggests the cause is the higher probability that at least someone will fall sick in larger households. Vietnam is exceptional in having a positive impact of household size on the mean OOP share.

Given the mean OOP share is always non-decreasing with total consumption and the variance is always increasing, the magnitude of the regression coefficient on total consumption should be greater at higher percentiles of the OOP share distribution.[4] We use quantile regression to examine such parameter heterogeneity directly. This allows us to estimate the sensitivity of the OOP share to total consumption across the conditional distribution of the OOP share and to concentrate on the effects at the upper tail, which are of greatest relevance to catastrophic payments. Quantile regression is also consistent with an alternative way of defining catastrophic payments. Rather than define them in an *absolute* sense – at 10% of the household budget, say – one could define them *relatively*, as the payments incurred by those within the top decile, say, of the OOP budget share distribution. According to this approach, payments are catastrophic in the sense that they are unexpected. Conditional on all else, expenditures on health care are far from their expected value. Uncertainty is certainly an important characteristic of catastrophic payments. But such a definition does not require that catastrophic payments be large in magnitude. There will always be a top 10%, even with full insurance.

OOP budget shares that define the median and the 90^{th} percentile of the distribution are given in the first two rows of Table 3. In Vietnam and Bangladesh, health care

absorbs 13.5-14.5% of the budget of the 10% of households spending most relative to incomes. In contrast, the OOP share is 4.1% or more for the top 10% in Thailand. The elasticity of the OOP share to total consumption is positive at all percentile points considered for all countries, with only one exception (for Vietnam).[5] The positive effect at the 90th percentile means that, all else constant, the OOP budget share defining the top 10% is increasing with total consumption. The final row of the table shows the difference between the regression coefficients on (log) total consumption per capita at the 90th percentile and at the median of the conditional OOP share distribution. As anticipated from the estimates of the heteroscedasticity model, the difference is positive in all cases and usually significant. Total consumption has a larger effect on the OOP share at the top of the distribution. The consumption elasticities do not always show the same pattern. This is because the elasticity is increasing with the partial effect but decreasing with the OOP share. Since the OOP share is much higher at higher percentiles, the elasticity can be lower even though the partial effect is higher. This is observed in Bangladesh, Hong Kong, India and Sri Lanka. In Vietnam, there is no significant correlation between total consumption and OOP at the middle of the distribution but a percentage point increase in total expenditure raises the 90th percentile point value in the OOP share distribution by 0.28%.

TABLE 3

4. Endogeneity of total household consumption

The positive association we find between total household consumption and catastrophic payments might be attributable to the greater capacity of better-off households to respond to health care needs. Poor households living at subsistence levels of food and shelter cannot afford to divert a substantial share of resources to other needs, including those for health care. But this is not the only possible interpretation. Total consumption can be endogenous for a variety of reasons. Health shocks are an important omitted variable that may impact on both total household resources and the OOP health payments share. Illness of an adult may reduce household earnings. Gertler and Gruber (2002), using data from Indonesia, find that labour supply consequences of health shocks have the strongest impact on household

living standards. If illness reduces household resources and raises medical expenditure, then its omission will bias the total budget–OOP share relationship in a negative direction. (Mocan 2004) find this to be the case for the relationship between household income and health payments in China. In the present study, correcting omitted variable bias driving from health shocks is difficult since the datasets we use to obtain health payments, being expenditure surveys, do not include health measures.[6]

The impact of illness on total household resources need not be negative. It will be positive if the household can draw on savings, borrow, obtain formal or informal transfers, sell assets, or increase the work effort of non-sick household members to cover medical expenses. Evidence suggests that households deploy a variety of strategies to finance medical care and do not rely only on the sacrifice of other consumption within a fixed, single-period budget constraint. In India, more than 40% of those hospitalized reported borrowing or selling assets to pay for hospital costs (Peters, Yazbeck et al. 2001) and such financing accounted for 19-28% of hospital costs on average (Bonu, Rani et al. 2005). Poorer households were more likely to resort to borrowing and the sale of assets (Peters, Yazbeck et al. 2001), as were rural dwellers, scheduled castes, uneducated, male and young patients (Bonu, Rani et al. 2005). In a study of poor, rural villages of northern Vietnam, 60% of households were in debt and one-third reported health care payments as the main reason for this (Ensor and Pham 1996). A study of 72 households including someone with dengue fever in one poor province of rural Cambodia found that up to 59% of households financed health care from borrowing, up to 34% by drawing on savings, and up to 30% sold assets (van Damme 2004). A detailed qualitative study of 24 households with very high OOP budget shares (mean=88%) in rural China found that only 3 met the full costs of health care from cash and/or savings and all 3 were amongst the better-off (Wilkes, Y. et al. 1998). One half of households borrowed from friends/relatives, 5 borrowed formally and 6 sold assets. A similar small-scale qualitative study of 2 villages in Burkina Faso found less reliance on inter-household transfers (Sauerbron, Adams et al. 1996). The sequence of strategies followed to cope with the financial costs of health care were: 1) draw on savings; 2) sell livestock; 3) take loan; 4) diversify income; 5) if all else fails, seek communal support.

Although the evidence is mostly from small-scale studies, it is sufficiently consistent to suggest that medical expenditures are not accommodated within a fixed

single-period constraint but that saving, borrowing and assets are used to spread the financial burden across periods. Spending on health care temporarily drives up the total household budget. This seems more likely for large medical expenditures than from small ones that could be financed by temporarily cutting back on other items of consumption. The direction of causality in the positive relationship we observe between catastrophic payments and total consumption may run from the former to the latter.

Endogeneity of total consumption could also arise from measurement error in medical or other expenditures. Measurement error in health payments will bias the relationship between total consumption and the health payments share in a positive direction. Measurement error in other items of expenditure will have the opposite effect.

Problems of measurement error and reverse causality can be tackled if instruments for total consumption can be found. That is, factors that determine total consumption but conditional on this, are not correlated with the OOP budget share. Indicators of access to savings and credit are most plausible. For a given initial income, a household that has opportunities to save and borrow has greater capacity to expand the household budget to meet medical expenditure needs. Apart from their instrumental role through the household budget, it is assumed that saving and borrowing opportunities have no independent influence on medical spending. For Bangladesh, India, Thailand and Vietnam, we use a dummy for any land holdings and (log) land size to instrument total consumption.[7] Land can be used as collateral to obtain credit. Even in the absence of formal credit markets, households with land may be granted loans on the agreement that part of the future produce of the land will go to the creditor. Land would not be a valid instrument if it were sold to finance health care. This is possible but it would represent an extreme catastrophe observed only rarely. More likely that a household will first try to obtain credit and only sell land if the burden of debt becomes unbearable. But this is unlikely to be observed within the same survey period within which the health expenditures are recorded. No data on land holdings are available for Sri Lanka and so we use rental income, capital income and a dummy for home ownership as instruments. Rental income and home ownership indicate possession of assets that could be used as collateral and households with such assets are more likely to have savings to draw on. Capital income indicates a stock of savings. Again, the instruments are not valid in the case that the assets are sold to

finance health care. For Thailand, we use a wealth index computed from a principal components analysis of asset holdings in addition to the land dummy. For Hong Kong, we use property income as the instrument for total expenditure. The Vietnamese data are part of a panel and so allow us to extend the instrument set with lagged (5 years) total expenditure. Controlling for current resources, past expenditure is unlikely to be a significant determinant of current spending on health care. We disaggregate past expenditure into that on food and non-food items, since the correlation of each with current consumption may differ, and we subtract past health payments from non-food expenditure since there may be serial correlation in health payments.

We test the exogeneity of total consumption in the probit for catastrophic payments by examining the significance of reduced form residuals added to the model (Rivers and Vuong 1988). In the instance that exogeneity is rejected, the augmented probit is consistent but inefficient. Total consumption coefficients (not elasticities) from the simple probit and the augmented probit are presented in Table 4, along with the results of the exogeneity tests. Estimates are presented at various threshold definitions of catastrophic payments in order to examine whether the exogeneity assumption becomes less plausible as the threshold is raised. In the second last row of the table it is clear that all instrument sets are highly significant in the reduced forms for total consumption. Overidentification tests reject the validity of the instruments only in India and marginally (10% significance) in Thailand.[8]

Consider first the estimates from the probits for catastrophic payments defined at 10% of total consumption, as in Table 1. Exogeneity of total consumption is rejected for every country but for Sri Lanka. Correcting for endogeneity by including the reduced form residuals has a dramatic effect on the total consumption coefficients. In every country, the coefficient changes from being significantly positive to being insignificant. Given the failure of the overidentification tests for India and, to a lesser extent, Thailand, one should not take the IV estimates in these cases too seriously. Bangladesh, Hong Kong and Vietnam provide stronger evidence in support of the claim that endogeneity results in a strong upward bias in the estimated effect of total consumption on the OOP budget share.

The pattern of the results as the threshold that defines catastrophic payments is raised provides some further support for the contention that total consumption is endogenous. In every country, the simple probit coefficient on total consumption

increases as the threshold is raised. The correlation is stronger for very large OOP payments. This is consistent with households being able to accommodate, to an extent, moderate OOP payments within a given budget but being forced to resort to credit, the labour market, or other means, to temporarily expand the household budget in order to finance very large expenditures on health care. In Vietnam rejection of exogeneity becomes more emphatic as the threshold is raised. In Sri Lanka, exogeneity is not rejected at the 5% and 10% thresholds but is clearly rejected at the 15% threshold.

The analysis suggests that the positive association between total household consumption and the incidence of catastrophic payments is not due to capacity of better-off households to devote a larger share of their greater resources to payments for health care. Rather, the explanation could be that households facing unusually high medical needs are forced to spend a lot on health care and to finance this by borrowing or depleting assets resulting both in a temporary rise in total household expenditure and the share of this going to health care. An alternative explanation, which we cannot rule out, is that there is measurement error in health care payments.

TABLE 4

5. Conclusion

Our analysis of data from six Asian territories has revealed some consistencies in the factors associated with catastrophic expenditures on health care but also some differences. Higher total household consumption is positively correlated with the probability of catastrophic payments in all countries. In all cases, this correlation is at least partly attributable to the increase in the variance of the OOP budget share with total consumption. In Bangladesh, India and Thailand, the mean OOP share is also increasing with total consumption. In Hong Kong and Sri Lanka, the mean is falling with total consumption but the variance rising and the latter effect dominates, such that the probability of the OOP budget share exceeding the 10% threshold rises with total consumption. But our analysis suggests that the positive association between total household consumption and catastrophic payments is *not* the result of the causal effect of the former on the latter. We consistently reject the exogeneity of total consumption. Correcting endogeneity greatly reduces the magnitude of the total consumption effect and usually leaves it insignificant. Substantial medical expenses

appear to raise total consumption as households deplete savings or other assets, borrow or work harder to cover medical needs.

In one sense it is reassuring that the household budget appears to be responsive to expenditures on health care. It implies that there is some self-insurance and at least a degree of consumption smoothing across time. Households that can adjust budgets to unforeseen medical needs are in a superior position to others that must absorb health expenditures within a fixed budget and so sacrifice consumption of other goods and services. This does not imply that there is complete self-insurance and is not necessarily inconsistent with evidence that households cannot fully smooth non-medical consumption in the presence of health shocks (Gertler and Gruber 2002; Wagstaff 2005). The down side is that inter-temporal adjustment to medical needs stretches the burden across time and may result in households sinking deeper and deeper into debt. This is a dimension of the catastrophic payments issue that should be addressed using panel data.

Except in India and Sri Lanka, larger households are more likely to incur catastrophic payments. In Bangladesh and Thailand, the incidence of catastrophic payments rises with household size as a positive variance effect dominates a negative mean effect. In Hong Kong, the mean and variance effects cancel out. The age and to a lesser extent the gender composition of the household is also correlated with the incidence of catastrophic payments. Education and employment of the head of household are negatively associated with catastrophic payments. The education effect could be causal. An educated household is more efficient in the production of health and need rely less on (self) medications that usually must be paid for. The employment effect might simply reflect the readiness to purchase health care for a sick, incapacitated head of household.

The probability of incurring catastrophic payments is generally higher in rural areas but not significantly so in the two countries (Sri Lanka and Thailand) that have a wider geographic distribution of public health services. Together with the fact that purchases of drugs account for a very larger share of OOP payments for health care (Van Doorslaer, O'Donnell et al. 2005), this suggests that the heavy reliance on medicines, often non-prescribed, in rural parts of Bangladesh, India and Vietnam is a significant contributor to the high incidence of catastrophic payments.

Sanitary toilets, safe drinking water and solid housing are all associated with a significantly lower risk of catastrophic payments. This suggests that public health

interventions might be effective measures to protect households from the risk of burdensome payments for health care. There is also some evidence from Vietnam and Thailand that health insurance, as would be expected, is effective in protecting against catastrophic payment risks.

All in all, our analysis suggests that care has to be taken in the interpretation and comparison of catastrophic spending ratios computed for a short period. Expenditures that appear as catastrophic in a given period need not necessarily be equally catastrophic when viewed from a longer run perspective. To the extent that households are capable of adjusting their budgets to accommodate health shocks, some of these shocks can be self-insured and absorbed. It is self-evident that this shock absorbing capacity increases with a household's income generating capacity, which, in addition to the short run increase in total spending, explains why apparent catastrophes are more frequently observed at higher levels of total consumption. The development of public or private prepayment mechanisms based on resource pooling would not only offer protection from catastrophic risks to those that are currently able to respond to unforeseen medical needs, they would make health care more affordable and accessible to poorer households operating within very tight and inflexible budgets that cannot currently respond to health shocks.

Table 1: Elasticity of probability of catastrophic payments

(Probit estimates for OOP payments > 10% total expenditure)

	Bangladesh		Hong Kong		India		Sri Lanka		Thailand		Vietnam	
	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE
hholds. > 10% threshold	15.57%		5.86%		10.84%		2.98%		3.52%		15.11%	
Elasticities												
Total hhold consumption	**1.4217**	0.1084	**0.3038**	0.0826	**0.7942**	0.0227	**0.7442**	0.1066	**0.8912**	0.0756	**0.4849**	0.1044
Household size & composition												
Household size	**0.4055**	0.1006	0.0937	0.1203	**-0.0961**	0.0241	**-0.3491**	0.1310	**0.5754**	0.1181	**0.3915**	0.1126
% female 0-5 years	0.0914	0.4294	-0.8248	0.6899	**0.2649**	0.1069	0.3557	0.7476	-0.9037	0.5817	**-1.3093**	0.4730
% female 6-15 years	**-0.9458**	0.4178	**-2.3113**	0.4976	**-0.8489**	0.0962	**-1.3541**	0.6837	**-1.9817**	0.4730	**-2.3362**	0.3943
% female 16-34 years	**-0.6824**	0.4146	**-2.1728**	0.3910	**-0.2962**	0.0820	0.0959	0.5330	**-1.4474**	0.3658	**-2.3198**	0.3433
% female 35-44 years	-0.5715	0.4539	**-1.2540**	0.3960	**-0.2188**	0.1047	-0.3293	0.6995	**-1.7410**	0.3918	**-1.9806**	0.3828
% female 45-64 years	-0.1723	0.3593	**-0.9903**	0.3096	**0.2782**	0.0754	-0.3307	0.5439	**-0.4535**	0.2718	**-0.8370**	0.2562
% male 0-5 years	0.3050	0.4439	-0.8509	0.6745	**0.3478**	0.1046	0.4442	0.7644	**-1.0485**	0.5836	-0.6407	0.4850
% male 6-15 years	-0.4957	0.3856	**-1.6324**	0.4752	**-0.7872**	0.0918	**-1.3744**	0.6896	**-1.8829**	0.4810	**-2.3692**	0.3535
% male 16-34 years	**-1.8472**	0.4191	**-2.4112**	0.4060	**-0.9675**	0.0666	-0.2819	0.5266	**-2.2391**	0.3783	**-2.3184**	0.3272
% male 35-44 years	**-2.5159**	0.5322	**-1.9971**	0.4095	**-1.0248**	0.0980	0.0579	0.7014	**-2.2156**	0.4520	**-2.4796**	0.4943
% male 45-64 years	**-2.5774**	0.5371	**-1.4428**	0.3532	**-0.4325**	0.0823	0.0443	0.6351	**-1.5008**	0.3669	**-1.8817**	0.4442
% male 65+ years	**-1.4441**	0.5344	**-0.7460**	0.3316	**0.7661**	0.1227	0.8188	0.6978	-0.1355	0.4011	**-0.7859**	0.3826
Head of household												
age	0.2232	0.3413	0.0678	0.5672	-0.1218	0.1094	0.6876	0.5798	0.2223	0.5274	**-1.1281**	0.4099
male	19.6023	19.7600	-6.3977	11.6207	**7.1098**	4.0642	29.5368	27.8002	1.2014	13.0545	-2.7217	8.7166
primary education	-12.2885	7.8243										
secondary education	-0.2585	8.0711	-16.0009	9.8903	**-31.5966**	2.1183	-8.8916	12.1837	-17.6120	10.8454	**-24.6233**	6.5325
tertiary education	**-55.2000**	8.1203	**-44.0063**	12.0930	**-43.3977**	2.7877	-46.7977	29.0168	**-60.2208**	9.7222	**-34.2214**	10.2207
in work	-18.8103	14.1170	-14.1744	10.7778	**-25.6484**	2.2591	**-46.3853**	8.8154	**-26.8173**	15.7448	**-62.9224**	5.9438
in paid work	**36.3422**	10.4229			**9.8777**	3.7547	36.0773	35.6562 [a]	-17.0875	11.6886	17.8143	11.9439
non-manual	5.6556	14.9948			**-10.5936**	3.0295 [b]	**-21.4727**	11.8932	27.2228	23.8617	39.7948	25.9248
agriculture	-3.7771	14.0307							17.9819	14.8530	45.1063	27.5709
skilled manual	-3.9279	14.9832 [c]							8.1823	20.5787	**46.2421**	26.3064
unskilled					-0.7382	2.3183					**71.0032**	34.1636
Location and living conditions												
urban	**-31.0521**	8.8346			**-30.7058**	1.5800	-3.1994	20.0403	-9.6031	8.8127	**-45.7105**	13.5129
region dummies	not significant				significant		not significant		not significant		significant	
sanitary toilet	**-23.7644**	7.0643					-11.9376	14.1811			**-26.4149**	9.4727
safe drinking water	**-30.2658**	13.8923					**-25.6146**	9.9569	**-23.3385**	9.4070		
solid built house	**-19.1668**	9.3767 [d]					-7.8003	11.9877			**-30.3594**	10.8720
Health insurance												
insurance 1			-0.1994	15.176					-8.5380	12.60187	-9.2381	5.76164
insurance 2									-7.1260	20.29628	**-23.662**	6.71911
insurance 3									**39.62228**	16.39543	-8.0867	11.3252

Notes:

SE = Robust standard errors. In additional to heteroscedasticity, standard errors corrected for within cluster correlation if cluster sample.

Bold indicates significant at 10% or less.

Insurance 1: HK = 1 if private insurance; Thailand = 1 if public sector employees scheme (CSMBS); Vietnam = # kids with health insurance.

Insurance 2: Thailand = 1 if formal private sector employees' scheme (SSS); Vietnam = # non-elderly adults with health insurance.

Insurance 3: Thailand = 1 if no health insurance cover (reference category is Universal Coverage); Vietnam = # elderly with health insurance.

a. professional occupation. b. self-employed c. other occupation

d. house has brick walls. Dummies for cement roof and electricity supply also negative and significant.

Table 2: Elasticities of OOP budget share with respect to total consumption and household size

	Bangladesh		Hong Kong		India		Sri Lanka		Thailand		Vietnam	
Total consumption elasticity												
2 part model	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE
Probit	**0.3635**	0.0375	**0.2300**	0.0208	**0.3063**	0.0055	**0.2982**	0.0193	**0.1874**	0.0129	**0.0178**	0.0048
OLS	**0.7915**	0.0579	**-0.1677**	0.0507	**0.2719**	0.0134	**-0.1653**	0.0300	0.0236	0.0297	0.0223	0.0611
Total	1.1550		0.0623		0.5782		0.1329		0.2110		0.0401	
Mulitplicative heteroscedasticity (non-zero observations)												
Mean	**0.7184**	0.0585	**-0.1510**	0.0486	**0.2651**	0.0130	**-0.1232**	0.0312	**0.0514**	0.0278	0.0497	0.0663
Variance	**0.3359**	0.0900	**0.3369**	0.0535	**0.0437**	0.0201	**0.3829**	0.0390	**0.4216**	0.0343	**0.3021**	0.0970
Household size elasticity												
2 part model	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE
Probit	**0.3734**	0.0391	**0.2627**	0.0279	**0.2080**	0.0052	**0.3044**	0.0184	**0.3061**	0.0170	**0.0175**	0.0043
OLS	**-0.1030**	0.0616	**-0.3417**	0.0642	**-0.0789**	0.0135	**-0.3882**	0.0388	-0.0477	0.0365	**0.2566**	0.0519
Total	**0.2704**		-0.0791		0.1291		-0.0838		0.2584		0.2742	
Mulitplicative heteroscedasticity (non-zero observations)												
Mean	**-0.1446**	0.0610	**-0.3355**	0.0621	**-0.0918**	0.0128	**-0.3619**	0.0381	-0.0573	0.0355	**0.2588**	0.0497
Variance	**0.1739**	0.0900	**0.2694**	0.0701	**-0.1411**	0.0197	0.0005	0.0504	**0.3261**	0.0472	-0.0534	0.0959

Notes:
SE = Robust standard errors. Bold indicates significant at 10% or less. Additional regressors as in Table 1.

Table 3: Elasticity of OOP budget share with respect to total consumption - quantile regression estimates

	Bangladesh		Hong Kong		India		Sri Lanka		Thailand		Vietnam	
OOP budget shares												
Median	1.11%		0.17%		1.58%		0.88%		0.34%		2.94%	
90th percentile	14.50%		6.56%		9.71%		5.57%		4.13%		13.57%	
Total consumption elasticities - quantile regression estimates												
	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE
Median	**1.1130**	0.0677	**0.9324**	0.1196	**0.6983**	0.0139	**0.4938**	0.0537	**0.2498**	0.0313	-0.0168	0.0334
60th percentile	**1.1009**	0.0672	**0.5197**	0.0803	**0.5604**	0.0118	**0.4037**	0.0396	**0.2958**	0.0287	0.0062	0.0315
70th percentile	**0.9982**	0.0622	**0.3809**	0.0613	**0.4696**	0.0100	**0.3465**	0.0347	**0.3247**	0.0394	**0.0907**	0.0411
80th percentile	**1.0223**	0.0603	**0.2517**	0.0567	**0.4141**	0.0096	**0.2796**	0.0284	**0.3661**	0.0317	**0.1375**	0.0345
90th percentile	**0.9299**	0.0804	**0.2122**	0.0574	**0.4238**	0.0108	**0.3197**	0.0356	**0.4575**	0.0389	**0.2886**	0.0427
Difference b/w regression coefficients on total consumption at 90th and 50th percentiles (dep. vbl. is OOP budget share)												
	0.1253	1.1785	**0.0111**	0.0040	**0.0326**	0.0011	**0.0135**	0.0025	**0.0182**	0.0017	**0.0399**	0.0057

Notes:
SE = Robust standard errors. Bold indicates significant at 10% or less. Additional regressors as in Table 1.

Table 4: Probability of incurring catastrophic payments - Total consumption (probit) coefficients at various thresholds and exogeneity tests

	Bangladesh		Hong Kong		India		Sri Lanka		Thailand		Vietnam	
OOP > 5% total exp.	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE	estimate	SE
hholds. > threshold	27.63%		12.98%		25.59%		10.97%		8.43%		33.77%	
Probit	**0.8096**	0.0586	**0.1196**	0.0339	**0.3958**	0.0102	**0.1841**	0.0344	**0.2850**	0.0267	**0.1447**	0.0698
Endog. corrected Probit	-0.3221	0.2714	**-0.6595**	0.2897	**-0.1784**	0.0711	**0.1800**	0.0990	0.0848	0.0595	0.1722	0.1376
Exogeneity test [$\chi^2(1)$]	16.6	p=.0000	7.37	p=.0066	66.41	p=.0000	0.00	p=.9641	14.77	p=.0001	0.07	p=.7925
OOP > 10% total exp.												
hholds. > threshold	15.57%		5.86%		10.84%		2.98%		3.52%		15.11%	
Probit estimate	**0.8860**	0.0645	**0.1499**	0.0408	**0.4462**	0.0125	**0.3252**	0.0469	**0.3898**	0.0325	**0.4009**	0.0718
Endog. corrected Probit	-0.1874	0.2939	-0.5418	0.3654	-0.1285	0.0892	0.1678	0.1421	0.0740	0.0759	0.1457	0.1397
Exogeneity test [$\chi^2(1)$]	13.38	p=.0003	3.65	p=.0561	42.14	p=.0000	1.38	p=.2406	22.71	p=.0000	5.2	p=.0226
OOP > 15% total exp.												
hholds. > threshold	9.87%		3.04%		5.52%		1.54%		1.92%		8.47%	
Probit estimate	**0.9941**	0.0748	**0.2199**	0.0506	**0.5676**	0.0156	**0.4203**	0.0576	**0.4161**	0.0388	**0.6146**	0.0777
Endog. corrected Probit	-0.1491	0.3296	-0.3594	0.4344	-0.1196	0.1117	0.0296	0.1834	0.0641	0.0933	0.0664	0.1401
Exogeneity test [$\chi^2(1)$]	12.02	p=.0005	1.8	p=.1801	38.34	p=.0000	5.01	p=.0252	18.89	p=.0000	22.5	p=.0000
Instrument validity												
Significance of IVs in RF	$F_{2,359}$=	72.9	$F_{1,7606}$=	118.44	$F_{4,118775}$=	532.67	$F_{3,9321}$=	436.32	$F_{2,17457}$=	1242.65	$F_{4,150}$=	161.4
		p=.0000		p=.0000		p=.0000		p=.0000		p=.0000		p=.0000
Overidentification test	$\chi^2(1)$=0.32	p=.5725	just identified		$\chi^2(3)$=19.81	p=.0000	$\chi^2(2)$= 4.00	p=.1354	$\chi^2(1)$= 2.76	p=0.0968	$\chi^2(3)$= 5.11	p=.1638

Notes: SE = Robust standard errors. Bold indicates significant at 10% or less. Additional regressors as in Table 1.
"Probit" gives coefficient on (log) total consumption in probit for catastrophic payments.
"Endog. corrected Probit" is same coefficient corrected for endogeneity by inclusion of reduced form (RF) residual (Rivers and Vuong, 1988).
Instrumental variables (IVs) : Bangladesh - dummy for any land and (log) land size; Hong Kong - property income;
India - dummies for marginal, medium and large land holdings and (log) land size; Sri Lanka - rental income, capital income and dummy for home owner;
Thailand - dummy for any land and wealth index; Vietnam - dummy for any land, (log) land size, lagged (5 years) food and non-food (excluding medical) expenditure.
Overidentification test is Wooldridge (2002, pp. 122-4)

Appendix

Table A1: Description of surveys

Territory	Year	Survey	Survey institution	National coverage	Survey design	Sampling unit	Response rate	Sample size
Bangladesh	1999-2000	Household Income Expenditure Survey	Bangladesh Bureau of Statistics	Nationally representative	Stratified, cluster sampling. Weights applied.	Household	100%	7,440
Hong Kong SAR	1999-2000	Household Expenditure Survey (HES)	Census & Statistics Department, Government of HK SAR	All land domestic households, except those receiving welfare.	Stratified. Weights applied.	Household	79.50%	6116
		HES on CSSA[a] (welfare) households	as above	All CSSA (welfare) cases, with some exceptions[b]	Stratified. Weights applied	Household	95.50%	1510
India	1999-2000	Consumer expenditure survey	National Sample Survey Organisation	Nationally representative	Stratified, sample weights applied.	Household	100%	120039
Sri Lanka	1996-1997	Consumer Finance Survey	Central Bank of Sri Lanka	Excluded Northern Province due to civil war.	Stratified. Weights applied	Household	98%	9,351
Thailand	2002	Socio-economic Survey	National Statistical Office	Nationally representative	Stratified, weights applied	Household	93%	17,489
Vietnam	1998	Living Standards Survey	General Statistical Office	National	Stratified, cluster sample. Weights applied.	household	70%	5999

Notes:

a. Comprehensive Social Security Assistance. For CSSA household members not on CSSA, expenditure estimate at 25 percentile of HES sample of same household size and housing type.

b. Covers 99% of CSSA families and 65% of CSSA single persons.

Table A2: Variable definitions - Living standards and OOP health payments

	Household living standards		OOP health payments	
	Concept[a]	**Period[b]**	**Services covered**	**Recall Period[c]**
Bangladesh	Consumption	1 year	Fees, hospital/clinic charges, medicines, test/investigation, transport, tips and other health service charges.	1 month
Hong Kong SAR	Expenditure	1 month	Inpatient, outpatient, medicines, traditional medicine, dental, medical supplies/equipment, health supplement, other health care.	Inpatient = 1 year; others = 2 weeks
India	Consumption	1 month	Fees, inpatient and outpatient hospital charges, medicines, tests, abortion, ambulance charge.	Inpatient =1 year; others =1 month
Sri Lanka	Consumption	1 year	Fees, hospital charges, medicines, tests, spectacles, dental, homeopathy and acupuncture, charms and others	1 month
Thailand	Consumption	1 month	Inpatient, outpatient, medicines, self-medication, traditional medicine	Inpatient = 1 year; others = 1 month
Vietnam	Consumption	1 year	Inpatient care costs plus total other amount paid in money and in-kind for diagnosing and treating illness and injury.	1 year

Notes:
a. *Consumption* includes the value of goods consumed from household production and where feasible the use value of durables and implicit rental value of housing. *Expenditure* is the value of goods purchased for consumption.
b. Expenditures on different items are reported for different recall periods. The period given is the one for which total consumption / expenditure is computed.
c. All OOP payments are scaled to the same period used to compute total consumption / expenditure.

References

Berki, S. E. (1986). "A look at catastrophic medical expenses and the poor." Health Affairs: 138-145.

Bonu, S., M. Rani, et al. (2005). "Does use of tobacco or alcohol contribute to impoverishment from hospitalization costs in India?" Health Polcy and Planning **20**(1): 41-49.

Ensor, T. and B. S. Pham (1996). "Access and payment for health care: The poor of nothern Vietnam." International Journal of Health Planning and Management **11**: 69-83.

Gertler, P. and J. Gruber (2002). "Insuring consumption against illness." American Economic Review **92**(1): 51-70.

Grossman, M. (1972). The demand for health: a theoretical and empirical investigation. NBER occasional paper. New York.

Harvey, A. (1976). "Estimating regression models with multiplicative heteroscedasticity." Econometrica **44**(3): 461-465.

Limwattananon, S., V. Tangcharoensathien, et al. (2005). Equity in financing of health care in Thailand, 2000-2004. Equitap Project Working Paper #16. Erasmus University, Rotterdam and IPS, Colombo.

Mocan, H. N., E. Tekin and J.S. Zax (2004). "The demand for medical care in urban China." World Development **32**(2): 289-304.

O'Donnell, O., E. van Doorslaer, et al. (2005). Who benefits from public spending on health care in Asia? EQUITAP Working Paper #3, Erasmus University, Rotterdam and IPS, Colombo.

Peters, D., A. Yazbeck, et al. (2001). Better health systems for India's poor. Findings, analysis and options. Washington DC, World Bank.

Pradhan, M. and N. Prescott (2002). "Social risk management options for medical care in Indonesia." Health Economics **11**: 431-446.

Ranson, M. K. (2002). "Reduction of catastrophic health care expenditures by a community-based health insurance scheme in Gujarat, India: current experiences and challenges." Bulletin of the World Health Organisation **80**(8): 613-21.

Rivers, D. and Q. Vuong (1988). "Limited information estimators and exogeneity tests for simultaneous probit models." Journal of Econometrics **39**: 347-366.

Russell, S. (2004). "The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome." American Journal of Tropical Medicine and Hygiene **71**(Supp. 2): 147-155.

Sauerbron, R., A. Adams, et al. (1996). "Household strategies to cope with the economic cost of illness." Social Science & Medicine **43**(3): 291-301.

van Damme, W. (2004). "Out-of-pocket health expenditure and debt in poor households: evidence from Cambodia." Tropical Medicine and International Health **9**(2): 273-80.

Van Doorslaer, E., O. O'Donnell, et al. (2005). Paying out-of-pocket for health care in Asia: Catastrophic and poverty impact. EQUITAP Working Paper #2, Erasmus University, Rotterdam and IPS, Colombo.

Wagstaff, A. (2005). The economic consequences of health shocks. World Bank Development Research Group, Policy Research Working Paper no. 3644. Washington DC.

Wagstaff, A. and E. Van Doorslaer (2003). "Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993-98." Health Economics **12**: 921-934.

Wilkes, A., H. Y., et al. (1998). Coping with the costs of severe illness in rural China. IDS Working Paper 58. Brighton, Sussex, UK.

Wooldridge, J. M. (2002). Econometric analysis of cross-section and panel data. Cambridge, Massachusetts, MIT Press.

World Health Organisation (2005). Sustainable health financing, universal coverage and social health insurance. 115th World Health Assembly Resolution EB115.R13. Geneva.

Wyszewianski, L. (1986). "Financially catastrophic and high cost cases: Definitions, distinctions and their implications for policy formulation." Inquiry **23**(4): 382-94.

Xu, K., D. E. Evans, et al. (2003). "Household catastrophic health expenditure: a multicountry analysis." Lancet **362**: 111-17.

Notes

[1] Catastrophic payments have also been defined as those in excess of a threshold share of non-food expenditure (Wagstaff and van Doorslaer, 2003) or estimated non-subsistence expenditure (Xu et al, 2003).

[2] All elasticities are computed at sample means. For continuous variables that enter the model in logs or proportions, the elasticity is $\varepsilon_k = \left(\phi\left(\bar{X}\hat{\beta}\right) \Big/ \Phi\left(\bar{X}\hat{\beta}\right) \right)\hat{\beta}_k$, where $\phi(\ )$ and $\Phi(\ )$ are the standard normal density and cumulative density functions, $\bar{X}$ is the vector of variable means and $\hat{\beta}_k$ is the coefficient on the variable x_k. A semi-elasticity is the percentage change in the probability for a unit change in the independent variable. For non-binary integer variables, it is given by $100 * \varepsilon_k$. For dummy variables, we define the elasticity as $\varepsilon_d = \dfrac{\Phi\left(\bar{Z}\hat{\theta} + \hat{\delta}\right) - \Phi\left(\bar{Z}\hat{\theta}\right)}{\Phi\left(\bar{Z}\hat{\theta}\right)} 100$, where $\bar{Z}$ is a vector of mean values of all variables except the dummy and $\hat{\delta}$ is the coefficient on the dummy.

[3] Computation is by `Stata`, using the command `reghv` (STB-42: sg77).

[4] Conditional on the OOP share being positive, results in Table 2 show that the mean share is decreasing with total consumption in Hong Kong and Sri Lanka. However, the third row of Table 2 shows that the expected value across all observations (zero and positive OOP share) is never decreasing with total consumption.

[5] The full specification of the quantile regressions is as in Table 1. For brevity, we do not present the estimates for the other regressors. In general, these take the same signs as in Table 1 but the magnitudes differ across quantiles.

[6] The data for Vietnam do include health conditions in previous 4 weeks and anthropometrics. The former have been found to be weak in picking up the impact of health on household resources relative to indicators of more severe health conditions Gertler, P. and J. Gruber (2002). While changes in the body mass index have been used as an indicator of health shocks Wagstaff, A. (2005), it would seem particularly difficult to disentangle changes in nutrition deriving from a genuine shock to health from those that derive from changes in economic circumstances. There is an additional problem of including individual level health measures in a household level analysis of expenditures.

[7] Actually, we use log(land size + 1) to allow for households with no land holdings. For Thailand, there is no information on land size and we include a dummy only. For India, we include dummies for marginal, medium and large land holdings plus a land size.

[8] Overidentification tests Wooldridge, J. M. (2002) p.p. 122-24) are implemented for a linear IV model estimated across all non-zero OOP shares. An overidentification test for the endogeneity corrected probit model is not available.