The Impact of Health Insurance on
Financial Protection and Access to Care:
Simulation Analysis for Kenya

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By

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Abstract

This paper derives a model for estimating the effect of implementing a social health insurance program on health services utilization and household out-of-pocket payments. It also expands the definition of catastrophic health expenditure to provide a more complete picture of its potential incidence. It uses simulation analysis based on Kenyan data to illustrate the results. The analysis shows that the implementation of a social health insurance program has a significant impact on changing the utilization of health services as well as on the incidence of catastrophic health expenditure. In addition, it also shows that the results from using an expanded definition of the incidence of catastrophic health expenditure are indicative of a need to further develop its measures and its interpretations.
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Introduction

Out-of-pocket health expenditures are a substantial burden of as well as barrier to accessing health care. The incidence of catastrophic health expenditure in a population is a valid indicator of the magnitude of the problem of out-of-pocket health expenditures. As a result, an analysis of catastrophic health expenditure is an interesting platform for analyzing health financing options. In this paper, the role of social health insurance systems will be studied through a necessary expansion of the definition of catastrophic health expenditure as well as the development of simple behavioural models. Data from Kenya will then be used to illustrate the results of the model.

Understanding Catastrophic Health Expenditure and Utilization

A previous multi-country analysis by Xu, Evans, Kawabata, Zeramdini, Klavus & Murray (2003) found that the percentage of households with catastrophic health expenditure, when it is defined as out-of-pocket health expenditure (including routine health expenditures) representing 40% or more of total non-subsistence expenditure, varied from less than 0.01% to 10.5% across the countries in the study. The study also found that countries with "advanced social institutions such as social insurance or tax-funded health systems protect households from catastrophic spending".

Analysis of the Household Health Expenditure and Utilisation Survey, 2003 of the Ministry of Health of Kenya (Ministry of Health, 2003) shows that there is marked difference in utilization of health services across different income groups. Lower income groups are also more likely to face catastrophic health expenditure. According to Xu, James, Carrin & Muchiri (2006) the number of households facing catastrophic health expenditure at the 2003 utilization levels is estimated to be around 4%. Additionally, lower income households that are not already below the poverty line are more likely to fall under the poverty line due to health expenditures than higher income households. Overall, 1.5% of Kenyan households are estimated to be impoverished due to health expenditures.

From data such as this, it becomes clear that health expenditures and health expenditures relative to household income play an essential role in the utilization of health care services. However the number of households exposed to the risk of catastrophic health expenditure is bound to be under-reported in these and other studies. The majority of previous research on catastrophic expenditure such as Ranson (2002) Su, Kouyate & Flessa (2006), Xu, Evans, Kadama, Nabyonga, Owang, Nabukhonzo et al (2006) and Waters, Anderson & Mays (2004) has only taken into account expenditures of households who have used health services. This represents only households with observed catastrophic health expenditure. A study by Pradhan &
Prescott (2002) based on Indonesian data took into account the potential incidence of catastrophic health expenditure and effects of social risk management. This study shows that there is a gap between the observed and the potential catastrophic expenditure. Undoubtedly, there are many households who are too poor to afford the out-of-pocket payments for health care and hence, are not able to use health services. By not including these households into the calculation of the incidence of catastrophic of health expenditure, the true burden from it across the population is being underestimated. This is especially the case for poorer households. In addition, whereas measuring the actual incidence of catastrophic expenditure is useful for some things, an approach that takes into account its total potential incidence is more useful when the effects of implementing a specific social health insurance program are considered.

In the context of Kenya, this study will estimate the total potential burden from catastrophic health by also taking into account households who would have faced catastrophic health expenditure had they chosen to seek health care when they needed it. It will then analyze the potential role of a social insurance system on health services utilization, the price of health services and total catastrophic health expenditure. The use of Kenyan data is particularly interesting because of its intention to expand the current National Hospital Insurance Fund (NHIF) (IPAR, 2005 and Kimani, Muthaka, & Manda, 2004). Overall, this research aims to develop methodological tools that can be used to understand the total burden from catastrophic health expenditure and the effects of implementing social health insurance systems. The use of Kenyan data also provides an interesting basis for comparison with other countries that may be considering similar reforms.

This paper is divided into five main sections including the "Introduction". The "Methodology" section will then go to discuss the development of the models used in this paper in detail. The results will be presented in the "Results" section and discussed along with the further particularities of the methodology in the final sections, "Discussion" and "Conclusion". These main sections are further divided into sub-sections.

Methodology

Overview

The data used for this study is from Household Health Expenditure and Utilisation Survey, 2003 of the Ministry of Health of Kenya (Ministry of Health, 2003). The data was collected by asking one member of each of the surveyed households to answer questions about their household's socio-economic conditions, health and health-related expenditures. This paper's catastrophic health expenditure methodology has built on the "fair financing" framework developed Xu (2005) and Murray & Evans (2003).

This section will initially discuss the social health insurance system considered. It will then go on to develop the expanded definition of catastrophic health expenditure that also takes into account unobserved catastrophic health expenditure. It will then discuss the models used to analyze the expected changes in utilization of health services as a
result of the implementation of the social health insurance program and the new out-of-pocket expenditures. It should be noted that models for inpatient and outpatient services were derived separately throughout the paper.

The effects of the social health insurance program considered were quite simple in nature. A prepaid mechanism led to percentage decreases in the out-of-pocket payments associated with outpatient and inpatient utilization. In this simulation model, we assumed that the insurance covers 50% of out-of-pocket payments for both inpatient and outpatient utilization for everyone. This was irrespective of the choice of health care provider and there were no caps on sums insured. It should be noted that contributions to the program were not taken into account in this paper.

Beyond the Conventional Paradigms on Catastrophic Health Expenditure

A key idea in this paper is the treatment of the incidence of catastrophic health expenditure. As discussed earlier, the analysis of catastrophic health expenditure has so far mainly concentrated on its observed incidence. This is not indicative of the real scale of the problem of catastrophic health expenditure. The decision to use health services is bound to be influenced by the expected financial burden that would be imposed by it. Only by considering the observed incidence of catastrophic health expenditure, we are effectively ignoring all the people who have refrained from using health services because the expected financial burden of use was too large. In addition, when assessing the effects of an insurance program, as is done in this paper, it is useful to look at its total potential effect on the incidence of catastrophic health expenditure. Therefore, everyone who reported the need to use health services was included in its calculation and expected out-of-pocket expenditures were calculated for everyone with the need to use health services. These expected out-of-pocket expenditures were then combined with observed out-of-pocket health expenditures for people who actually used services to arrive at the total incidence of catastrophic health expenditure.

Predicted Out-of-Pocket Expenditures and the Total Potential Catastrophic Health Expenditure

Out-of-pocket expenditures were predicted by regressing reported out-of-pocket expenditures against combined elements of general health status, economic and demographic criteria. In this fashion, predicted out-of-pocket expenditures of non-users who reported the need to use services were derived. A log-linear regression model was used because of the skewed nature of the original data. \( \text{price} \) was predicted through the following model (where the function \( f \) was linear):

\[
\log (oop) = f(age_{5i}, age_{65i}, urban, male, yes\_educ, chroi, real\_insi, q2, q3, q4, q5) + \text{error}
\]  

(Where \( age_{5i} = 1 \) is an individual is less than 5 years old, \( age_{65i} = 1 \) if an individual is 65 or more years old, \( urban = 1 \) if an individual lives in an urban area, \( male = 1 \) if an individual is male, \( yes\_educ = 1 \) if an individual’s household head is educated, \( chroi = 1 \) if an individual suffers from chronic illness, \( real\_insi = 1 \) if an individual subscribes to a health insurance other than the scheme that is simulated in this paper, \( q2 = 1 \) if an individual in the second expenditure quintile, \( q3 = 1 \) if an individual in the third expenditure quintile, or \( q4 = 1 \) if an individual in the fourth expenditure quintile)
For the observed catastrophic health expenditure, only the reported out-of-pocket expenditures incurred by those who utilized services need to be used. However, for calculating the total potential (unobserved and observed) incidence of catastrophic health expenditure, the reported out-of-pocket expenditures for those who utilized health services were combined with the predicted out-of-pocket expenditures (from Equation 1) for those who did not use health services but reported the need to. It should be noted that a Heckman analysis was initially carried out to derive predicted out-of-pocket expenditures for non-users. However, the analysis was insignificant for this data (i.e. there was no evidence of a selection bias) and therefore a regression was sufficient.

**Out-of-Pocket Payments and Utilization**

In the simulation model, we assume that the insurance plan will reimburse 50% of the total health care cost. However, this decrease will not exactly be 50% of an individual’s current health expenditure since the demand for health services is influenced by the out-of-pocket expenditures associated with it. Therefore, the utilization of health services will increase, and the overall decrease in an individual’s out-of-pocket health expenditure will not quite be 50%. The subsequent parts of the methodology try to take this into account.

The second model developed tries to understand the role of the predicted out-of-pocket expenditures, in addition to some individual demographic and general health status variables, on the use of services. The predicted out-of-pocket expenditures were used as an explanatory variable for use vs. non-use of health services by dividing them by the per capita capacity to pay, which has been developed by Xu (2005) and Murray & Evans (2003). This was done since seeking health care is thought to be influenced by the expected financial burden imposed by it, which can be approximated by the ratio of predicted out-of-pocket service costs over the per capita capacity to pay. Indeed, if the expected financial burden was high, then health services may not be used despite their perceived need. A variable called financial_burden was generated by calculating this ratio for all individuals who needed health services.

It should be noted that some of the demographic and general health status variables used in predicting prices were also used in the utilization model. However, the separate and combined correlation of these variables was quite minimal, and therefore it was felt that they could still be used. Ideally of course, a completely different set of variables would have been used for the utilization model. Unfortunately this was not possible within this dataset.

The precise specification of the utilization model with the ratio of predicted prices over per capita capacity to pay was through a logit model (where the probability of use is \( \Pr(y = 1 \mid X) \)) and the odds ratio is:

\[
OR = \frac{\Pr(y = 1 \mid X)}{\Pr(y = 0 \mid X)} = \frac{\Pr(y = 1 \mid X)}{1 - \Pr(y = 1 \mid X)} \tag{2}
\]

After the logit transformation, the linear model can be written as (where the matrix X includes financial_burden):
\[
\ln\left( \frac{Pr(y = 1 \mid X)}{1 - Pr(y = 1 \mid X)} \right) = \beta X
\]

(3)

In reality, in addition to the factors considered in the explanatory matrix, elements such as the perceived quality of health services, distance to facilities, income loss due to health service use, etc. will also play potentially important roles in leading to the decision to use or not use health services. Whereas there was not enough information in the data to include these factors, ideally a utilization model should try to incorporate as many potential factors as possible.

Using this model, the sensitivity of utilization to changes in the financial burden was estimated. It was then possible to estimate the overall population level change in utilization given a change in out-of-pocket payments. This overall population level change in utilization if out-of-pocket expenditures decreased by 50% was calculated as \textit{use\_change\_pop}.

\textit{Effects of Changes in Out-of-Pocket Payments}

At this point, it is also important to reconsider the limitations of the models used until this stage. By its very nature, the health services utilization model derived in the preceding section only provides information regarding the average population-wide change in use if parameters such as \textit{financial\_burden} change. As stated earlier, the population wide change in utilization calculated from the model if out-of-pocket expenditure decrease by 50% can be represented as \textit{use\_change\_pop}. However, the predictive power of the model for individuals’ use is not be valid and a slightly more complicated model needs to be developed in order to predict individual level changes in utilization.

In the model developed to address this, it was assumed that everyone valued the additional opportunity cost of the financial burden imposed by using health services in the same way. In other words, the model equalized the financial burden based-marginal disutility of the use of health services for all people who reported the need to use services. This assumption could very realistically represent the changes in use of health services if out-of-pocket payments are uniformly decreased for all individuals (since marginal disutility can be expected to be affected by the new \textit{financial\_burden}). In order to make this model even more valid, the sum of the capacity to pay (the denominator in the equation below) was calculated using the household weights provided in the survey. The mathematical representation of this model is:

\[
\alpha = \frac{\sum_{i=1}^{n} (price_i - 0.5 \cdot price_i \cdot use\_change\_pop / n)}{\sum_{i=1}^{n} ctp_i}
\]

(4)

where \((i \in n)\)

In the equation above, "n" is total number of people who report the need to use health services and each individual who needs services is represented by "i". \textit{price}_i is the original predicted out-of-pocket payment for an individual. \textit{ctp}_i is an individual’s capacity to pay. Finally, \textit{use\_change\_pop} represents the overall population wide
change in use with the new out-of-pocket expenditures. In this fashion, $\alpha$ is the equalization constant of the marginal disutility derived from utilization across all individuals because of implementation of the social health insurance. The equalization constant can then be used to predict changes in an individual’s health expenditures. The new individual expected total out-of-pocket expenditure then becomes:

$$new\_oop_i = price_i - 0.5(price_i) + \alpha * ctp_i$$  \hspace{1cm} (5)

In Equation 5, “$\alpha * ctp_i$” is the marginal change in health expenditure due to changes in an individual’s use of health services. The first part, $price_i - q(price_i)$, simply models the decrease in an individual’s health expenditures if his utilization did not change. Therefore, the addition of these two parts represents an individual’s new total health expenditure.

It should be noted that for individuals who had actually used health services, $price$ was substituted with their actual out-of-pocket payment. The $new\_oop_i$ of both outpatient and inpatient services of the all individuals in a household who had reported the need to use health services was then added. The total household out-of-pocket expenditure was then divided by the household's capacity to pay to calculate the total (both observed and unobserved) number of households in the survey population facing catastrophic expenditure.

$$\sum_{i=1}^{hhsize_j} new\_oop_i \over ctphh_j$$  \hspace{1cm} (6)

(For all individuals "i" with need who are part of a household "j" ($i \in j$) and where $ctphh_j$ is a household’s capacity to pay.

The incidence of catastrophic health expenditure takes into account the household weights provided in the survey and is defined as (for out-of-pocket expenditure $new\_oop$ and capacity to pay $ctphh$):

$$\text{catas}_j = 1 \text{ if } hfc_j \geq 0.4 \text{ or} \quad \text{catas}_j = 0 \text{ if } hfc_j < 0.4$$  \hspace{1cm} (7)

Results

The results of the intermediate models as well as the specific social health insurance scenario on catastrophic expenditure will be presented in this section.

Predicted Out-of-Pocket Payments

The results of the log-linear regression used to separately predict outpatient and inpatient out-of-pocket service costs are shown in Table 1 and 2.
The log-linear regression models for outpatient and inpatient out-of-pocket payments share some common parameters. For example, \texttt{age5i} which is a dummy variable for identifying children who are under 5 years of age, seems to have a significant negative correlation with out-of-pocket service costs. This could be indicative of the presence and relative success of low-cost or free primary health care programs targeted towards childhood illness. The other common parameter in the two regressions is \texttt{urban}, the variable identifying people living in urban areas. However, its relationship to out-of-pocket service costs is different for outpatient and inpatient services. The existence of subsidized inpatient facilities and a wide range of outpatient facilities in urban areas could explain this phenomenon. Although this may be valid, it should also be noted that there seems to have been an over-reporting of the need for inpatient services in urban areas. Additionally, there is a clear and consistent positive relationship between out-of-pocket payments and household expenditure. This strongly suggests that richer households pay higher out-of-pocket payments. It should also be noted that subscription to a health insurance scheme (other than the social insurance simulated in the paper), represented by \texttt{real_insi} was not significant in predicting out-of-pocket expenditures.

\textit{Utilization of Health Services}

The results from these regressions were then used to predict the out-of-pocket payments associated with all people who reported the need for either outpatient or inpatient services. The relevance of these predicted out-of-pocket expenditures on the decision to use or not to use health services was then modelled. The results of the logit models to predict health services utilization are shown in Table 3 and 4.

The variables, \texttt{financial\_burden\_o} and \texttt{financial\_burden\_i}, which represent the financial burden on an individual if he chooses to seek health care in outpatient or inpatient facilities respectively, have very significant predictive power in both the models. Additionally, as could have been expected the relationship between the size of this financial burden and utilization of health services is negative. With respect to other explanatory variables, individuals whose household heads are educated are more likely to use outpatient services, which is something that is in conjunction with many health and education paradigms. The elderly seem to be less likely to use outpatient services which may suggest that people are more concerned with the health status of younger groups or that the elderly face other barriers in accessing health services. In terms of the use of inpatient services, subscription to insurance, represented by \texttt{real\_insi}, (other than the proposed social health insurance) has a positive relationship with use. This is a classic indicator of the problem of moral hazard. It should also be noted that the lack of widely available outpatient insurance schemes may explain the absence of insurance as a predictor in the use of outpatient services. The last variable that is significant in predicting the use of inpatient services is living in an urban area. As mentioned earlier, it is believed that the direction of this relationship is misleading because there is an observed over-reporting of the need to use health services in urban areas when compared to rural areas. This over-reporting may be due to expectations about health care services and potentially undermines the predictive power of this particular variable.
**Observed and Total Potential Catastrophic Health Expenditure**

The calculation of total potential catastrophic health expenditure compared to observed catastrophic health expenditure (without any changes in out-of-pocket expenditures) across expenditure quintiles is shown in Figure 1. This provides basis of comparison for the effects of implementing the discussed social health insurance program as well as illustrate the differences in the two definitions of catastrophic health expenditure.

With current out-of-pocket expenditure, more than 6.5% of households in the first quintile had observed catastrophic health expenditures. In comparison, only around 2% of households in two highest quintiles had observed catastrophic health expenditures.

However, there is a significant difference between the total households potentially facing catastrophic expenditure and the observed households who faced catastrophic expenditure. This is, of course, partially due to the fact that poorer households who initially did not use services because they could not afford to are now assumed to be using services (since everyone who reported the need to use health services is assumed to have used them in the calculation of total potential catastrophic health expenditure).

This is further demonstrated in the following: only an additional 0.80% of households in quintile 5 who did not initially use services now face catastrophic expenditure whereas an additional 23.19% of households in quintile 1 who did not initially use services now face catastrophic expenditure.

**Results of Decreasing Out-of-Pocket Expenditure by 50%**

The intermediate models were then used to analyze the effect decreasing out-of-pocket expenditures by 50% (with no caps) on the incidence of catastrophic health expenditures. With the implementation of the proposed social health insurance program, there would a 12.47% and 41.22% increase in the use of outpatient and inpatient services respectively (due to the decreased financial burden associated with seeking care). The marginal cost of the program (which represents the difference in revenue collected from out-of-pocket expenditures if everyone who needs services uses them with and without the social health insurance) is KSh 2,207,972 for the sample size of 38,000 people for one month. This corresponds to around 2.64% of total monthly income. The overall incidence of total potential catastrophic health expenditure will decrease to 4.53% under this scenario. Figure 2 separates this incidence across expenditure quintiles.

In addition to the significant increase in utilization, the implementation of the social health insurance leads to significant decreases in the incidence of total potential catastrophic health expenditure. In addition, the decrease is higher for lower quintiles than for higher quintiles in absolute terms. The incidence in the first expenditure quintile decreases from 29.82% to just 13.67%. Similarly, the incidence in second expenditure quintile decreased from 17.31% to just 6.07%. In comparison, the incidence in the highest expenditure quintile decreased from 2.81% to 0.70%. This means that more lower expenditure households are benefiting from the implementation of the social health insurance than higher expenditure households.
Discussion

The objective of this paper was to try to understand the effects of a social health insurance program on the incidence of catastrophic health expenditure. Indeed, the results presented highlight some very interesting points.

In terms of utilization, the results demonstrate a significant increase in the utilization of health services after the 50% decrease in out-of-pocket payments (a 12.47% and a 41.22% increase in the use of outpatient and inpatient services respectively). This result stresses the elastic nature of the relationship between out-of-pocket payments and the utilization of health services. It also serves to reinforce the finding that decreases in out-of-pocket expenditures have a positive impact on the utilization of health services such as Burnham, Pariyo, Galiwango & Wabwire-Mangen (2004), Collins, Quick, Musau, Kraushaar & Hussein (1996) and Nabyonga, Desmet, Karamagi, Kadama, Omaswa & Walker (2005).

However, the key result shows that if the insurance covers all the population, the incidence of catastrophic expenditure will be greatly decreased in lower expenditure quintiles. The percentage of families in the first expenditure quintile potentially facing catastrophic health expenditure decreased by 16.15% after the implementation of the social insurance scheme as compared to just 2.11% of families in the fifth expenditure quintile. Considering the number of households facing catastrophic health expenditures in the lower quintiles to start off with, the decrease is extremely important and encouraging. In addition, it is important to note that the cost of the simulated scheme was just a small fraction of the self-reported income of the survey participants (around 2.64%).

However, low expenditure quintiles are still facing a higher incidence of catastrophic expenditure than higher expenditure quintiles. Results from the simulated models show that the catastrophic expenditure in the poorest quintile is 13.67% compared to just 0.7% in the richest quintile. These results indicate that more effort may be needed in ensuring that lower income households are not faced with catastrophic health expenditure. In terms of a social health insurance program, differential subsidies for lower and higher income households (where lower income households’ out-of-pocket is decreased more than higher income households) may be a way of achieving this.

This study contributes to advancing the methodology of measuring potential catastrophic expenditure and applies it to estimate the impact of social health insurance plans. We only presented one scenario as an example in this paper. More options can be established using the same methodology. However, there are still many barriers to make the predictions more accurate. One of the important issues is the availability and quality of the data. The survey data needs to be subject to the usual degree of scrutiny, taking into account the occurrence of both systematic and non-systematic errors. As was mentioned earlier, there are certain indications about data quality such as the over-reporting of the need to use health services among urban dwellers. Whereas this particular incident was identified and acknowledged, it is plausible that other more subtle biases in the data set have not been detected and thus their potential effects on the results have been not considered. Also, ideally, when modelling the out-of-pocket service costs and utilization, distinctions should be made between the types of provider (e.g. public, private-for-profit, etc.) since there are many differences among them both
in terms of prices as well as the potential coverage for social health insurance programs.

The variety of data gathered within the survey is also quite limited with respect to this exercise. In the preliminary regressions and models of utilization, it would have been extremely useful to have different sets of variables that could be used in the models. Similarly, there was no data available with regards to variables that would be pivotal for health-care seeking decisions such as the perceived seriousness of the condition, the loss of income that would be associated with seeking health-care and the perceived quality of health care providers. Therefore, in order to arrive at an even more holistic and reliable model, it should be recognized that additional data is needed.

Furthermore, the use of self-reported need in this context is not without its constraints. Indeed, the basic assumption in understanding the complete burden from catastrophic health expenditure in this dataset is completely dependant on the accuracy of this self-reported need. Undoubtedly, there is bound to be a certain degree of inaccuracy since self-reported need may not actually translate into real need.

In addition, it should be noted that model can take into account the effects of contribution to social health insurance programs (through the financial burden). Whereas this was not done here due to lack of data available to translate income contributions to decreases in capacity to pay, it can indeed be quite a powerful tool in helping to draw a more encompassing picture of the effects of specific insurance programs.

**Conclusion**

Overall, this methodology is supposed to only serve as a preliminary platform for development around more comprehensive models for the incidence of catastrophic health expenditure. Indeed, there should be significant caution applied to generalizing these results to other settings. The results, however, offer some valuable insight for the implementation of social health insurance programs. They show that decreasing out-of-pocket payments result in significant increases in utilization. In addition, they also showed that implementation of a social health insurance program has a protective effect on households who potentially face catastrophic health expenditures. The study, however, also indicated that in order to reduce the inequality of catastrophic expenditure among the population, government subsidies and different benefit packages in terms of reimbursement rate for different income groups should be considered.

There is a lot more work to be done in understanding the true burden of catastrophic health expenditure. More than anything, this paper is an attempt to encourage further research and development of the methodology presented here as well as other methodology targeted at advancing the work on catastrophic health expenditure as well as that on modelling the effects of changes in out-of-pocket expenditures.
References


### Tables and Figures

#### Table 1. Results of log-linear regression of outpatient out-of-pocket expenditures

| ln_oopouti | Coef. | Std.  | Err.  | P>|t| |
|------------|-------|-------|-------|------|
| age5i      | -0.319| 0.053 | -5.990| 0.000|
| Chroi      | 0.279 | 0.062 | 4.490 | 0.000|
| Urban      | 0.114 | 0.056 | 2.030 | 0.043|
| Malei      | 0.094 | 0.044 | 2.150 | 0.032|
| yes educ   | -0.278| 0.053 | -5.240| 0.000|
| q2         | 0.258 | 0.070 | 3.700 | 0.000|
| q3         | 0.535 | 0.070 | 7.600 | 0.000|
| q4         | 0.750 | 0.072 | 10.400| 0.000|
| q5         | 1.410 | 0.079 | 17.900| 0.000|
| _cons      | 4.658 | 0.066 | 70.120| 0.000|

Number of obs 3023
F(9,3013) 68.79
Prob > F 0.00
R-squared 0.170
Adj R-squared 0.168
Root MSE 1.194

#### Table 2. Results of log-linear regression of inpatient out-of-pocket expenditures

| ln_oopinpatient | Coef. | Std.  | Err.  | P>|t| |
|-----------------|-------|-------|-------|------|
| age5i           | -0.441| 0.183 | -2.410| 0.016|
| age65i          | 0.829 | 0.332 | 2.500 | 0.013|
| urban           | -0.238| 0.173 | -1.370| 0.170|
| q4              | 1.092 | 0.260 | 4.190 | 0.000|
| q5              | 2.099 | 0.274 | 7.650 | 0.000|
| q2              | 0.862 | 0.256 | 3.370 | 0.001|
| q3              | 0.909 | 0.256 | 3.550 | 0.000|
| _cons           | 6.873 | 0.207 | 33.210| 0.000|

Number of obs 417
F(7, 409) 12.71
Prob > F 0.00
R-squared 0.1787
Adj R-squared 0.1646
Root MSE 1.4612
Table 3 Results of logit model of outpatient utilization

|     | Coef. | Std. | Err. | P>|z| |
|-----|-------|------|------|-----|
| age5i | 0.029 | 0.061 | 0.480 | 0.632 |
| age65i | -0.135 | 0.111 | -1.210 | 0.225 |
| urban | 0.002 | 0.058 | 0.040 | 0.970 |
| yes_educ | 0.317 | 0.060 | 5.310 | 0.000 |
| malei | -0.046 | 0.050 | -0.910 | 0.363 |
| financial_burden_o | -0.110 | 0.019 | -5.800 | 0.000 |
| chroi | -0.044 | 0.071 | -0.620 | 0.536 |
| _cons | -0.016 | 0.066 | -0.240 | 0.813 |

Log likelihood: -4493.48
Number of obs: 6579
LR chi2(7): 125.07
Prob > chi2: 0.00
Pseudo R2: 0.0137

Table 4 Results of logit model of inpatient utilization

|     | Coef. | Std. | Err. | P>|z| |
|-----|-------|------|------|-----|
| age5i | 0.129 | 0.169 | 0.770 | 0.444 |
| age65i | -0.064 | 0.273 | -0.230 | 0.814 |
| urban | -0.311 | 0.142 | -2.200 | 0.028 |
| yes_educ | 0.033 | 0.153 | 0.210 | 0.832 |
| malei | -0.043 | 0.130 | -0.330 | 0.740 |
| financial_burden_i | -0.014 | 0.004 | -3.260 | 0.001 |
| real_insi | 0.730 | 0.169 | 4.310 | 0.000 |
| chroi | -0.122 | 0.158 | -0.770 | 0.441 |
| _cons | 0.082 | 0.181 | 0.450 | 0.650 |

Log likelihood: -712.86
Number of obs: 1063
LR chi2(8): 44.41
Prob > chi2: 0.00
Pseudo R2: 0.0302
Figure 1 Incidence of catastrophic health expenditure by quintile

Figure 2 Incidence of total catastrophic health expenditure by quintile: Before and after the proposed the social health insurance program