ARC Centre of Excellence in Population Ageing Research

Working Paper 2018/25

Health Care Spending and Hidden Poverty in India

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by

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October 24, 2016
Revised January 21, 2018

Abstract

India has a high level of out-of-pocket (OOP) health care spending, and lacks well developed health insurance markets. As a result, official measures of poverty and inequality that treat medical spending symmetrically with consumption goods can be misleading. We argue that OOP medical costs should be treated as necessary expenses for the treatment of illness, not as part of consumption. Adopting this perspective, we construct poverty and inequality measures for India that account for impoverishment induced by OOP medical costs. For 2011/12 we estimate that 4.1% of the population, or 50 million people, are in a state of "hidden poverty" due to medical expenses. Furthermore, while poverty in India fell substantially from 1999/00 to 2011/12, the fraction of the remaining poverty that is due to medical costs has risen substantially. Economic growth appears less "pro-poor" if one accounts for OOP medical costs, especially since 2004/05, and especially in rural areas.

Keywords: Poverty, Consumption, Healthcare, Medical Costs, Inequality, Growth.

JEL Codes: I14, I32, O15, O53, N35

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Acknowledgements: Support for this project was received from the EU's Erasmus Mundus Experts4asia program, and from Australian Research Council grant FL110100247. The views expressed are solely those of the authors, and do not necessarily reflect the views of these organizations.

I. Introduction

In the 60 years since independence, India experienced substantial improvements in many health measures, such as life expectancy, infant mortality and maternal mortality. Nevertheless, health outcomes still lag behind many other developing countries (see Reddy et al, 2011, Alkire and Seth, 2015). The Indian government's expenditure on health care is only 1% of GDP (World Bank, 2015), and less than 16% of the population is covered by health insurance (WHO, 2006, MOSPI, 2015). Thus, India's health system ranks as one of the most heavily dependent on out-of-pocket expenditures in the world. According to GOI, 2005, NCMH, 2005 and WHO, 2006, more than 70 percent of total health expenditure in India is out-of-pocket (OOP).

In this paper we examine the impact of OOP health expenditures on the incidence and depth of poverty. We argue that official measures of poverty derived from consumption surveys tend to mask impoverishment due to OOP health care costs. An adverse health shock S has the effect of shifting the expenditure function $e(U,S)$ upward, raising the expenditure level e required to attain any given level of utility U. This means the relevant poverty line for a person who suffers a health shock S is shifted upward by (at least) the cost of treating the illness.[1]

From this perspective, a person with consumption C who suffers an episode of illness that requires R rupees to treat is no better off than a comparable but healthy person with consumption of only C-R.[2] Letting P denote the poverty line, we define "hidden poverty" ($C>P$ but $C-R<P$) and "reinforced poverty" ($C<P$, $C-R<C<P$). We then use consumer expenditure survey (CES) data from the National Sample Survey Organization (NSSO) to construct new poverty measures for India that account for impoverishment either induced or reinforced by medical costs.

Specifically, we use the NSS-CES data for the period 1999-2000 (55th round), 2004-05 (61st round) and 2011-12 (68th round). The use of three surveys allows us to examine trends in out-of-pocket spending and its effect on poverty calculations and on inequality measures.

The prior studies to which ours is most closely related are Peters et al (2002), van Doorslaer et al (2006) and Garg and Karan (2009). Peters et al (2002) use the NSS Health Survey for 1995-96 and estimate that the poverty rate would increase by 2.2 percentage points if one accounts for OOP medical costs. Garg and Karan (2009) argue the Health Survey data understate

[1] Of course, illness may have other costs besides treatment costs (e.g., pain and suffering). So in general $e(U,S)$ may shift up by even more than the cost of treatment. We abstract from this issue, which means we are likely to understate the true cost of health shocks.

[2] Indeed, the former may well be worse off, once we factor in any disutility created by the illness and the treatment (see footnote 1).

OOP costs, so they instead use the NSS-CES data for 1999-2000. They estimate a 3.2 point increase in the poverty rate after accounting for OOP costs. Finally, van Doorslaer et al (2006) also use the NSS-CES data for 1999-2000, and estimate that counting OOP costs would increase the poverty rate by 3.7 points (from 31.1% to 34.8%), corresponding to 37 million people.

We extend this earlier analysis in several important ways. First, we update prior results to 2012, and look at trends in poverty and inequality from 1999/2000 to 2011/12. This update is of particular interest as it allows us to gauge the impact of the rapid economic growth that India experienced in the 2000s on poverty rates (net of OOP). Second, we extend earlier work by looking at the differential impact of OOP health care costs at different quantiles of the consumption distribution. Third, we analyze the effect of OOP costs on the entire shape of the consumption distribution (using kernel density analysis), rather than focusing only on particular statistics such the poverty rate or poverty gap. Finally, we also examine how accounting for health care costs affects traditional inequality measures like the Gini coefficient, and show how these scalar measures can be quite misleading regarding impacts of OOP on inequality.

Our calculations indicate that both the prevalence and depth of poverty are significantly understated as a result of failure to account for out-of-pocket health care costs. For instance, in the 2011-12 survey we estimate a poverty rate of 22.3% under the standard total consumption measure, rising to 26.4% if we deduct out-of-pocket costs. This increase of 4.1% represents roughly 50 million people (as the population of India in 2012 was approximately 1.22 billion). Thus, our estimate of "hidden poverty" due to medical costs is higher than earlier estimates.

Our distributional analysis reveals that, in 2011-12, the largest fraction of households in "hidden poverty" (68.9%) were located in the 3rd and 4th deciles of the income distribution. In those deciles total income is typically large enough that households are above the poverty line, but significant health care costs can easily push them below it.

Of course, almost all "reinforcement" of poverty due to OOP health spending occurs in the 1st and 2nd deciles (80.3%). Notably, households in the 1st decile spent only 3.85% of total consumption on medical costs vs. the population mean of 5.87%, and 28% had zero health spending vs. 20% for the population. The low level of health spending by 1st decile households suggests they are often too poor to afford needed treatment (as it would be implausible to believe they are in above average health). This illustrates a limitation of consumption (even net of medical costs) as a measure of well-being, as 1st decile households with health shocks but zero health spending are surely worse off than their total consumption would indicate.

Our trend analysis shows that the conventionally measured poverty rate fell from 42.3% to 37.2% between the 1999/2000 and 2004/5 surveys, and then to 22.3% in the 2011/12 survey. Once we factor in OOP medical costs, the figures are 46.9%, 30.5% and 26.4% respectively. Thus, by any standard, poverty fell substantially in India over this period. The decline was 47.3% if we look at the conventional poverty rate measure. However, if we factor in hidden poverty due to medical costs, the decline was a bit more modest at 43.7%.

Put another way, hidden poverty due to medical costs rose from 10.9% of total measured poverty in 1999/2000 to 18.2% in 2011/12. Thus, as poverty rates have fallen, medical costs have become a larger factor contributing to residual poverty (i.e., the poverty that still remains). Tackling the rising importance of health care costs is clearly an issue of increasing importance if India is to continue to make progress in reducing poverty in the future.

The outline of the paper is as follows: Section II gives some background on the health care system in India. Section III discusses the theoretical framework of our analysis in more detail. Section IV discusses the data and Section V discusses the methods used in our analysis. Section VI presets the empirical results, and Section VII closes with conclusions and discussion.

II. Background

The Indian health care system has been characterized by predominantly private provision of services and out-of-pocket financing since independence. However, the NSS-CES data clearly indicates that both for inpatient and outpatient health care the role of the private sector has increased in recent years, both in urban and rural areas (see Selvaraj and Karan, 2009a). There are several reasons why the private sector has grown: These include the introduction of user charges in public health facilities as a part of health sector reforms initiated in the early 1990s, as well as the initiation of World Bank sponsored health system reforms in late 1990s and 2000s (Ghose, 2011), the decline in the share of the public sector under the IMF Structural Adjustment Programme (1991), the New Drug Price Control Order (DPCO) in 1994 (National Commission on Macro-economics and Health, 2005) and the lack of quality in the public sector (Powell-Jackson et al, 2011, Planning Commission of India, 2005).[3]

[3] Notably, many private providers and health centers, especially in rural areas, are not suitably qualified and/or lack basic amenities (Rao et al., 2005). Most private inpatient health facilities are located in urban areas and are very expensive. Thus, many households use untrained practitioners because they are relatively inexpensive, and so there is evidence that much of healthcare spending is simply not productive (see Balarajan et al. 2011).

Furthermore, health insurance markets are not well developed (Garg, 2006). According to (GOI, 2005, Table 2.2.2) only 1.5% of household spending on health goes to insurance premiums. And, as we noted in the introduction, more than 70 percent of total health expenditure in India is out-of-pocket, which is one of the highest rates in the world. There is evidence that health care expenditures are a major cause of debt and poverty for low and middle income families (Balarajan et al. 2011, World Bank, 2000). In rural areas in particular, healthcare expenses are a major factor leading to impoverishment (Krishna, 2004). Here we seek to more accurately quantify the extent of poverty induced by healthcare costs.

III. Theoretical Framework

As noted in the introduction, our main argument is that healthcare spending should be excluded from consumption when calculating the poverty rate. In this section we discuss the assumptions that justify this exclusion. Such assumptions are implicit in earlier work such as Peters et al, 2002, van Doorslaer et al, 2006, Garg and Karan, 2009, but we think it is important to state them explicitly so readers can assess their plausibility. Furthermore, the exercise also gives us interesting insights into how health spending varies with income.

Because we use annual consumption as our measure of well-being, it makes sense to adopt a two-stage budgeting approach: Let I_t denote lifetime income allocated to year t, and assume consumers maximize within period utility subject to this resource constraint. Henceforth we ignore the time subscript, and simply let I denote income, C denote consumption of goods and services (excluding medical spending), and E denote medical expenditure. Furthermore, we decompose E into two parts: Let E_T denote spending on medical treatment (necessitated by illness), while E_M denotes discretionary spending on health maintenance and improvement (we often refer to this below as "health investment" or "preventive care").

Suppose an individual experiences an episode of illness that requires E_T rupees to treat. We would argue on *a priori* grounds that this person is no better off than an otherwise identical but healthy person with income of I-E_T. That is, imagine two identical people A and B, where A experiences a health shock that costs E_T to treat. *At best* this restores person A to full health, and gives him/her the same utility level as person B would achieve at expenditure level I-E_T.

The proper way to handle the E_M component of medical spending is more subtle. We interpret E_M as consisting of discretionary spending on goods like preventive care, vitamins, food supplements, exercise equipment, and so on, that may enhance health and/or make a person feel

healthier (thus increasing utility). As this type of spending is a choice (i.e., not necessitated by any particular illness episode), it should be treated symmetrically with other consumption categories like food and clothing. Thus, it would be impossible to justify simply excluding E_M from consumption in the same way that we exclude E_T.

Nevertheless, we will argue that it is plausible to ignore the problem of E_M-type medical spending when doing poverty calculations on both empirical (i.e., data) and theoretical grounds:

First, empirical evidence indicates that discretionary spending, defined as spending on preventive care, is a very small fraction of healthcare spending in India. According to National Health Systems Resource Centre (2016), Table 13 on p. 34-35, only 1.2% of total consumer OOP spending in India is devoted to preventive care. Thus, even if this spending is fully captured by our data and we ignore it, it represents too small a fraction of OOP spending to have much influence on our findings.[4]

Second, it is unlikely that medical spending as measured in the NSS-CES data would include much E_M-type spending. The survey defines medical spending as consisting of inpatient and outpatient expenditures. Inpatient spending, which includes doctor fees, diagnostic tests, hospital and nursing home charges, prescription medicines, and a miscellaneous category (e.g., transport expense to the hospital), are all clearly part of E_T (not E_M). Outpatient spending includes the same categories except that hospital/nursing home charges are removed (obviously), while family planning/birth control expenses are included. The proper categorization of family planning expenses involves value judgements that we seek to avoid. We simply note that, if we view an unwanted pregnancy as a type of adverse health shock, it justifies treating such expenses as E_T-type spending.[5]

It is worth emphasizing that the NSS-CES survey does not include non-prescription drugs (including homoepathic and ayurvedic medicines that many households use) in the medical spending category. Nor does it include spending on medical equipment, such as glasses, contact lenses, hearing aids and orthopaedic equipment (these are recorded as durables). And it excludes dental costs. Thus, it is likely that our health spending measure understates E_T type spending.

[4] Even in developed countries, spending on preventive care is small compared to spending on treatment. For example, in 2015 spending on preventive as a fraction of total health spending was only 2.9% in the U.S., 3.0% in Germany and 3.6% in the Netherlands (www.oecd.org/els/health-systems/health-data.htm).

[5] Furthermore, according to GOI (2005) Table 2.2.2, family planning makes up only 1.8% of household spending on health care. And according to National Health Systems Resource Centre (2016), family planning represents only about 1.2% of total healthcare spending. So it again appears that excluding it should have little effect on our results.

Third, from a theory perspective, we can justify the claim that E_M-type spending is a small part of total medical expenditures for households near the poverty line under plausible assumptions. And those are the households relevant for quantifying impoverishment due to medical costs. The following analysis formalizes this argument. Let utility be given by:

(1) $U = U(C, H, S)$

where C is consumption exclusive of medical spending, H is health and S is an illness shock. Utility is increasing in C and H and decreasing in S. The within-period budget constraint is:

(2) $I = C + E_M + E_T$

Furthermore, we make two assumptions about the production function for health:

(3) $H = H(C, E_M) \qquad H_k > 0 \quad H_{kk} < 0 \quad for \quad k = C, E_M$

(4) $S = S(E_T) \qquad S(0) = S \qquad S_{E_T} < 0 \quad for \quad 0 \leq S(\bar{E}_T) < S$

Equation (3) says health is affected by consumption (e.g., food) and health investment (e.g., vitamins). Eqn. (4) says a health shock is mitigated by spending on treatment E_T. A high enough level of treatment $\bar{E}_T$ may resolve the shock entirely, and spending above $\bar{E}_T$ is not useful.

The optimal levels of (non-medical) consumption, C^*, health maintenance spending, E_M^*, and health treatment spending, E_T^*, maximize (1) subject to the constraints (2)-(4), as well as non-negativity constraints on the inputs. Let $\Omega^* = \{C^*, E_M^*, E_T^*\}$ denote the vector of optimal choices. At the optimum the first order condition for E_M is:

(5) $$\frac{\partial U}{\partial E_M} = -\frac{\partial U}{\partial C} - \frac{\partial U}{\partial H}\frac{\partial H}{\partial C} + \frac{\partial U}{\partial H}\frac{\partial H}{\partial E_M} \geq 0$$

The second term on the right hand side of (5) captures the health benefit of extra consumption spending (e.g., better nutrition), which is likely to be large for households near the poverty line.

A corner solution where $E_M^* = 0$ will arise if $\partial U/\partial E_M > 0$. This occurs if:

(6) $$\left.\frac{\partial U}{\partial C}\right|_{C^*,0,E_T^*} + \left.\frac{\partial U}{\partial H}\frac{\partial H}{\partial C}\right|_{C^*,0,E_T^*} > \left.\frac{\partial U}{\partial H}\frac{\partial H}{\partial E_M}\right|_{C^*,0,E_T^*}.$$

That is, at the optimum, the marginal utility of an extra dollar spent on non-medical consumption C exceeds that of a dollar spent on health maintenance/investment even when $E_M^* = 0$.

Let P denote the poverty line level of consumption. We will assume that:

(7) $$\left.\frac{\partial U}{\partial C}\right|_{P,0,0} + \left.\frac{\partial U}{\partial H}\frac{\partial H}{\partial C}\right|_{P,0,0} > \left.\frac{\partial U}{\partial H}\frac{\partial H}{\partial E_M}\right|_{P,0,0}$$

That is, at the poverty line level of consumption of goods and services, a consumer is at a corner solution where optimal expenditure on health investment is zero.

In fact, we will invoke a slightly stronger assumption. Let Δ_M denote a small increment of income above the poverty line. We will assume that:

(8) $$E_M^* = 0 \quad if \quad C^* < P + \Delta_M$$

That is, for incomes less than Δ_M above the poverty line, households are at a corner solution for health investment spending. Put simply, such poor households are more concerned with immediate needs (food, clothing, shelter) than with health investment.

Thus, for $C < P + \Delta_M$ we have that $C = I - E_T$ and so:

(9) $$U = U(C,H,S) = U\big(I - E_T, H, S(E_T)\big) \qquad \text{because} \qquad E_M = 0$$
$$\leq U(I - E_T, H, 0) \qquad \text{because} \qquad 0 \leq S(E_T) < S$$

That is, a person with an adverse health shock $S > 0$ that induces spending E_T on medical treatment is no better off than an otherwise healthy person with consumption of goods and services (i.e., non-medical consumption) of $C = I - E_T$. This rationalizes our procedure of using income net of medical expenses (i.e., consumption of goods and services exclusive of medical spending) in our calculations of poverty.

It is useful to give a concrete example of a simple model that satisfies these conditions, as this helps to clarify their meaning. Assume the utility function takes the form:

(1') $$U = ln(C - C_m) + \beta lnH - \alpha \ln(1 - S) \qquad \text{where} \quad \beta > 0,\ \alpha > 1 \quad \text{and} \quad 0 \leq S \leq 1$$

where α and β are parameters, and the production functions for health take the form:

(3') $$lnH = H_0 + \gamma \ln(C - C_m) + \theta \ln(E_M + m_0) \qquad \text{where} \quad \gamma > 0,\ \theta > 0,\ m_0 > 0$$

(4') $$S = S(E_T) = S_0 \cdot \exp(-\delta E_T) \qquad \text{where} \quad \delta > 0$$

Here C_m is the minimum subsistence level of consumption. Equations (1') and (3') capture two

key features: First, as $C \downarrow C_m$ we have $H \downarrow -\infty$ and $U \downarrow -\infty$ (i.e., health and utility deteriorate without bound as consumption falls to C_m). Second, if health investment is set to zero ($E_M = 0$) health may deteriorate, but this deterioration is bounded (as $m_0 > 0$). In other words, investment in health is not absolutely necessary for survival. Both features are highly intuitive.

The severity of illness is measured on a scale of 0 to 1, where $S_0=0$ denotes absence of illness and $S_0=1$ denotes an illness severe enough to cause death if not treated. Consider first the case with $S_0=0$ (i.e., no illness shock). It is then optimal to set $E_T=0$, and it is simple to show that:

$$(10) \quad E_M = \begin{cases} (I - C_m)\frac{1+\beta\theta}{\beta\gamma} - m_0 & iff \quad I > C_m + \frac{1+\beta\gamma}{\beta\theta} m_0 \equiv C_m + \Delta_M \\ 0 & otherwise \end{cases}$$

Thus, this simple model satisfies the requirement that discretionary medical spending is positive *iff* income exceeds the subsistence level C_m by an increment $\Delta_M = \frac{1+\beta\gamma}{\beta\theta} m_0$. Note that Δ_M is larger if consumption is more effective at improving health (β), and smaller to the extent that health investment spending is more effective at improving health (θ). In our framework we may interpret the poverty line (P) as lying somewhere between C_m and $C_m+\Delta_M$. (Obviously $C_m<P$ as we observe households that do subsist at income levels below the official poverty line P).

Now consider the case where $1 \geq S > 0$. Given that $E_T > 0$ *iff* $\left.\frac{\partial U}{\partial E_T}\right|_{E_T=0} > 0$, we have:

$$(11) \quad E_T > 0 \quad iff \quad I > C_m + \frac{1+\beta\gamma}{\alpha\delta}\frac{1-S_0}{S_0} \equiv C_m + \Delta_T$$

Note that as $S_0 \rightarrow 1$ this condition approaches simply $I > C_m$. Thus, for a sufficiently severe illness, consumers will spend a fraction of <u>any</u> income above subsistence on treatment.

From (10) and (11), the threshold income level to induce spending on treatment is <u>below</u> that to induce spending on preventive care, *provided* that the illness (S_0) is not too minor:

$$(12) \quad \Delta_T < \Delta_M \quad \Rightarrow \quad \frac{1+\beta\gamma}{\alpha\delta}\frac{1-S_0}{S_0} < \frac{1+\beta\gamma}{\beta\theta} m_0 \quad \Rightarrow \quad S_0 > \frac{\beta\theta}{\beta\theta + \alpha\delta m_0}$$

Here $\alpha\delta$ and $\beta\theta$ capture effects of treatment for current illness vs. preventive care on current utility. Intuitively, we expect $\alpha\delta >> \beta\theta$, that is, even for mild illnesses (small S_0) immediate treatment has more impact on utility than preventive care. This would explain the previously noted fact that preventive care accounts for only about 3% of total medical spending in wealthy

countries. The model explains why spending on preventive care is even lower in India (i.e., about 1%), as an income hurdle $(C_m + \Delta_M)$ must be met before there is any preventive spending at all. This hurdle is typically higher than that required to induce spending on treatment.

Of course, these results are derived from particular functional forms chosen for analytical tractability. But the two key features of the model in (1') to (4') are that, evaluated at E_M=E_T =0: (i) the marginal utility of preventive care is bounded near subsistence, and (ii) the marginal utility of treatment for sufficiently severe illness is large even near subsistence. We conjecture that any model that maintains these two intuitive features will generate that spending on health investment should be a very small fraction of total medical spending for households near the poverty line. The Appendix discusses some other properties of the model that shed light on how different types of medical spending are likely to vary with income.

Finally, one last issue worth considering is the timing of medical shocks. If we assume that E_M is chosen after the realization of (I,S) then any household with $I < P + \Delta_M$ or even satisfying the weaker condition $I - E_T < P + \Delta_M$ will have E_M = 0. However, it is possible that a household whose income is in the range $(P + \Delta_M) < I < (P + \Delta_M - E_T)$ might chose a positive E_M and then suffer a surprise health shock afterwards. In this case, the household will wish, *ex post*, that it had chosen E_M = 0. Thus, we would argue that in such cases it is still appropriate to base poverty calculations on $I - E_T - E_M$, as we do here.

IV. Data – The NSSO's Consumer Expenditure Surveys

Our analysis is based on the nationally representative Consumer Expenditure Survey (CES) data collected by the National Sample Survey Organization (NSSO), in the three rounds 1999-2000, 2004-05 and 2011-12.[6] The three surveys include 120,310, 124,644 and 101,662 households, respectively. Of those, 71,386, 79,298 and 59,695 were rural, and 48,924, 45,346 and 41,967 were urban, respectively. The surveys adopt a very detailed item classification, including 142 items of food, 15 items of energy (fuel, light and household appliances), 28 items of clothing, bedding and footwear, 51 items of durable goods, 19 items of educational and medical expenses, and 89 other items (NSSO, 2013).

As we noted earlier in Section III, the survey defines medical spending as consisting of inpatient and outpatient expenditures, which are further broken down into several sub-categories like doctor fees, diagnostic tests, hospital and nursing home charges, prescription medicines, etc.

[6] These are the 55th, 61st and 68th rounds of the NSSO surveys. Note that detailed consumption data is only collected in a subset of rounds, of which these three are the most recent available.

As we also noted, our health spending measure is likely to somewhat understate total out-of-pocket health care costs. This is because the NSS-CES measure of medical spending excludes non-prescription drugs, as well as dental expenses and spending on various types of medical equipment (e.g., glasses, contact lenses, hearing aids) that are instead classified under durable goods. This means our results will, if anything, tend to understate the extent to which medical costs lead to increased poverty.

The NSSO's goal is to measure as accurately as possible the "typical" or average monthly consumption expenditure of each surveyed household. Of course, in measuring consumption one must define a reference or recall period. The philosophy that guides the NSSO is that a tradeoff exists in choosing the period length. Because consumption is variable over time, longer reference periods give a more accurate picture of average consumption flow per month. However, longer reference periods are also likely to lead to more recall error. The current consensus (see, e.g., the expert group report GOI (2009)) is that best practice is to use longer reference periods (i.e., one year) for less frequently purchased items (e.g., durables), and shorter reference periods (i.e., one month) for frequently purchased items (e.g., food items). Consumption of all items is then projected to a monthly rate. This is called the "mixed reference period" approach (MRP). The NSSO has tried other referenced periods, but we focus on the MRP because it is available for all three waves (1999-00, 2004-05 and 2011-12) and it is recommended by GOI (2009).[7]

V. Methods

Given household consumption data, one must define an equivalence scale and a poverty line in order to measure poverty. Unfortunately, there is no one agreed upon "correct" way to do either, so for the sake of comparability with Indian government statistics we adopt the same approach as the GOI Planning Commission (see GOI (2009)).

An equivalence scale maps household consumption into an estimate of "equivalent" consumption for each individual household member. The Planning Commission uses a per capita equivalence scale. This means total household consumption is simply divided by the number of

[7] Over the years, the NSSO has used three different reference periods to measure household monthly consumption: The "Mixed Reference Period" approach (MRP) uses the last 365 days as the reference period for commodities that are bought infrequently (e.g., clothing, durable goods, education, in-patient medical expenses), while using the last 30 days for more frequently purchased items like food (see Planning Commission, GOI, 2013). The "Modified Mixed Reference Period" (MMRP) approach (NSSO, 2013) is like the MRP approach except that a short 7-day reference period is used for very frequently purchased items (e.g., fish, meat, vegetables, fruits). Finally, the so-called "Uniform Reference Period" (URP) method uses the last 30 days as the reference period for all items. One reason we use MRP is that the MMRP is available only for 2011/12, while URP is not available for 1999-2000.

household members to obtain the consumption of each individual household member. Of course this simple approach has two problems: First, it ignores household economies of scale. Second, it ignores the fact that consumption needs may differ for adults vs. children. However, the Planning Commission has used a per capita measure for many years (see the expert group Alagh in GOI, 1979) – and the literature has not devised a universally accepted ideal alternative – so we retain the per capita approach here.

Under advice from the expert groups Alagh and Lakdawala (see GOI, 1979, 1993), the Planning Commission developed an approach to defining the poverty line that began with an attempt to scientifically measure caloric and other nutritional requirements.[8] One first measures the cost of these inputs, and then adds in basic levels of consumption for other goods. Differences in both nutritional requirements (due in part to differences in the nature of work) and the cost-of-living led to separate urban and rural poverty lines. These were further disaggregated to the State level to account for State differences in the cost of living. Finally, these poverty lines were adjusted over time for changes in the cost-of-living.

Given the urban/rural poverty lines for each Indian State, one can count the number of people in poverty by: (i) calculating consumption of each individual by assigning them the per capita consumption of their household, and (ii) comparing each individual's consumption to the relevant state-urban/rural-specific poverty line.

The Tendulkar expert group (see GOI, 2009) observed that, based on the Lakdawala poverty lines, the urban poverty rate in 2004-2005 was 25.7, while the rural poverty rate was 28.3. They went on to note that: "The estimated urban share of the poor population … is generally accepted as being less controversial than its rural counterpart … that has been heavily criticized as being too low." The expert group attributed the implausibly low measure of rural poverty as resulting from flaws in the price indices used to adjust the poverty lines over time, as well as changes in the composition of rural consumption over time.

Given this state of affairs, the Tendulkar expert group (GOI, 2009) recommended that the urban poverty line for 2004-2005 be kept at the same level. However, they recommended abandoning the rural/urban poverty line distinction. That is, the rural poverty line was set at the same value in real terms as the urban poverty line. Of course, cost-of-living differences still led to different values in nominal terms. The nominal urban and rural poverty lines for 2004/05 were

[8] These are 2155 calories per day in rural areas and 2090 per day in urban areas, 48 grams of protein per day in rural areas and 50 grams in urban areas, 28 grams of fat in rural areas and 26 grams in urban areas.

set at 579 and 447 INR respectively.[9] When they applied the (higher) urban poverty line to the rural population, the rural poverty rate for 2004/05 increased to 41.8%. The expert group argued that this was a more plausible figure.

It is notable that the Tendulkar expert group explicitly shifted away from the idea of an objective scientific basis for setting poverty lines. They noted that: "Given an inevitable element of arbitrariness in numerically specifying the poverty line … the Expert Group found it desirable … to situate it in some generally acceptable aspect of the present practice." In other words, the poverty line was essentially set so as to generate poverty rates that appeared plausible in 2004/05.[10] The expert group also noted that the new poverty line was close to (but less than), the $1.25 PPP per day poverty line used by the World Bank in 2005. Finally, the expert group also recommended improved price indices to adjust the poverty line over time.

Based on the methodology suggested by the Tendulkar expert group, the poverty rate in 2004/05 was 37.2%, consisting of 41.8% in rural areas and 25.7% in urban areas. For 2011-12 these figures were 21.9% for all India consisting of 25.7% in rural areas and 13.7% in urban areas (GOI, 2013).[11] Thus, in the 7-year period from 2004-05 to 2011-12 there was a substantial drop in measured poverty rates of 15.3 points, 16.1 points and 12.0 points in all India, rural India, and urban India, respectively.

This looks like a massive drop in poverty for a 7-year period. But it is possible that this substantial drop in measured poverty may reflect a situation where a large part of the mass of the consumption distribution was initially concentrated just below the poverty line. In that case, a small increase in average consumption may translate into a large drop in poverty. In other words, a large drop in poverty may be consistent with a small improvement in living standards, depending on the shape of the consumption distribution and where poverty lines are set. We will explore this issue below using kernel density plots of the entire consumption distribution.

Another measure that focusses on the depth of poverty is the "poverty gap." This is a measure of the total amount of resources that would be needed to raise all those in poverty up to the poverty line (abstracting from any behavioral responses induced by such a transfer). To construct the poverty gap, one first takes the sum over all individuals in poverty of the amounts

[9] These translate into monthly consumption levels of 48.25 and 37.25, respectively.
[10] However, note that the Lakdawala urban poverty line for 2004/05, which the Tendulkar group kept, was constructed on the traditional "objective" basis, using scientific measurement of nutrition requirements.
[11] NSS-CES surveys are normally conducted on every 5 years. The last quinquennial survey in this series was conducted in 2009-10. However, because of a severe drought 2009-10 was not considered a normal year. Thus, the NSSO repeated the survey in 2011-12.

by which their consumption falls below the poverty line. Call this the "total nominal poverty gap." For our purposes this statistic is not in itself very meaningful, as it does not adjust for either the population size or the nominal currency units in which consumption is measured.

Thus, we first divide the "total nominal poverty gap" by the total population size of the country. We call this the "nominal poverty gap," although in the literature it is often simply called the "poverty gap" (see Wagstaff and van Doorslaer, 2003, van Doorslaer et al, 2006).

Second, we divide the nominal poverty gap by the nominal poverty line, to obtain what may be called the "real poverty gap."[12] This gives the mean amount (per member of the whole population) that must be transferred to the poor to eliminate poverty, expressed as a fraction of the poverty line. Note that a number of authors, such as Wagstaff and van Doorslaer (2003) and van Doorslaer et al (2006), refer to this as the "normalized poverty gap." In the subsequent discussion, in order to save on words, we will simply refer to the "poverty gap," assuming the reader recognizes that we have normalized as discussed here.

The poverty gap has certain advantages over the poverty rate as a measure of poverty. For example, take the hypothetical scenario mentioned earlier where a large number of people are close to the poverty line. In this case, a small increase in the average consumption level could raise many people out of poverty, without actually making them much better off. However, in this scenario the poverty gap would only drop by a small amount, giving a more accurate picture of what is happening (i.e., only a modest increase in living standards).

Unfortunately, both the poverty rate and poverty gap can only describe what is happening in a certain part of the consumption distribution (as determined by the choice of poverty line). For example, it is simple to construct examples where, using one poverty line, a certain policy substantially reduces *both* the poverty rate and poverty gap, while, using another poverty line, the same policy has no effect whatsoever:

E.g., consider a policy that transfers resources to the 3rd decile of the consumption distribution. If the poverty line is defined as the top limit of the 3rd decile then both the poverty rate and poverty gap will fall. But if the poverty line is defined as the top limit of the 2nd decile then neither the poverty rate nor poverty gap will change. Thus, one needs to examine kernel density plots of the complete consumption distribution to get a full picture of what is happening.

In our analysis we use urban and rural poverty lines of INR 1000 and 816, respectively,

[12] There is one complication: We do not have one overall poverty line, but rather an array of poverty lines specific to urban/rural areas of Indian states. Hence we must construct person specific real poverty gaps for each individual in the data, and add these up to get the real poverty gap for the whole population.

for 2011/12. Using a purchasing power parity (PPP) exchange rate of US $1 = 15.11 rupees (see World Bank (2014)), this corresponds to US $54 per month in rural areas and US $66.18 in urban areas. We adjust these to the other years using the respective year's price index. This led to very small deviations of our poverty lines and poverty rates from those reported by the Tendulkar expert group. For example, for 2004/05 they reported a poverty rate of 25.7% in urban areas while we calculate 25.3%.

VI. Results

VI.A. Health Expenditures and Consumption

Figures 1 and 2 report summary statistics on health expenditure in the NSSO data. As we see in Figure 1, health expenditure as a share of total consumption rose from 5.1% in 1999-2000 to 6.8% in 2011/12. This 33% increase is consistent with the general pattern that the health share of consumption increases as countries become wealthier. For instance, Getzen (2000) reviews several studies that look at the elasticity of national health expenditure with respect to GDP. The estimates range from 1.2 to 1.6 with a mean of 1.35. According to the World Bank, real per capital GDP in India (2011$, PPP) rose from $2471 in 1999/2000 to $4732 in 2011/12, a 92% increase.[13] Given this, an income elasticity of 1.56 would generate the 33% increase in the health share of consumption that we find, and this is within the range of estimates in the literature.

Figure 1 also reveals that the health expenditure share is 1.1 to 1.3 points higher in rural than in urban areas, and that it rose slightly faster. Specifically, health expenditure in rural areas went from 5.5% of consumption in 1999/2000 to 7.4% in 2011/12. However, as we see in Figure 2, the absolute level of health expenditure is much higher in urban areas than in rural areas. And the gap has been widening, from 47% higher in 1999-2000 to 59% higher in 2011/12. Thus, the higher share of medical spending in rural areas arises only because rural income levels are lower.

Table 1 describes how the health expenditure share of consumption varies in the cross-section. It reports, for each decile of consumption, the health spending share for households in that decile, as well as the percentage with zero health spending. Aside from the secular upward trend in the health share noted in Figure 1, the pattern across deciles of consumption has remained very stable over time, so we only report results for 2011-12.

For instance, for rural households in the 1st decile of the consumption distribution the health spending share was 3.55%, and 28.9% of these households had zero health spending. But

[13] See https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD?locations=IN.

for rural households in the 6th decile, the health share was 5.47% and only 17.9% had zero health spending. Thus, the health share rises sharply, and the incidence of zero health spending falls sharply, with household income. These results are consistent with the predictions of the simple model of Section III, in particular equation (11), which indicates that the threshold level of illness severity to induce positive healthcare spending is decreasing in household income.

Table 1 reports similar results for urban households. Here the mean health share for households in the 1st decile was 4.01%, and 28.6% of these households had zero health spending. As with rural households, the health share rises and the incidence of zero spending falls as households become wealthier. But it is evident that the rate of change is more modest. In fact, the bottom panel of Table 1 reports regressions of the health spending share on total household consumption. For rural households the implied elasticity of the health share with respect to total consumption (evaluated at the means) is 1.44, while for urban households it is only 1.14.

Why is the elasticity of health spending with respect to total consumption lower in urban than in rural areas? The most obvious explanation is simply that urban areas are much wealthier (mean consumption of 2469 INR per month compared to 1285 INR in rural areas, see Table 1).[14] As we noted earlier, the absolute level of health expenditure was 59% higher in urban than in rural areas in 2011/12. The simple model of Section III predicts that health care spending should rise quickly with income at very low income levels, as the severity of illness needed to induce positive spending on treatment falls. Then, as income increases, the level of health spending should grow more slowly, with total medical spending converging to a fixed share of consumption as consumers grow wealthier (see Appendix).

Obviously, one could rationalize the patterns in Table 1 by assuming healthcare is a normal good with appropriately shaped Engel curves. Thus, it is important to emphasize that our simple model in Section III can also generate these patterns. But in our model healthcare is not a consumption good at all – rather, it is an input into the production of heath and treatment of illness. This perspective justifies our exclusion of health spending from consumption in the following Sections.[15]

[14] Another potential factor is the poor quality of health facilities in rural areas, which may lead to lack of access for poor households. For instance, Planning Commission of India (2005) stated that "… rural public health infrastructure is abysmal…" Thus, a larger rural elasticity of health expenditure with respect to consumption may arise in part from access constraints that are relaxed for better off rural households.

[15] Notably, the growing macro literature on the effect of health shocks on consumption risk views healthcare spending in the same way as we do. See, e.g., De Nardi, French and Jones (2010), De Nardi, Pashchenko and Porapakkarm (2017), Capatina (2015).

VI.B. Health Expenditures and Poverty Rates

Table 2 reports our main results on poverty rates, with and without accounting for medical expenses. In the 2011-12 survey we estimate an all India poverty rate of 22.3% under the standard total consumption measure, rising to 26.4% if we deduct out-of-pocket medical costs. This increase of 4.1% represents roughly 50 million people (as the population of India in 2012 was approximately 1.22 billion). As we noted in the introduction, this calculation of the extent of hidden poverty due to medical costs is larger than prior estimates.[16]

Our results also indicate that the extent of hidden poverty due to medical costs is much greater in rural areas. Using the standard total consumption measure, we estimate that in 2011/12 the rural poverty rate was 25.8%, but this increases to 30.5% if we account for medical spending. This difference of 4.7% represents roughly 39 million people (as the rural population of India in 2011 was approximately 833.5 million). In urban areas accounting for medical costs increases the poverty rate from 13.7% to 16.1%, or 2.4 points, which represents roughly 11 million people.

Table 2 also reports the fraction of the population who are already in poverty and who are pushed further into poverty by medical costs, which we could call "poverty deepening" or "reinforced poverty." In 2011/12 this represented 17.7% of the all India population – 20.4% in rural areas and 11.0% in urban areas. Altogether, in 2011/12 a total of 21.8% of the population experienced an impoverishment effect of medical costs (either hidden poverty or reinforced poverty). This figure represents about 218 million people.

Figures 3 to 5 report a distributional analysis where we ask how medical expenditures affect poverty at different deciles of the consumption distribution. For example, Figure 3 reports results from 1999-2000. According to these results, 30.9% of those households that suffered from hidden poverty were in the 5th decile of the consumption distribution, while 34.9% were in the 6th decile. Thus, a sizeable number of households who appeared to be relatively well off, in the sense of being above median consumption, were actually in a state of hidden poverty.

But in Figure 5 we report results for 2011/12. Here, only a fairly small fraction of the households that suffer from hidden poverty are in the 5th decile or 6th deciles of the consumption distribution (12.4%). Most are now in the 3rd or 4th decile (42.8% and 26.1% respectively). This change is a manifestation of the general increase in the wealth of the country during the decade from 1999/2000 to 2011/12. That is, households in the 5th and 6th deciles are now high enough income that they are unlikely to be pushed into poverty by health shocks, while it is households

[16] See Peters et al (2002), van Doorslaer et al (2006) and Garg and Karan (2009)).

in the 3rd and 4th deciles who are most "at risk."[17]

The results shift even more for reinforced poverty (i.e., households below the poverty line whose poverty is further deepened by health care spending). In 1999-2000 reinforced poverty was prevalent among households in 1st through 5th deciles. This may seem surprisingly high up in the consumption distribution, but recall that in 1999-2000 the poverty rate for rural households was 47%, putting the poverty line in the 5th decile. But by 2011-12 almost all the reinforcement of poverty occurs in the 1st and 2nd deciles (80.3%). This change is another manifestation of the general increase in the wealth of the country during the sample period.

VI.C. Health Expenditures and Changes in Poverty Rates over Time

Our trend analysis in Table 2 shows that the conventionally measured poverty rate for all India fell from 42.3% to 22.3% in the 2011/12 survey. Once we factor in OOP medical costs, the figures are 46.9% and 26.4% respectively. Thus, by any standard, poverty fell substantially in India over this period. The decline was 47.3% if we look at the conventional poverty rate measure. However, if we factor in hidden poverty due to medical costs, the decline was slightly more modest at 43.7%, although that difference still represents 50 million people.

Viewed another way, Table 2 reveals that hidden poverty due to medical costs rose from 10.9% of total measured poverty in 1999/2000 to 18.2% in 2011/12. Thus, although poverty rates have fallen, medical costs have become a larger factor contributing to poverty. This is related both to rising incomes and the fact that the share of medical expenditure in total consumption rose from 5.1% in 1999-2000 to 6.8% in 2011/12 (see Figure 1). Tackling the rising importance of health care costs is clearly an issue of increasing importance if India is to continue to make progress in reducing poverty in the future.

Next, we examine how accounting for OOP medical expenses alters estimates of the effectiveness of economic growth in reducing poverty. Specifically, we refer to Ravillion (2001), who examined how poverty rates are related to economic growth using data on 47 developing countries from the 80s and 90s. Regressing the growth rate of poverty on that of per capita consumption, he obtained a mean elasticity of poverty with respect to consumption of roughly -2, with a 95% confidence interval ranging from about -0.6 to -3.5.[18]

[17] Obviously, the same amount of health expenditure will have different effects on households in different parts of the income (or expenditure) distribution (see Xu et al. 2003, Wagstaff and van Doorslaer, 2003). Thus, we would expect to find that most instances of households being pushed into poverty will occur in the part of the distribution that is slightly above the poverty line.

[18] Ravillion defined poverty as $1 per day at 1993 PPP price levels, which is close to the value used here.

Table 3 reports a similar analysis for India. For All India, the annual growth rate of consumption per capita was 3.44% from 1999/2000 to 2004/05 (the period between our first and second NSSO surveys), accelerating to 6.65% from 2004/05 to 2011/12 (see World Bank national accounts data). Fortuitously for our analysis, inspection of the aggregate consumption data reveals that the jump in the consumption growth rate occurred in 2004/05 – that is, precisely at the boundary between our two periods.

Table 3 reveals that in the earlier period (1999/2000 to 2004/05) the annualized rate of poverty reduction in All India was -2.54%. Given the 3.44% consumption growth rate, this implies an elasticity of poverty with respect to consumption of -.74. This is near the lower end of the confidence interval obtained by Ravillion (2001). In the latter period (2004/05 to 2011/12) the annualized rate of poverty reduction in All India was -7.06%. Given the 6.65% consumption growth rate, this implies an elasticity of -1.06. This is better, but still near the low end of the confidence interval obtained by Ravillion. Thus, the growth in India from 1999-2012 was not particularly "pro-poor." Nevertheless, growth has been so rapid that massive poverty reduction (i.e., 47%) has still been achieved.

It is clear from Table 3 that once medical costs are taken into account growth in India has been even less "pro-poor" than the standard poverty figures would suggest. For example, for All India in the second period, the elasticity of poverty with respect to consumption drops from -1.06 to -.94 if we take medical costs into account. Medical expenses have an especially large impact in rural areas. For example, for Rural India in the second period, the poverty elasticity drops from -.98 to -.78 if we take medical costs into account.

It is also interesting to compare the impact of growth on poverty in urban vs. rural areas. In the earlier period (99/00 to 04/05) growth was actually slightly more "pro-poor" in rural areas than in urban areas (i.e., poverty elasticities of -.69 vs. -.61 once medical expenditures are accounted for). But in the later period there is a substantial shift, and growth has a much greater poverty reducing effect in urban areas. Adjusting for medical costs, the elasticity of poverty with respect to consumption is -1.17 in urban Indian but only -.78 in rural India. This is consistent with our earlier finding (Table 1) that a larger share of increased income goes to medical costs in rural India than in urban India.

VI.D. Health Expenditures and the Poverty Gap

Table 4 reports calculations of the "poverty gap." Recall this is defined as the amount of resources needed to raise all those in poverty up to the poverty line, normalized by population

size and measured as a fraction of the poverty line. This is in some ways a superior measure of poverty to the poverty rate because it factors in both the number of people in poverty and the depth of poverty. For all India the poverty gap was 9.1% in 1999-2000,[19] and it fell sharply to 3.8% in 2011/12. If we account for medical costs, these figures rise to 10.5% and 4.7%. Thus, by either measure, poverty fell dramatically in India over this period.

It is notable, however, that the share of the poverty gap due to out-of-pocket medical costs increased from 13.4% in 1999-2000 to 19.3% in 2011-12. Thus, as poverty has fallen, medical costs have become a relatively more important factor in explaining the poverty that remains. Again, these results suggest that improvements in the provision of health care will be important if India is to make further progress on reducing poverty in the future. This is obviously related to a hierarchy of needs. At very low levels of development substantial reduction in the poverty gap can be achieved by improving nutrition/housing, but at higher levels of development further progress requires improving health care, education and other higher order needs.

Table 4 also reveals that the poverty gap in rural areas is about twice as great as in urban areas, as is the poverty gap accounting for by medical costs (1.25% vs. 0.61%). The latter fact highlights the need for improved rural health services that we noted in the introduction.

We also analyze how economic growth affected the poverty gap, complementing Ravillion's (2001) analysis of the poverty *rate*. This is reported in Table 5. Clearly, economic growth had a greater impact on the poverty gap than on the poverty rate. For All India, the poverty gap elasticities in the earlier and later periods were -1.09 and -1.27 respectively, compared to only -.69 and -.94 for the poverty rate. Thus, the poverty gap elasticities were 58% and 35% greater than the poverty rate elasticities in the two periods, respectively.

According to the poverty gap metric, growth was more "pro-poor" in the later period, just as we found with the poverty rate. But now this is only true for Urban India. Once we account for medical expenses, the poverty gap elasticity for Urban India increased substantially from -.69 in the earlier period to -1.49 in the later period. But for Rural India, in contrast, the poverty gap elasticity actually fell from -1.26 to -1.13.

In addition, we see that growth was much more favorable to the poor in Rural India in the earlier period (i.e., rural vs. urban elasticites of -1.26 vs. -.69). But in the post-2005 period this pattern is reversed, and growth is much more favorable to the poor in Urban India. In particular, the rural vs. urban elasticites are -1.13 vs. -1.49.

[19] Thus, *per capita* resources needed to eliminate poverty are 9.1% of the poverty line consumption level.

An important difference between the earlier period (1999/00 to 2004/05) and the later period (2004/05 to 2011/12) is that, in the former, medical expenses have a negligible effect on poverty gap elasticities. But in the post-2005 period accounting for medical expenses makes growth appear notably less "pro-poor." For example, for All India the poverty gap elasticity drops from -1.41 to -1.27 when one factors in out-of-pocket medical costs.

VI.E. Health Expenditures and the Distribution of Consumption

As we noted earlier, neither poverty rates nor the poverty gap give us a complete picture of what is happening to the consumption distribution. So next we examine kernel density plots of the entire distribution. Figure 6 reports the results for rural India for all three waves, while Figure 7 reports the results for urban India.

It is clear from Figure 6 that the dramatic drop in the rural poverty rate from 1999/00 to 2011/12 was not merely the result of an incremental shift of many households from just below to just above the poverty line. Rather, the improvement in the consumption distribution is evident across-the-board at all consumption levels. While the rural poverty line is only 816 INR, the consumption density fell at all levels below about 1100 INR, and a large fraction of that mass moved to levels above 1600 INR (i.e., nearly double the poverty line). Thus, what occurred in the 1999/00 to 2011/12 period was a dramatic historical event. Not only did millions of people move out of poverty, but many did so by substantial margins.

In Figure 7 we see that the shift in the urban consumption distribution was even more dramatic. While the urban poverty line is only 1000 INR, the consumption density fell at all levels below about 1500 INR, and a large fraction of that mass moved to levels well above 2000 INR. There is considerable mass above 5000 INR in 2011/12, while the mass of people with consumption above this level was almost negligible in 1999/00.

It is clear from the changes in shape of the consumption distributions in Figures 6 to 7 that inequality increased in both urban and rural India from 1999/00 to 2011/12. (And this is confirmed by the Gini coefficients we discuss in the next Section). But, as others have noted (see Cain et al, 2010), the growth in mean consumption over this period was great enough to outweigh the increase in inequality so as to greatly reduce poverty.

Turning to the role of health care costs, Figures 8 to 9 report consumption distributions for 2011/12 with and without accounting for medical expenses. Figure 8 reports the results for rural India. One can see in this figure that medical expenses have an important effect on the shape of the whole consumption distribution. Their impact goes well beyond shifting a few

marginal households from slightly above to slightly below the poverty line. Rather, one can see that the mass of the whole density increases quite substantially to the left of about 1200 INR.

Indeed, the most striking aspect of Figure 8 is not so much the increase in mass below the poverty line (816 INR), but rather the shift in mass from the whole right tail into the region of about 816 to 1200 INR. In other words, overall poverty rate figures miss the fact that medical expenses are pushing many relatively well-off households into a "near poverty" or "at risk" zone where consumption is only modestly above the poverty line. This suggests that improvements in health care services are not only necessary to reduce poverty, but also to provide consumption risk protection for the emerging middle class and those at risk of falling into poverty as a result of adverse health shocks. Figure 9 for urban India tells a very similar story.

VI.F. Health Expenditures and Inequality Measures

Here we examine how accounting for health expenditures affects measures of inequality. As in Section II, let *C* denote consumption of goods and services only (i.e., excluding medical costs), and let *C+E* denote the conventional measure of consumption that includes medical spending. Obviously, adverse health shocks are events that affect some households much more than others; in particular, as we saw in Table 2, in 2011-12 fully 4.06% of households were pushed into poverty by medical expenses. Thus, a plausible hypothesis is that treating medical expenses as a consumption good would cause one to understate inequality, because it causes one to exaggerate the "true" consumption of households with high medical costs. In other words, we hypothesized that health shocks would artificially reduce the variance of *C+E* relative to *C*.

In Table 6 we examine this hypothesis by looking at three standard measures of inequality: the Gini, the coefficient of variation (CV) and the mean log deviation (MLD). First, note that the (conventional) consumption Gini for All India went from .321 in 1999/2000 to .359 in 2004/05, but then stabilized at .358 in 2011/12.[20] Second, note that the Gini for consumption *excluding* medical expenses was .320, .352 and .349 over those same three waves. Thus, contrary to our hypothesis, excluding medical expenses actually *reduces* the consumption Gini.

[20] According to the World Poverty and Inequality Database of the World Bank, the consumption Gini for India in 2004/05 was .334, which is slightly below our figure of .359. As a point of comparison, some other values they report are: South Africa (.674), Brazil (.569), Mexico (.461), China (.425), Russia (.408), the United States (.406), Malaysia (.379), the United Kingdom (.376) and Vietnam (.368). Thus, India can be viewed as a relatively low inequality country. To put these figures in context, it is worth recalling that inequality measures based on consumption data are generally much lower than measures based on income data. According to the India Human Development Survey (a household survey collected by the National Council for Applied Economic Research and the University of Maryland) the income Gini for India in 2005/06 was .532.

Focusing on rural India in 2011/12, we see in Table 6 that the Gini for total consumption is .287, while that for consumption excluding medical costs is .271. This difference of .016 points is the largest we observe for any time-period or region. These two Gini coefficients correspond to the consumption distributions graphed in Figure 8. As we see there, removing medical spending shifts the mass of the consumption distribution towards the left *except* near the very low end. Recall that in discussing Table 1 we noted that households in the 1st decile of the consumption distribution spend less on health care than wealthier households (often spending nothing). This clarifies why excluding medical spending makes consumption appear more equal: it is simply because poor households spend relatively little on medical care.

It is interesting that if we examine consumption net of medical spending we find the implied level of poverty increases, while the implied level of inequality declines. This highlights the limitations of looking at the distribution of consumption using a unidimensional measure like the Gini coefficient.

Another interesting point is that the consumption Gini for India increased by .037 over the twelve-year period (i.e., from .321 to .358). But the Gini for consumption net of medical spending only increased by .029 (i.e., from .320 to .349). Thus, counting medical spending as equivalent to consumption of goods and services exaggerates the increase in inequality (as measured by the Gini) that occurred over this period. This is because a non-negligible share of the increased consumption by wealthier households took the form of higher medical spending (as is clear from Figures 8 and 9 and Table 1).

As is well known (see Atkinson (1969)), the Gini emphasizes inequality near the center of a distribution, while the CV emphasizes inequality in the right tail and the MLD emphasizes inequality in the left tail. A striking finding in Table 6 is that inequality as measured by CV and MLD *declined* in India (both rural and urban) over the 1999-2011/12 period. According to the CV, the decline is quite a bit greater if we look at consumption net of medical spending rather than the conventional total consumption measure. This is because in 1999 there was substantial heterogeneity in medical spending among better off households, but by 2011/12 this had been reduced. In contrast, if we look at the MLD, there is very little difference between values based on total consumption vs. consumption net of medical spending. This obtains because, as noted earlier, households at low levels of consumption spend very little on medical care.

These results illustrate both (i) how unidimensional measures like the Gini, CV and MLD can lead to conflicting inferences about changes in inequality, and (ii) how the impact of medical

costs on inequality may appear quite different depending on the inequality measure we use. In particular, OOP medical spending has a negligible impact on inequality as measured by the MLD or CV. But if we look at consumption net of medical costs the resultant increase in the Gini for India over the 1999-2012 period is 9% compared to 12% by the conventional measure. This again highlights the importance of looking at how OOP medical costs affect the entire consumption distribution (not just scalar summary statistics).

VII. Discussion and Conclusions

We have analyzed the effects of health care costs on poverty in India using consumer expenditure data from the NSSO. Our calculations indicate that both prevalence and depth of poverty are significantly understated in official statistics due to failure to account for poverty induced by OOP health care costs. In particular, for 2011/12 we estimate an all India poverty rate of 22.3% under the standard total consumption measure, but this rises to 26.4% if we deduct OOP medical costs. This increase of 4.1% represents roughly 50 million people in a state of hidden poverty induced by medical costs.

Poverty in India fell dramatically from 1999/00 to 2011/12. The conventionally measured poverty rate fell from 42.3% to 22.3%. Once we factor in OOP medical costs, the figures are 46.9% and 26.4% respectively. Thus, by any standard, poverty fell substantially over this period. However, as the overall poverty rate fell, health spending became a more important factor driving the poverty that remains. Hidden poverty due to medical costs rose from 10.9% of total measured poverty in 1999/2000 to 18.2% in 2011/12. Similarly, the fraction of the poverty gap that is due to medical costs rose from 13.4% in 1999/00 to 19.3% in 2011/12.

This increased importance of medical costs as a cause of poverty is predicted by a simple model (Section III) where medical spending is an input rather than a consumption good, and the derived demand for the medical input increases as income increases (in India the medical share of consumption rose from 5.1% in 1999/00 to 6.8% in 2011/12). Clearly then, tackling high OOP health care costs is a priority if India is to make further progress in reducing poverty as it becomes wealthier.[21] This point has been recognized by the GOI Planning Commission (2011).

Our analysis also extends earlier work by looking at the how OOP medical costs affect the entire consumption distribution (not just the poverty rate or poverty gap). Our results show that medical expenses have an important effect on the shape of the distribution. In particular,

[21] At low levels of development, large reductions in poverty can be achieved by improving nutrition alone, but further progress requires improving provision of higher order needs like health care.

OOP medical costs not only push many people below the poverty line, but also shift considerable mass from the right tail of the consumption distribution into the range of 1.0 to 1.5 times poverty. Thus, official poverty rate figures mask the fact that medical expenses push many apparently well-off households into a "near poverty" or "at risk" zone. Thus, improvements in health care services, as well as enhanced provision of health insurance, are not only needed to reduce poverty, but also to provide consumption risk protection for the emerging middle class.

It is well-known that India has poor health infrastructure in general, and little access to health insurance in particular, relative to countries of similar income level. As Alkire and Seth (2015) note "India's rate of reduction of health and educational deprivations has been relatively sluggish in comparison with her reduction of [other poverty] indicators." This is consistent with work by Anand and Ravallion (1993) and Fay et al (2005) who find public health spending has a much larger effect on health outcomes than economic growth or the consumption level *per se*.

But in recent years there has been serious interest in the possibility of expanding health insurance coverage in India, as illustrated by Reddy et al (2011), HLEG (2011), Selvaraj and Karan (2009b), Garg (2006), Ranson (2002) among others. The RSBY national health insurance plan was introduced in 2008, but it only provides rather limited benefits to the very poor (see Palacious (2011) and Sun (2011) for assessments). The state of Andhra Pradesh introduced the far more ambitious Aarogyasri insurance plan in 2007, and evaluations by Fan et al (2012) and Rao (2014) suggest it has been successful in reducing OOP costs. Given these considerations, the GOI Planning Commission (2011) stated: "the burden of financing healthcare falls excessively on households in the form of out of pocket expenses" and "the Twelfth Plan [2012-17] will explore the possibilities of introducing a government funded health insurance plan for every citizen along the lines of the RSBY, which is currently limited to the poor and for certain select groups." Yet, according to MOSPI (2015), in 2014 only 18% of urban and 14% of rural households had any form of health insurance (with roughly 12.6% publicly provided).

One limitation of our analysis is that we may understate the problems created by high OOP health expenses because, as other work suggests, those expenditures often fail to provide useful services. The quality of public sector health care in India has been severely criticized. For example, in a study of public primary care facilities, Powell-Jackson et al (2011) state that "most facilities fall far short of minimum standards," while Planning Commission of India (2005) states: "the quality of care across rural public health infrastructure is abysmal…" The quality of private sector care has also been seriously questioned (see Peters et al., 2002, NSSO, 2006).

Second, looking at poverty induced by OOP health care costs understates the problem of lack of access to health care. For example, people in the 1st decile of consumption in 2011/12 had a 28% incidence of zero OOP health expenses, compared to 20% in the population as a whole. It is unlikely this difference arose because those in the 1st decile were relatively healthy – more plausible is that they often can't afford formal treatment (see MOSPI (2015)).

Only looking at OOP costs also ignores the utility cost of illness and the economic costs of lost labor productivity. Improved public health care and health insurance would lead to improved health outcomes, and increased productivity. There is even evidence that a healthier population enhances growth and foreign direct investment (Bloom et al, 2004, Alsan et al, 2006).

An obvious extension of our study would be to look at the relationship between economic growth, health spending and poverty at the State level. It is well-know that some Indian States spend considerably more on public health services than others (see, e.g., Cavatorta et al, 2015, GOI, 2005, Table 1.3). Public spending ranges from only 7.5% of total spending in Uttar Pradesh to 37.8% in Himachal Pradesh. And there is also evidence that economic growth has more of a "pro-poor" impact in States with better initial conditions in terms of health and education (see Ravillion and Datt, 2002). Thus it would be interesting to examine the relationship between public health spending/infrastructure and the extent to which state level growth is "pro-poor."

In conclusion, our findings highlight the need for substantial and sustained investment in the public health system in India. While poverty has fallen substantially since 2000, the fraction of remaining poverty due to medical costs has risen substantially. Thus, access to affordable health care is a priority for achieving further reductions in poverty, as well as to improve health outcomes and insure middle class households against consumption risk. Another key point is that the extent of hidden poverty due to medical costs is much greater in rural areas (39 million people) than in urban areas (11 million people). And, since 2005, economic growth has been much less "pro-poor" in rural than in urban areas. This suggests a policy emphasis on promoting rural public health infrastructure may be appropriate.

Appendix: Additional Properties of the Simple Model of Medical Spending

In Section III we discussed how the model in (1') to (4') generates income thresholds that must be attained to give positive spending on preventive care (E_M) and treatment (E_T). Here, we instead consider the case where income is sufficiently high to give interior solutions for both E_T and E_M. As we are considering two-stage budgeting the appropriate demand functions are the Frisch demands, which hold within period marginal utility of consumption (MU_C) fixed:

(A1) $$E_T = \frac{1}{\delta} ln S_0 - \frac{1}{\delta} ln\left[\frac{MU_C}{MU_C+\alpha\delta}\right] \qquad iff \quad I > C_m + \frac{1+\beta\gamma}{\alpha\delta}\frac{1-S_0}{S_0} \;\; and \;\; S_0 > \frac{\beta\theta}{\beta\theta+\alpha\delta m_0}$$

(A2) $$E_M = \beta\theta/MU_C - m_0 \qquad iff \quad I > C_m + \frac{1+\beta\gamma}{\beta\theta} m_0$$

where:

(A3) $$MU_C \equiv \frac{1+\beta\gamma}{C-C_m} > 0 \qquad \frac{dMU_C}{dI} = \frac{dMU_C}{d(C-C_m)} = -\frac{1+\beta\gamma}{(C-C_m)^2} < 0$$

These equations imply that as $C - C_m \to \infty$ we have:

(A4) $$\frac{E_T}{C-C_m} \to \frac{1}{\delta C_m}\frac{ln(C-C_m)}{(C-C_m)/C_m} \equiv \frac{1}{\delta C_m} k(C) \qquad and \qquad \frac{E_M}{C-C_m} \to \frac{\beta\theta}{1+\beta\gamma}$$

Equation (A4) says that expenditure on treatment as a share of consumption, $E_T/(C\text{-}C_m)$, is zero at $C=C_m$, peaks at $C=C_m+e$, where e is Euler's constant, at which point it reaches $1/\delta e$, and then (very) gradually declines as consumers become more wealthy ($C>>C_m$).[22] Note that the consumption share of medical treatment approaches a ratio that depends only on consumption itself and the technology of treatment, as characterized by δ in equation (4').[23] It is interesting that this share depends on treatment effectiveness, and not on preference parameters.

In contrast, the share of consumption devoted to health investment approaches (from below) the constant $\beta\theta/(1+\beta\gamma)$ where β is the utility weight on health, and θ and γ are parameters of the technology (3') that maps health investment and consumption into health, respectively.

Finally, note that total medical spending converges to a fixed share of consumption as consumers grow wealthier, with relative spending slowly shifting from treatment to investment.

[22] In the limit $E_T/(C\text{-}C_m)$ approaches zero. However, due to the nature of the function $k(C)$ in (A4), this convergence towards zero is so slow that it is of little practical relevance for developing (our even developed) countries. For example, using data on the per capita income and the poverty for the US in 2015, which give C=\$38k and C_{min}=\$12k, we obtain that $k(C) \approx 1.5$, which is still far above zero.

[23] The multiplication of δ by the constant C_m merely adjusts the technology parameter for the monetary units in which consumption and medical spending are expressed.

These properties of the model are broadly consistent with two key patterns in the data: (i) the increase in the consumption share of medical spending in India from 5.1% to 6.8% over our sample period (during which there was substantial economic growth) and (ii) the fact that the medical shares of almost all high income countries are currently in the 10% to 11% range and have grown quite gradually over the past 25 years.[24]

In conclusion, the main point of this section is simply to show that our model rationalizes the exclusion of medical spending from consumption, while generating consumer behaviour that seems plausible in other respects.

[24] For example, the health spending share of GDP in France grew from 8% in 1990 to 11% in 2016, while that in Germany grew from 9% in 1992 to 11.25% in 2016 (see https://data.oecd.org/healthres/health-spending.htm). Of course, an exception to this pattern is the US, which is an extreme outlier.

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Figure 1: Health Expenditure as a Percentage of Total Consumption

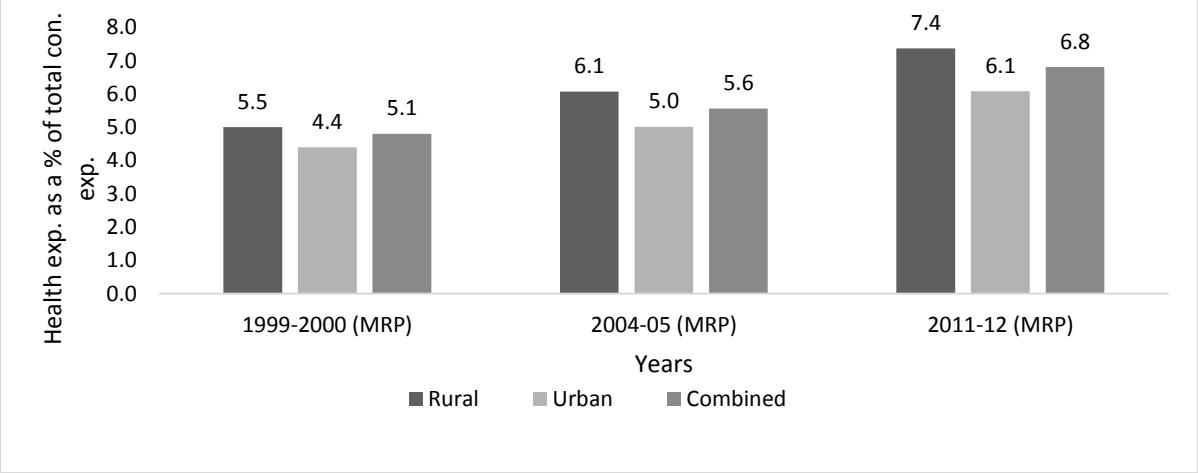

Figure 2: Average Monthly per capita Health Expenditure (Nominal)

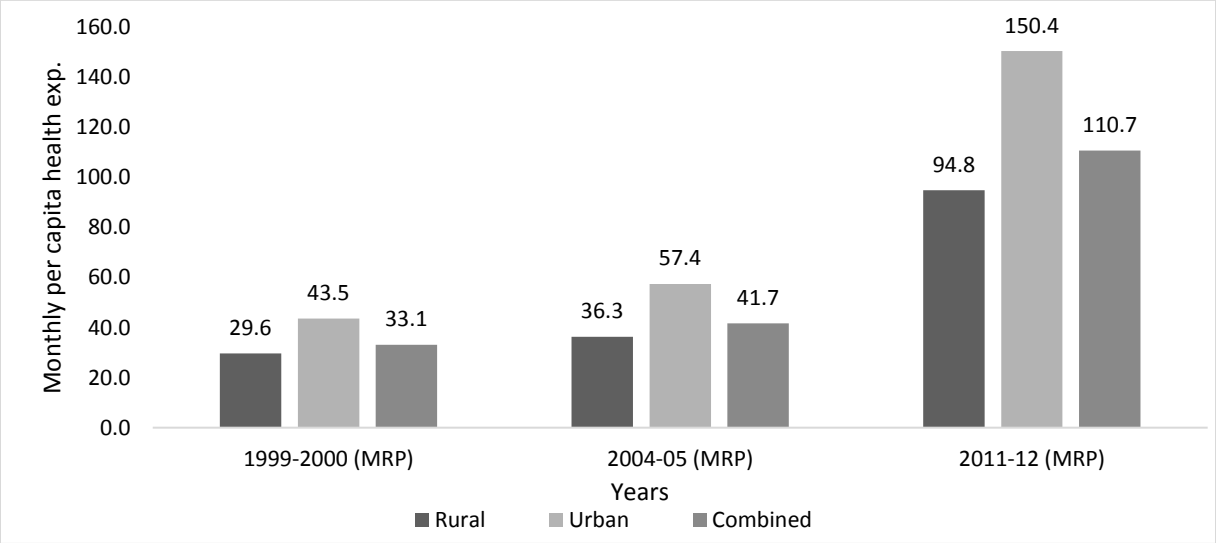

Figure 3: Distribution of Hidden and Reinforced Poverty - All India, 1999-00

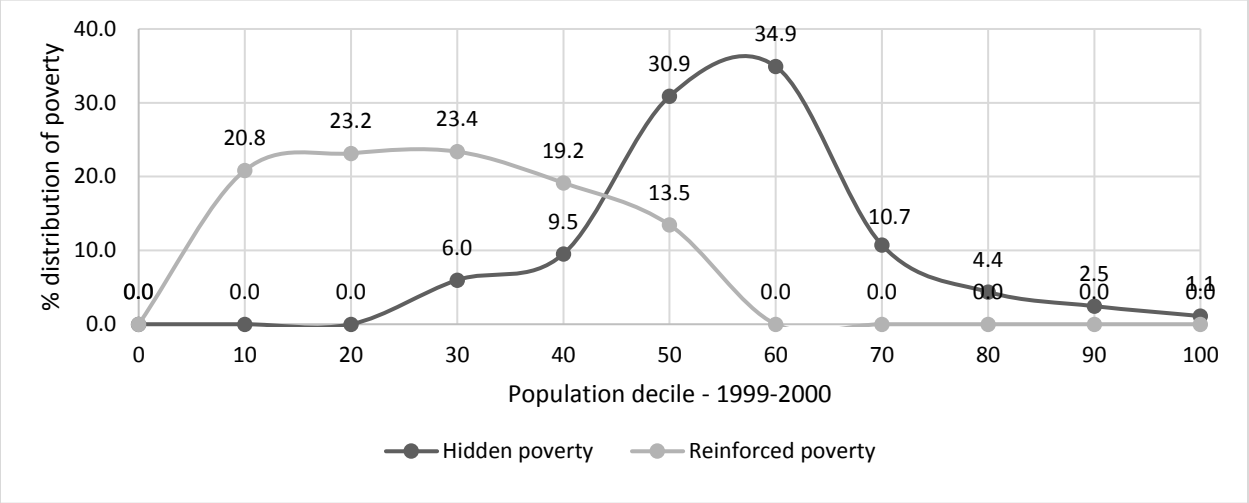

Figure 4: Distribution of Hidden and Reinforced Poverty - All India, 2004-05

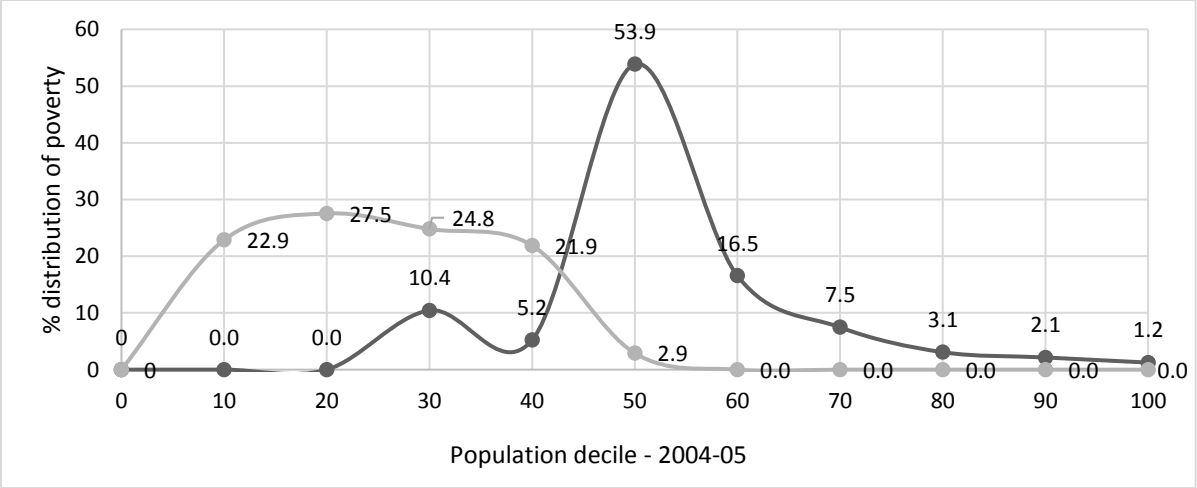

Figure 5: Distribution of Hidden and Reinforced Poverty - All India, 2011-12

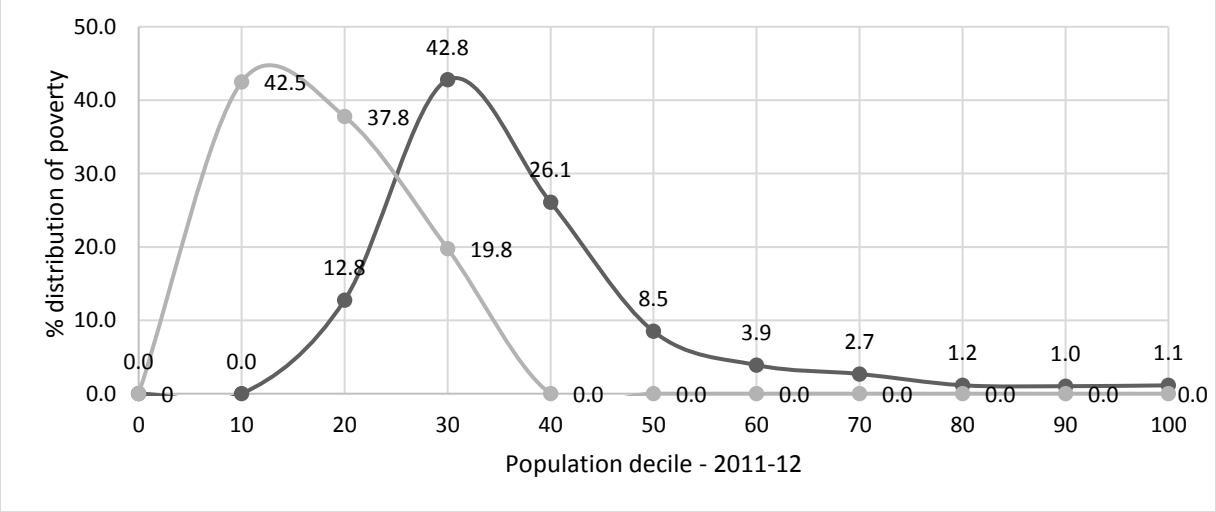

Figure 6: Changes in the Distribution of Consumption, Rural India (1999 to 2011)

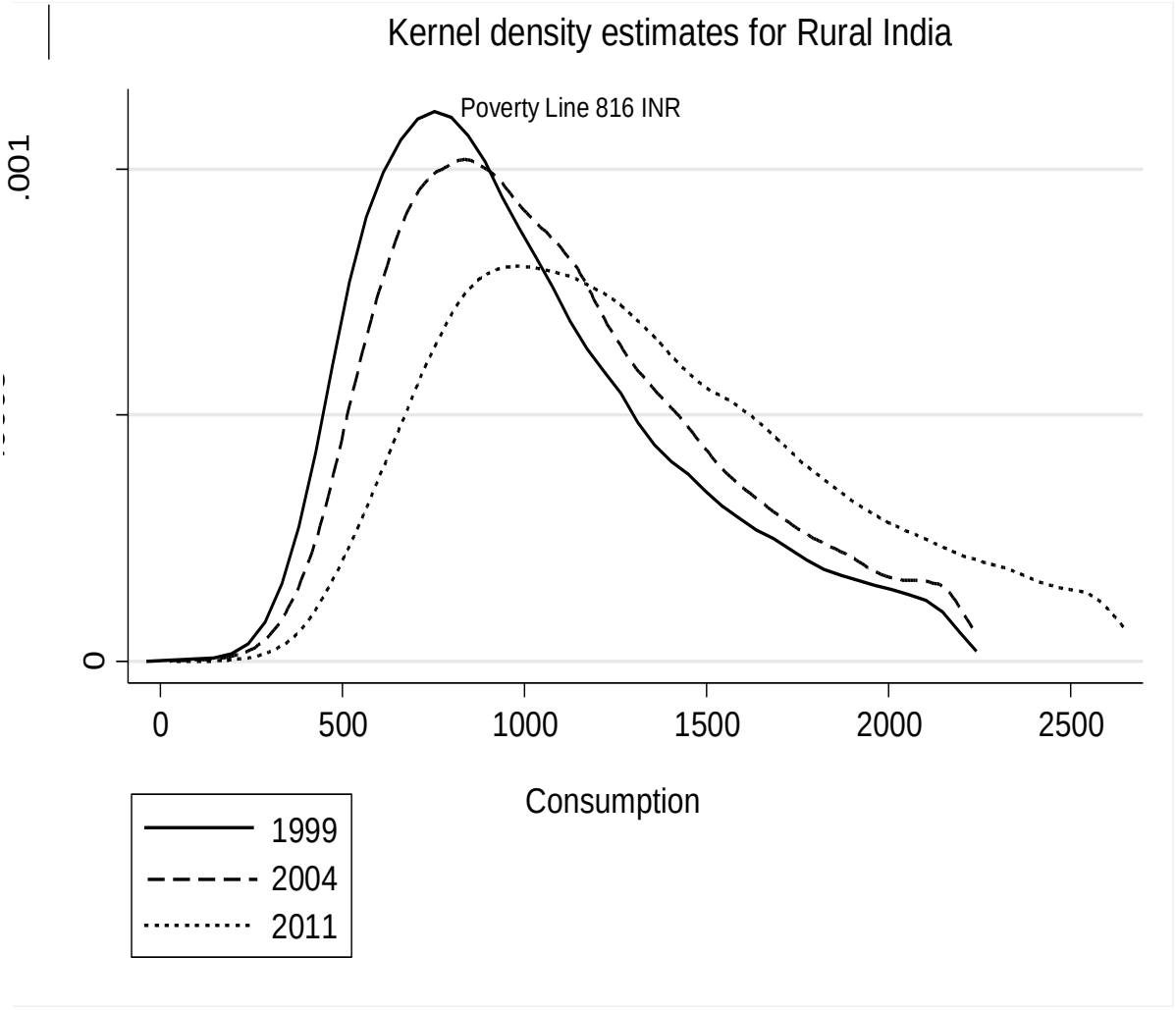

Figure 7: Changes in the Distribution of Consumption, Urban India (1999 to 2011)

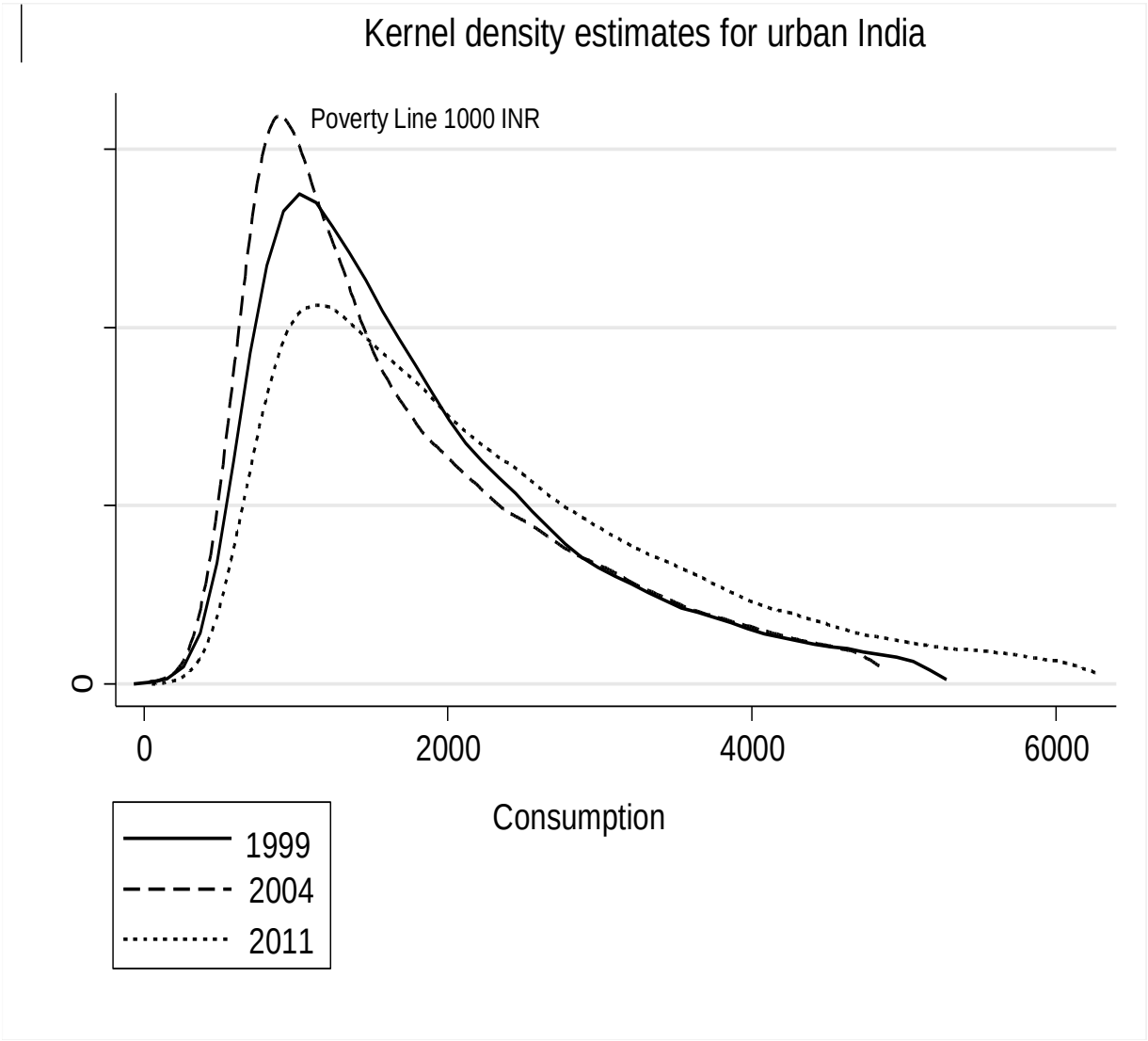

Figure 8: Medical Costs and the Distribution of Consumption
Rural India, 2011-2012

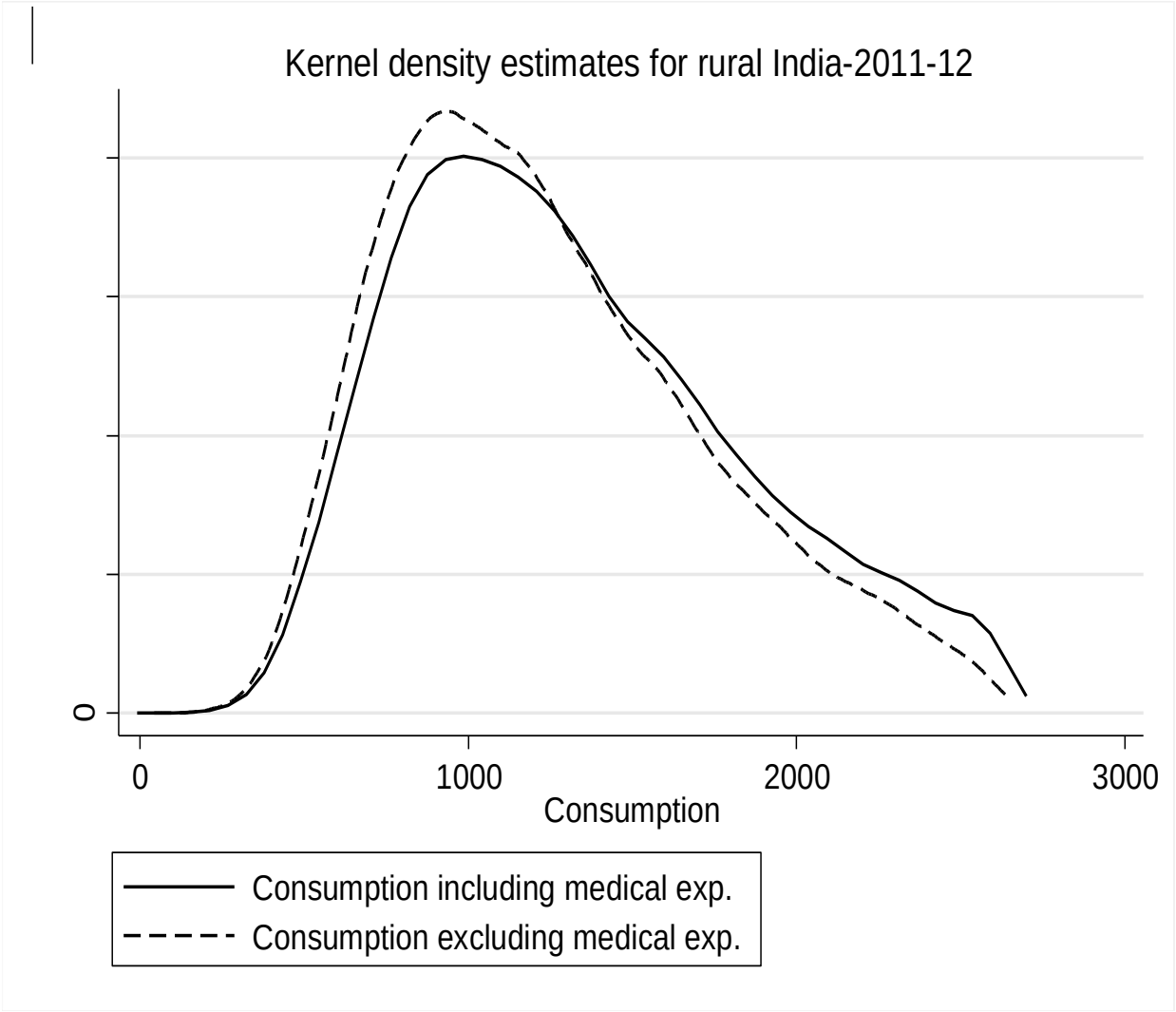

Figure 9: Medical Costs and the Distribution of Consumption
Urban India, 2011-2012

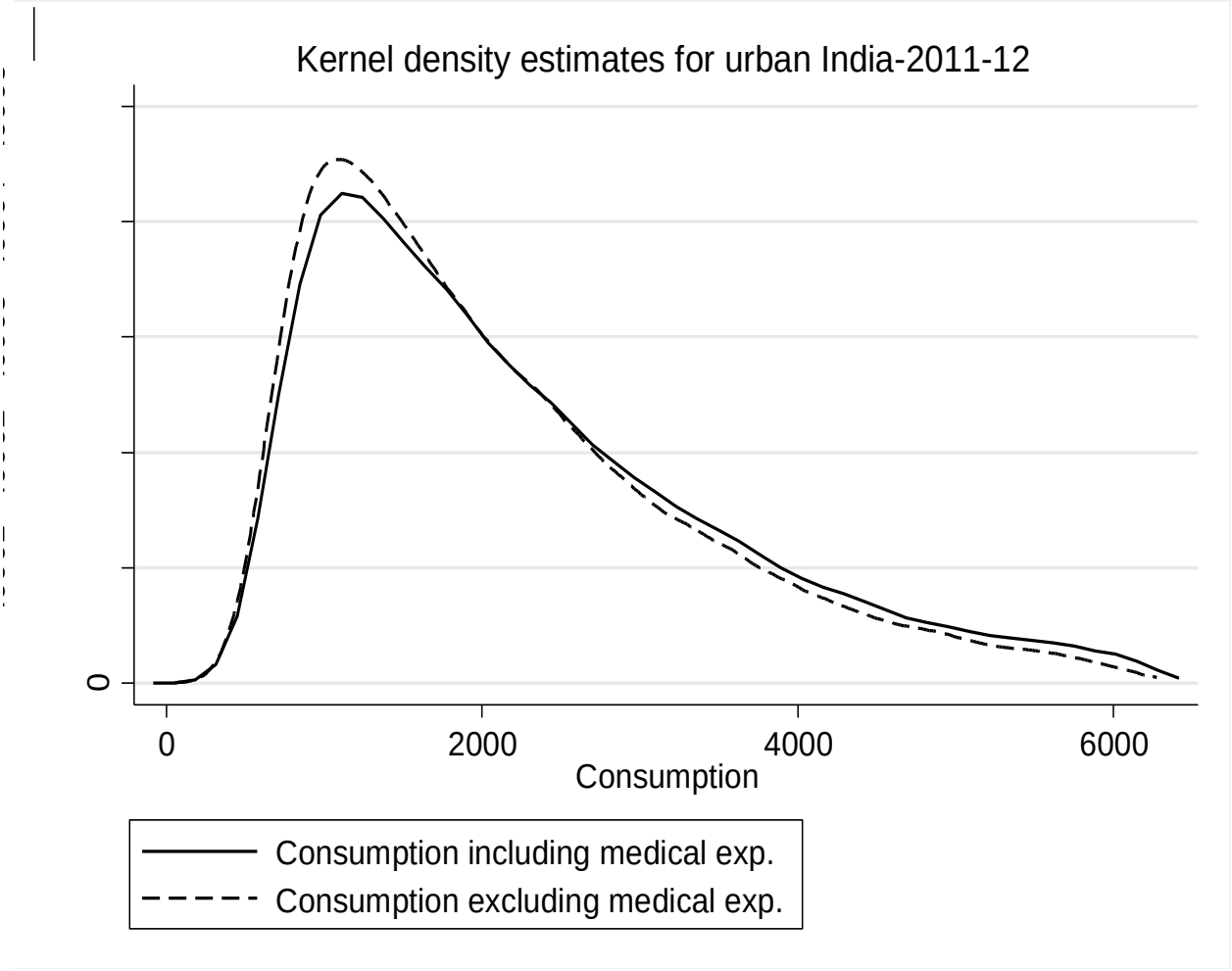

Table 1: Medical Expenditure Share (*E/C*) by Decile of Consumption, 2011-12

Decile	Rural		Urban		All India	
	E/C	**%E>0**	**E/C**	**%E>0**	**E/C**	**%E>0**
1	.0355	28.9	.0401	28.6	.0385	28.0
2	.0442	22.4	.0431	23.6	.0449	22.9
3	.0479	20.3	.0480	22.8	.0464	20.6
4	.0479	19.4	.0516	20.1	.0500	20.8
5	.0532	19.7	.0534	19.1	.0540	19.0
6	.0547	17.9	.0566	19.7	.0578	18.1
7	.0602	17.5	.0581	19.5	.0634	17.2
8	.0674	16.4	.0628	18.8	.0709	18.5
9	.0817	16.4	.0628	19.6	.0790	17.9
10	.1100	15.1	.0715	21.4	.0823	18.9
Medical Expenditure Share (summary statistics)						
Mean	.0603		.0548		.0587	
Median	.0311		.0283		.0302	
Std.Dev.	.0869		.0777		.0844	
Household per capita Monthly Consumption/1000						
Mean	1.285		2.469		1.623	
Median	1.072		1.864		1.218	
Std.Dev.	0.915		2.202		1.505	
Regression: $E/C = \beta_0 + \beta_1 C$						
	Coeff.	**Std.Err.**	**Coeff.**	**Std.Err.**	**Coeff.**	**Std.Err.**
Constant	.0337	.0017	.0471	.0011	.0477	.0009
Consumption	**.0207**	.0014	**.0031**	.0004	**.0068**	.0005
$\eta_{E,C}$	**1.44**		**1.14**		**1.19**	
R^2	.048		.008		.015	
N	59,695		41,967		101,662	

Note: The top panel reports the mean of *E*/*C* within each decile of *C*, as well as the fraction of households with zero health expenditures. The regressions use monthly per capital household consumption/1000 as the independent variable. $\eta_{E,C}$ denotes the elasticity of health care spending with respect to consumption implied by the estimates, evaluated at the means of *E/C* and *C*. For this functional form, the elasticity is defined as $\eta_{E,C} = 1 + \beta_1 \cdot C \cdot (E/C)^{-1}$.

Table 2: Poverty Rates Before and After Out-of-Pocket Health Expenditures

	1999-2000			2004-2005			2011-2012		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Poverty Rate	47.02	28.21	42.29	41.27	25.31	37.23	25.76	13.71	22.31
Poverty Rate Accounting for Medical Expenses	52.04	31.60	46.90	46.06	28.43	41.60	30.48	16.11	26.37
% Increase in Poverty due to Medical Costs	10.7%	12.0%	10.9%	11.6%	12.3%	11.7%	**18.3%**	**17.5%**	**18.2%**
Hidden Poverty due to Medical Expenses	5.02	3.39	4.61	4.79	3.12	4.37	4.72	2.40	4.06
Reinforced Poverty due to Medical Expenses	31.54	19.04	28.39	24.80	16.12	22.60	20.37	11.03	17.70
Total	36.56	22.43	33.00	29.59	19.24	26.97	25.09	13.43	21.76

Table 3: Elasticities of Poverty with Respect to Growth

	Change in Poverty		**Change in Poverty Accounting for Medical Expenses**	
Time Period	99/00 to 04/05	04/05 to 11/12	99/00 to 04/05	04/05 to 11/12
All India				
Change in Poverty Rate	-12.1%	-40.1%	-11.3%	-36.5%
Annualized Change	-2.54%	-7.06%	-2.37%	-6.28%
Elasticity of Poverty with respect to Consumption	**-.74**	**-1.06**	**-.69**	**-.94**
Rural India				
Change in Poverty Rate	-12.1%	-37.5%	-11.3%	-33.8%
Annualized Change	-2.54%	-6.49%	-2.37%	-5.72%
Elasticity of Poverty with respect to Consumption	**-.74**	**-.98**	**-.69**	**-.78**
Urban India				
Change in Poverty Rate	-10.3%	-45.8%	-10.0%	-43.3%
Annualized Change	-2.15%	-8.38%	-2.09%	-7.79%
Elasticity of Poverty with respect to Consumption	**-.63**	**-1.26**	**-.61**	**-1.17**

Note: For All India, the annual growth rate of consumption per capita was 3.44% from 1999/2000 to 2004/05, and 6.65% from 2004/05 to 2011/12 (see World Bank national accounts data)

Table 4: Poverty Gap Before and After Out-of-Pocket Health Expenditures

	1999-2000			2004-2005			2011-2012		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Poverty Gap (Real normalized)	11.83	6.70	9.07	9.47	5.95	7.49	5.06	2.71	3.76
Poverty Gap Accounting for Medical Expenses (Real normalized)	13.63	7.77	10.47	10.92	6.89	8.65	6.31	3.32	4.66
Difference	1.80	1.07	1.40	1.45	0.94	1.16	1.25	0.61	0.90
% of Poverty Gap due to Medical Expenses	13.2%	13.8%	13.4%	13.3%	13.6%	13.4%	**19.8%**	**18.4%**	**19.3%**

Note: The last row reports the fraction of the "poverty gap accounting for medical expenses" that is due to the medical expense component (e.g., In the last column, 0.90/4.66 = 19.3%).

Table 5: Elasticities of Poverty Gap with Respect to Growth

	Change in Poverty Gap		**Change in Poverty Gap Accounting for Medical Expenses**	
Time Period	99/00 to 04/05	04/05 to 11/12	99/00 to 04/05	04/05 to 11/12
All India				
Change in Poverty Gap	-17.4%	-49.8%	-17.4%	-46.1%
Annualized Change	-3.75%	-9.38%	-3.75%	-8.45%
Elasticity of Poverty Gap wrt Consumption	**-1.09**	**-1.41**	**-1.09**	**-1.27**
Rural India				
Change in Poverty Gap	-19.9%	-46.6%	-19.9%	-42.2%
Annualized Change	-4.34%	-8.57%	-4.34%	-7.53%
Elasticity of Poverty Gap wrt Consumption	**-1.26**	**-1.29**	**-1.26**	**-1.13**
Urban India				
Change in Poverty Gap	-11.2%	-54.5%	-11.3%	-51.8%
Annualized Change	-2.35%	-10.64%	-2.37%	-9.90%
Elasticity of Poverty Gap wrt Consumption	**-.68**	**-1.60**	**-.69**	**-1.49**

Note: For All India, the annual growth rate of consumption per capita was 3.44% from 1999/2000 to 2004/05, and 6.65% from 2004/05 to 2011/12 (see World Bank national accounts data)

Table 6: Inequality Measures Before and After Health Expenditures

	Rural			Urban			All India		
	99/00	04/05	11/12	99/00	04/05	11/12	99/00	04/05	11/12
Gini Coefficient									
C+E	.263	.295	.287	.342	.377	.375	.321	.359	.358
C (exclude medical)	.256	.282	.271	.342	.373	.370	.320	.352	.349
Δ Inequality	-.007	**-.013**	**-.016**	.000	-.004	-.005	-.001	-.007	-.009
Coefficient of Variation									
C+E	1.163	.823	.713	1.427	.915	.892	1.394	.974	.927
C (exclude medical)	1.198	.818	.685	1.466	.922	.897	1.437	.980	.927
Δ Inequality	+.035	-.005	-.028	+.039	+.007	+.005	+.040	+.006	.000
Mean Log Deviation									
C+E	.177	.145	.135	.296	.231	.229	.243	.211	.209
C (exclude medical)	.175	.138	.126	.299	.230	.227	.244	.207	.204
Δ Inequality	-.002	-.007	-.009	+.003	-.001	-.002	+.001	-.004	-.005

Note: *C* is our preferred measure of consumption that excludes spending on medical expenses, while *E* denotes medical costs. The coefficient of variation and mean log deviation can be sensitive to outliers, so we top coded the top 60 consumption values in each year. But this had little effect on the results (due to the large sample sizes).