5-7-2013

Do User Fees Increase Tuberculosis Notifications?

Chioma Y. Chukwumah
Macalester College, chommychucks@yahoo.com

DO USER FEES INCREASE TUBERCULOSIS NOTIFICATIONS?

AUTHOR: CHIOMA YVONNE CHUKWUMAH

ADVISOR: PROFESSOR RAYMOND ROBERTSON

READERS: PROFESESSOR AMY DAMON
DEAN CHRISTY HANSON

ECONOMICS SENIOR HONORS THESIS

5/7/2013

I. INTRODUCTION

Tuberculosis or TB (short for *tubercle bacillus*) is an infectious chronic disease caused by various strains of mycobacteria that attack the lungs and possibly other body parts. Dr. Robert Koch announced his discovery of TB on March 24th 1882. During this period, TB killed one out of every seven people living in the United States and Europe. It was the main cause of death worldwide in the nineteenth century and modern TB cost between US$1.4 and US$2.8 billion in gross domestic product annually worldwide (Grimard and Harling, 2010). The World Health Organization lists TB as second only to HIV/AIDS as the most deadly disease due to a single infectious agent. TB's intriguing profile has led public health sectors to strive to provide quality and affordable care to patients. Growing populations and increasingly tight government budgets are driving many countries to search for ways to finance their health services. One dominant solution is to institute user fees (Alleyne, 2010). I define user fees for TB as the reported amount patients pay for treatment at medical facilities.

The World Bank's (1987) agenda for health financing reform asserts that the implementation of user fees will improve equity by generating more revenue to expand cost effective basic health care services. Since then, user fees have come to play a significant role in the financing and delivery of public health care services in many countries. After the World Bank published studies to support the implementation of user fees in 1987, 90% of the 47 Sub-Saharan African countries put in place some form of user fee (Gordon-Strachan et al. 2010). As of 2010, Witter (2012) lists six countries without any form of user fee: Angola, Timor-Leste, Liberia, South Sudan, Malawi, and Uganda while the others have some form of user fee system inplace. Interestingly, these countries are not linked by income as they range from wealthy countries to below average based on the purchasing power parity terms. Since 1987, health care user fees have been scrutinized. The main arguments for and against the use of user fees in the literature can be grouped under the welfare enhancing effect of equity, efficiency, and revenue generation (Alleyne, 2010).

Some studies support the equity enhancing potential of user fees. These studies support that user fees provide non-discriminatory access. In examining the case in Peninsular Malaysia, Heller (1982) argues that the implementation of user fees does not affect access to health care because the total medical demand is inelastic to cash price. Heller states that the demand for health services is primarily influenced by other factors such as the quality and proximity of health care services rather than cash prices, such that an increase in revenue increases access to quality care. Similarly, Audibert and Mathonnait (2000) found that utilization of health services increased following the introduction of user fees in Mauritania. The increase in utilization in Mauritania was due to an increase in the quality of healthcare. Their results suggest that users are willing to pay more when the quality of care increases. Soucat et al. (1997) found an increase in utilization of curative and antenatal care due to an increase in quality of services following the implementation of the Bamako Initiative (user fees were implemented) in Benin and Guinea. Studies in literature that supports user fees ability to achieve equity based on the reasoning that the retained fees are used to improve and expand the coverage and quality of health facilities.

Also, some studies support the efficiency enhancing potential of user fees. These studies suggest that user fees rationalize the use of health services among users. Krutilová (2010) found that user fees help in efficient use of health care services from the significant decrease in frivolous use observed in Czech Republic after user fees were implemented. Also, Griffin (1988) stated that user charges are helpful in making health care more efficient and equitable by rationing the use of health care services and teaching individuals how to prioritize their needs to unnecessary visits.

Some studies question the equity and efficiency enhancing nature of user fees. Burnham et al. (2004) stated that Uganda abolished user fees in 2001 because they led to unnecessary suffering and death of citizens. Moreover, Nyonator and Kutzin (1999) found that official exemptions from user fees put in place for the poor were non-functional in the Volta region of Ghana. They conclude that these fees failed to protect access and income for poor members even though they contributed to the financial sustainability for the health facilities.

Other studies in the literature support the revenue generating potential of user fees. After reviewing different works in the literature on user fees, James (2006), argues that the major role of user fees is revenue generation. He states that overall user fees are too small in absolute terms to finance all uncovered areas. Burnham et al. (2004) found that revenues from user fees were at least sufficient to improve drug supply. Gilson's (1997) study showed that the national user fee systems have on average generated about 5% of total recurrent health system expenditure. Gilson also found that Ghana recovered 12% percent its total recurrent government expenditure from user fees in 1993. Hence, the amount of revenue generated by user fees varies in across counties and by year.

Inefficiency in collecting revenues and inability to easily determine exemptions hinder the ability of user fees to serve as a means of generating revenue (Heller, 1993).In addition to the pressure to keep fees low, weak accounting and resource management practices undermine revenue generation levels of user fees. Heller concludes that if introduced alone, fees are unlikely to achieve equity, efficiency, and sustainability.

Although some papers have analyzed the effect of user fees on regular patient visits, other studies have analyzed the impact of user fees on specific diseases. For example, Moses (1992) found that during the user fee period in Kenya at a referral center for sexually transmitted diseases, the mean attendance decreased in both sexes but male attendance decreased more than that of females. Alleyne (2010) found that user fees decreased access to diabetes and hypertension services in Jamaica. However, Wilkinson et al. (2001) found that when user fees were abolished in rural South Africa, preventative services for antenatal care and childhood immunization decreased. His rationale is that the observed increased consultations for curative services caused clinic congestion that prevented visits for preventative care that were less urgent.

The closest study to my work is Ansah (2009) because it analyses the effect of user fees on a health outcome (deaths from malaria and prevalence of malaria). Ansah analyzed the effect of removing user fees for both health care utilization and health outcomes in Ghanaian children. This study on malaria randomized households into an intervention group in which the research provided free access to basic secondary care, and a control group in which the families paid for health care. The intervention arm attended formal health care facilities more and informal health care providers slightly less. The health outcomes in both groups were similar: 3% of the children in both groups had moderate anemia and the number of deaths were the same. They concluded that the change in cost revealed a change in health care seeking behavior but not necessarily a change in health outcome.

The above literature review discusses the existing debate on the impact of user fees on equity and efficiency, and revenue for different health sectors (e.g. malaria). Ansah (2009) is the closest study to this research because it goes beyond the effect of user fees on equity, efficiency and revenue raising potential. My study follows the path of Ansah’s study to examine the long run effect of how user fees affect the level of level of diseases. My paper adds to the literature by specifically investigating the effect of user fees on TB notifications—new cases of tuberculosis. Section II explains the economic theory used to address this question. Section III summarizes the data used and section IV discusses my analysis and results. The paper ends with a conclusion (section V) that also contains the limitations of this work and proposals for future studies.

II. THEORY

The theory section explains the demand for TB services. It also explains the choices the government faces when implementing user fees. This section ends with an explanation of the market structure of TB services which is used to derive the guiding equation and hypothesis of my empirical analysis.

The Consumer's Choice: Demand for TB treatment services

This paper builds on Heller's (1982) theory that explains the factors that affect demand for health services in Malaysia. Heller's is one of the first works in the literature that empirically analyzes the determinants of demand for medical services. Alleyne (2010) also uses Heller's theory to investigate whether user fees reduce access to health care services without raising the quality of services**.** Alleyne finds that the type of disease determines the impact of user fees. This paper looks specifically at TB services rather than general health services.

Heller's theory assumes that an individual's health status *H* is derived from the health production function:

$$\mathrm{H} = \mathrm{H}(\mathrm{p}, \mathrm{e}, \mathrm{a}, \mathrm{x}) \tag{1}$$

Where *p* is preventive services, *e* is the hygienic quality of the country, *a* is age, and *x* is other goods and services. My theory differs from Heller's and Alleyne's because I assume that if this function holds for an individual, it holds on an aggregate level for a country as well. Moreover, I assume that the level of TB is a function of all the factors in equation (1) because the notifications of TB (my measure of TB infection in a country) are a subset of the health status of a country. I added curative services, *c*, to the function because TB is a contagious disease and user fees are usually implemented for TB treatment services. The more people that seek curative services, the less transmission of TB that will occur and fewer new cases will appear. I added a new variable *t* to incorporate the state of health services available in each country. A higher quality of health facilities and services will result in better health status of populations and thus a decrease in the level of TB. Lastly, because HIV and TB are co-epidemic, I introduced the variable *v* for HIV. Therefore, I assume that the health status of TB (measured by notifications of TB) is:

$$\mathrm{T} = \mathrm{T}(\mathrm{p}, \mathrm{e}, \mathrm{a}, \mathrm{t}, \mathrm{x}, \mathrm{c}, \mathrm{v}) \qquad (2)$$

I assume that an individual derives utility by consuming health services and other consumption goods. The consumer's choice is represented by the indifference curve (IC) in Figure 1. Also, an individual's choice is constrained by their income, represented as the budget line, BL. The optimum point of consumption is where the IC is tangent to the BL.

I denote utility of the household U, health services H, and other goods, G. Hence, the utility function to be maximized is U(H, G). I also denote: household income, I, price of health services, P^h, and price of other goods, P^g. Hence, an individual's utility is constrained by: I - HP^h - HP^g .Using the Lagrangian multiplier, the consumer optimization problem (COP) becomes:

$$\mathrm{COP} = \mathrm{U}(\mathrm{H}, \mathrm{G}) - \lambda(\mathrm{I} - \mathrm{HP}^{h} - \mathrm{GP}^{g}) \qquad (3)$$

The optimal level of consumption for health services which includes TB services is derived by solving the equations:

$$\frac{\partial \mathrm{COP}}{\partial \mathrm{H}} = \frac{\partial \mathrm{U}}{\partial \mathrm{H}} + \lambda P^h = 0 \tag{4}$$

$$\frac{\partial \mathrm{COP}}{\partial \mathrm{G}} = \frac{\partial \mathrm{U}}{\partial \mathrm{G}} + \lambda P^g = 0 \tag{5}$$

$$\frac{\partial \mathrm{COP}}{\partial \lambda} = -(I - HP^h - GP^g) = 0 \tag{6}$$

Solving these equations gives the factors that affect the demand for health services

$$H = \frac{1}{P^g} \cdot I \cdot \frac{\partial H}{\partial G} - \frac{P^h}{P^g} \cdot G \cdot \left(\frac{\partial H}{\partial G}\right)^2 \tag{7}$$

The solution derives demand curve for TB services is shown in Figure 1. Hence, this model shows that TB services are normal goods. This assumption is similar to those of Alleyne (2010) and James (2006) when they examined the impact of user fees.

The Government's Choice: Supply

This paper assumes that the market structure of TB services is a monopoly as shown in figure 2. The government, a benevolent social planner is the sole seller in the market because it owns all the public hospitals. It also has the power to decide what fees to charge for its services and faces the market demand derived in figure 1. The goal of the government is to maximize social welfare and it is constrained by its resources. TB reduction and provision of other public goods are subsets of social welfare that the government wants to maximize.

As shown in figure 2, the government faces a tradeoff between using its available resources (revenue, technology and human capital) towards the reduction of TB or towards the provision of other public goods. The resources used are not perfectly mobile between the two sectors. Hence, the production curve is concave to the origin. The social welfare curve shows the combinations of TB reduction and other goods that the government will provide. Ideally, the government will pick the efficient point where its preference curve is tangent to the production possibility frontier. At this point the government is maximizing all of its resources to produce the highest social welfare possible. In an extreme scenario, when the government institutes an unaffordable fee for TB treatment, no patient can afford the cost, and so TB will rise to its worst level. If the government decides to eliminate user fees, TB notifications will be at the lowest possible level. But, the government will have to give up the provision of other services in order to fund the free treatments. Therefore, the government faces a tradeoff between the level of user fees and the reduction in TB.

The Market of TB Services

My paper assumes that the market for TB services is a monopoly as shown in figure 3. Prior to the implementation of user fees for TB treatments, consumers face a cost of P0. Note that P0 is greater than zero because consumers incur other costs when seeking care. At this price, the government fund is used to cover the total cost of TB treatment which is equivalent to the difference between C3 and P0. The implementation of user fees implies an increase in the amount paid by consumers from P0 to P1. This rise in price results in a fall in the quantity demanded from Q2 to Q1 from the laws of demand and the assumption that TB services are a normal good. The magnitude of this fall depends on the elasticity of demand. The fall in the quantity of TB treatment services is a cost to society as indicated by a possible rise in TB levels. My paper investigates whether the fall in quantity of TB treatment services from Q2 to Q1 will cause a rise in the new cases of TB using panel data.

The Hypotheses on the Effect of User Fees

The null hypothesis from theory is that the implementation of user fees will cause a fall in the demand for TB treatment services, which will increase the notifications of TB. The increase in notifications arises because people stop getting treatments and spread the bacteria to healthy individuals. The alternative hypothesis from theory is that the implementation of user fees does not worsen the level of TB. A reason for this may be that the demand for TB treatment services is price inelastic or that TB treatment services are not normal goods. It may also be that the revenue generated by user fees effectively improves the quality and quantity of treatment services.

The Guiding Equation

Based on figure 2, the elasticity and factors affecting the demand for health services (equation 7) determine the magnitude of the fall in quantity demanded. Therefore, the level of TB, measured as TB notification, is a function of the factors that affect the elasticity of demand and the other factors mentioned in equation (2). Mathematically, the guiding equation from the theory is:

$$\text{TB level}_{ij} = \alpha + \beta_1\text{Userfees}_{ij} + \beta_2\text{factors affecting demand and elasticity}_{ij} + \beta_3\text{age structure}_{ij} + \beta_4\text{composite consumption of other goods consumed}_{ij} + \beta_5\text{hygienic quality of the environment}_{ij} + \beta_6\text{quality of the health care system}_{ij} + \beta_7\text{HIV} + \varepsilon_{ij} \quad (8)$$

The factors affecting demand and its elasticity are: price of TB service (user fees), the price of substitutes, income, preferences and population.

III. SUMMARY STATISTICS

The WHO Global Task Force on TB Impact Measurement lists incidence (estimated number of newly arising cases), prevalence (estimated number of TB at a given time) and mortality (number of deaths due to TB) as the major indicators that measure the epidemiological burden of TB and its trends. I utilized notifications of TB over the three impact indicators because it gives the actual number of new cases detected by the internationally recommended TB control strategy, Directly Observed Treatment Short-course (DOTS) program. It is calculated from the multiplication of TB incidence per 100,000 people and TB case detection rate. Here, TB case detection rate is the percentage of newly notified tuberculosis cases to the estimated incident cases. Some studies in literature, including Ansah (2009), use the number of new cases of diseases when measuring the impact of user fees.

Usually, studies in the literature go directly to clinics within a given geographic location to determine the exact user fee charged. Instead, this paper uses out-of-pocket expenditures per capita as a proxy for TB's user fees Out-of-pocket expenditures are direct payments made by households to health care practitioners for any good or service provided with the intent of restoring the health status of an individual for any health condition. My method is advantageous because it provides the opportunity to examine over 200 countries at once and determine the most likely impact of implementing user fees. The variable, out-of-pocket expenditures per capital, is calculated from the product of out-of-pocket health expenditure (expressed as a percentage of total expenditure on health), the total health expenditure (expressed as percentage of Gross Domestic Product) and GDP per capita. Out-of-pocket payment is expected to contain user fees specific to TB and if TB's user fees rise, we expect out-of-pocket payments to rise.

From the guiding equation, income, taste and preferences are controlled using Gross Domestic Product per capita. It is defined as the gross value added by resident producers divided by the mid-year population. Moreover, GDP per capita is a measure of an individual's income and is used to control for the composite consumption of other goods and services. I expect a negative sign on GDP per capita because a larger income means individuals can pay the necessary medical fees which will decrease the level of TB. But, because GDP is used to control for a lot of factors, it's sign could differ from my predictions. The size and age structure of countries are controlled using the percentage of working population (ages 15 to 64 years). From the theory, I expect a positive sign on this variable because with a larger population there is greater probability of having more TB cases. Studies have shown that TB is dominant among the working population. Moreover, the level of HIV was controlled using the HIV prevalence of the working population. It is calculated from the product of HIV prevalence (percentage of working population) and the working population. The theory predicts a positive coefficient on this variable because persons with a positive HIV status are 21- 34 times more likely to develop TB disease (WHO Fact Sheet, 2012)

The hygienic quality of the environment is controlled for by using the sum of carbon dioxide emissions from solid (coal), liquid (petroleum-derived fuels) and gas (natural-gas) fuel consumption. This variable is used because carbon dioxide is the main atmospheric component that can activate inactive TB (Chauhan, 1991). Theory predicts a positive sign on Carbon dioxide because an increase in its amount means that more people will have active TB. Life expectancy at birth is used to capture other classifications of the quality of the environment including that of the health care systems. Theory predicts a negative sign on life expectancy because a better quality of health services should cause a reduction in the level of TB.

All the data used to estimate the variables in the final guiding equation are from the World Development Indicators and Global Development Finance Databases. Table 2 gives detailed information on the primary source of each variable. I used annual data from 1960 to 2012. The table 2 shows the summary of all the final variables. Data were collected from 142 countries. They were collected over a 52 year period. The entire panel data set is unbalanced but contains a balanced subset of 1909 observations, which could result in selection bias. On average, the TB notifications per year are approximately 74 per 100,000 people with a largest observation of 855 in Swaziland in the year 2009. South Africa follows closely with 728 cases per 100,000 people. This is expected because both are among the 22 high burden countries as classified by the World Bank. Grenada, the Cayman Islands and Bermuda are among the few countries with no new TB cases in certain years. HIV prevalence was highest in South Africa with 1,582 cases per 100,000 people and lowest in Tunisia with 5 cases per 100,000 people.

Switzerland had the highest out-of-pocket expenditure per capita of 13,397.20 (thousand USD) in 2010. On average, out-of-pocket expenditure is 1,008.939 thousand USD. The average GDP per capita is 6,466.19 (constant 2000 USD) and is within one standard deviation of BBC's reported income per person[1] in 2012. The largest GDP per capita 108,111 USD was observed in Monaco in 2008. On average, in any given country, the working population makes up approximately 58% of the entire population. Countries that lie significantly above this mean will have greater likelihood of having higher burden of TB. Moreover, in any given year, the average carbon dioxide emission per country is 92mt. The average life expectancy is 62.5 years. Most countries have a life expectancy that is below that in the United States (75yrs).

IV. ANALYSIS

Estimation Issues

I took the natural log of all variables except for working population (already a percentage), to interpret results as percentages and to normalize the skewed distribution of each variable. The final estimation equation is:

$$LnTBnotifications_{ij} = \alpha_{ij} + \beta_1 LnOut\text{-}of\text{-}pocket\ payment_{ij} + \beta_2 Working\ population_{ij} + \beta_3 LnLife\ expectancy_{ij} + \beta_4 LnCO2\ emissions_{ij} + \beta_5 LnGDP\ per\ capita_{ij} + \beta_6 LnHIVprevalence_{ij} + e_{ij} \quad (4)$$

[1] $10,000.

Here, "i" and "j" represent country and year respectively. Hence, available data points were collected for each variable for 142 different countries from the year 1960 to 2012. The residuals of the modified guiding equation were tested for serial correlation using the Wooldridge test. The results[2] provide evidence that there is first order autocorrelation. Hence, I rejected the null hypothesis of no first order serial correlation. Serial correlation is corrected by using robust standard errors. Robust standard errors increase the standard errors to reduce the probability of making false conclusions. The corrected results diminish the likelihood of biased standard errors of our coefficients. The Fisher test is used to test for unit roots in all variables. The results[3] show that all the variables are stationary. Hence, the null hypothesis of presence of unit roots is rejected. Therefore, the likelihood of spurious correlation that inflates R^2 and t-scores is reduced.

Figure 4 shows a plot of the residuals, which signals the presence of heteroskedasticity. The Breusch-Pagan / Cook –Weisberg test for heteroskedasticity confirms a non-constant variance[4], which is addressed by using robust standard errors. Then, a pairwise correlation is used to estimate the presence of multicollinearity between the variables. The results show a statistically significant negative correlation between the natural log of TB notification cases (lnTBnotification) and all the explanatory variables. The correlation coefficients between LnOut-of-pocket payment and the other explanatory variables are statistically significant and positive. The largest coefficient, 0.8 is between LnOut-of-pocket payment and LnGDP is expected because larger income countries will have larger out-of-pocket payments. The variance inflation factor test gives a mean VIF of 3.35. Therefore, I conclude that multicollinearity is not severe.

I determined the best estimator first by using the Breusch-Pagan Langrange Multiplier

[2]Probability > F statistics = 0.00.
[3] Probability > Chi-square = 0.00 for all variables.
[4] Probability > Chi-square= 0.00.

test. It is used to decide between OLS estimator (Pooled regression) and the Random effects regression. The results[5] provide evidence to reject the null that the variance of the groups are zero (no panel effect) and that a random effects model is appropriate. Then, I conducted a Hausman test to choose between a fixed effects and a random effects model. The results[6] provide evidence to reject the null hypothesis of zero correlation between error terms and that the fixed effects regression is more appropriate. A fixed effects regression controls for time invariant characteristics (constant cross-sectional variation) that differ between countries but are constant over time. The result is consistent with the theory, since I am interested in observing the effects of user fees over time while holding constant country specific traits.

Main Results

Table 3 shows the main regression (fixed-effects) results for this study. All of the variables have a statistically significant effect on user fees, measured as out-of-pocket payments, with the exception of the working population and life expectancy variables. The result has a negative coefficient for LnOut-pocket payment. This implies that when all individual country characteristics are held constant, a 1% increase in out-of-pocket payments decreases the notifications of TB by 0.14% over time. This result fails to support my theoretical prediction that an increase in user fees will result in an increase in the notifications of TB. The R-squared value for this regression model implies that the model is efficient in explaining 5.8% of the variation in TB notifications.

A Granger causality test is conducted to identify the temporal order between out-of-pocket payments and notifications of TB to address the causality problem between user fees and TB notifications. It is not necessarily a true causality but a close estimate in determining whether

---

[5] Probability > Chi-square = 0.00.
[6] Probability > Chi-square = 0.00.

one variable is useful in forecasting another. The results in Table 4 show that out-of-pocket payment precedes the new cases of TB. Hence, it is not the decline in new cases of tuberculosis that drives the increases in user fees for TB treatment. Instead, the implementation of user fees or an increase in user fees “granger causes” the decrease in TB notifications. A possible reason for this relationship is that the revenue generated by user fees is effective in improving the quantity and quality of treatment services (Audibert and Mathonnait, 2000).

Moreover from the main results, a 1% increase in the prevalence of HIV results in a 0.16% increase in TB notifications. This result is in line with my theoretical prediction that a co-epidemic disease like HIV will increase the notifications of TB. The carbon dioxide coefficient is also statistically significant and implies that an increase in the level of carbon dioxide activates dormant TB, and thus increases TB notifications. Although not statistically significant, the signs of the coefficients for life expectancy and GDP are the same as theoretical predictions. Both coefficients are negative and imply that an increase in either life expectancy, a measure of quality of health services, or an increase in GDP, a measure of income per person, will result in a decrease in TB notifications. Lastly, the sign of the coefficient on working population is negative and different from theoretical predictions. However, it is neither economically nor statistically significant. Overall, this model is significant in explaining a within country variation of 6%.

Robustness tests

This section tests the robustness of the main results above to changes in my assumptions. In each robustness test, when new variables are added, I address estimation issues and the proper estimator remains the fixed effects regression.

Trend of Tuberculosis

New cases of tuberculosis have been falling for several years. The 2012 Global Report for TB cites that the rate fell by 2.2% between 2010 and 2011 while mortality rate has decreased by 41% since 1990. The already decreasing trend in TB could be a reason why TB notifications are decreasing despite the increase in user fees as observed in the main regression results. In order to address this possibility, I controlled for the trend in TB by including the variable year in my regression. The results shown in Table 5 reinforce previous findings that out-of-payments decrease TB notifications even after the decreasing trend of TB is eliminated. The magnitude of the impact of user fees on TB notifications decreases by 0.004% after controlling for the trend in TB notifications. Here, the model explains 6.8% variation in TB notifications which is one percentage point higher than that explained in the main regression results.

Lagged effect of out-of-pocket payment

A current increase in user fees can have a delayed effect on the notifications of TB. This occurs because TB can remain dormant in the human body for years before it is activated to produce an obvious illness that compels people to get tested and before it can spread to others. Hence, it is necessary to investigate the lagged effect of payments on the notifications of TB. The regression results in Table 6 show a 6 year lag effect of fees. All the lagged coefficients for LnOut-of-pocket payment are statistically and economically significant. They are all negative coefficients and imply that there is a lagged effect of the increase in out-of-pocket payments on the notification of TB. The magnitude of the coefficient for out-of-pocket payments increased as the lagged year increased up until the fifth year lag after which it began to decline. The results suggest that an increase in out-of-pocket payments five years ago has the largest impact on the current notifications of TB. The Table 7 shows the lagged effect of user fees after the trend in

TB notifications is eliminated. The results are similar with those without TB trend eliminated (Table 6). Hence, there combined lagged effect suggests that an increase in user fees has a negative lagged effect on the level of TB. The amount of variation in TB notifications explained by the lagged effect model varied by each time lag but averaged out to be 5.3%.

Regressions by regions

Geographically, the TB burden is highest in Asia and Africa. The 2012 Global Report states that about 60% of TB cases are in South-East Asia and Western Pacific regions. The African region has 24% of the world's cases. Hence, user fees might have a different impact on TB notifications for certain regions of the world. Scholars in my literature review focus on specific hospitals in different countries. And so, examining all countries together could mask the difference in the effect of increasing user fees. Table 8 shows the regression results for six WHO regions. The coefficients for out-of-pocket payment are negative in all regions. Only the region of the Americas has a statistically significant coefficient for out-of-pocket payments. It is also the region with the largest impact, where a 1% increase in out-of-pocket payment causes a 0.187% decrease in TB notifications. A possible explanation for this is that out-of-pocket payments are used more effectively and efficiently in this region relative to the others.

The Table 9 shows the regression results after the TB trend is eliminated. Here, the coefficient for out-of-pocket payments in the Americas region is still negative and statistically significant but the coefficient in South East Asia is positive and statistically significant. It implies that when out-of-pocket payments increase in South East Asia, the notifications of TB also increase. A possible explanation for this result is that the revenue generated from user fees in South East Asia are not used to improve the quality of treatment services. The R-squared values increased in magnitude in comparison to the R-squared value for my main regression results. In South East Asia, when the trend in TB is eliminated, the regression model is efficient in explaining 82% of the variation in TB notifications. On average the model explains 33% of the variation in TB notifications within each region in comparison to the 5% variation in TB notifications explained when all regions are combined (Table 1).

Regression High Burden Countries

The WHO classifies 22 countries as high burden TB countries (HBC), most of which are in Africa and South-East Asia. These countries account for approximately 80% of new TB cases each year. According to the 2012 Global TB report, India and China account for about 40% of the world's TB cases. Therefore, it is important to discover if the regression results for HBCs differ from those when all countries are combined. In Table 10, regression (i) shows the regression results for HBCs using fixed effects. The coefficient for out-of-pocket payment is not statistically significant but its magnitude is greater than that in the main regression by 0.1%. This result suggests that an increase in out-of-pocket payment has a greater impact in reducing in the notifications of TB in high burdened TB countries. HIV prevalence is the only statistically significant coefficient. Just like the theory predicts, a 1% increase in HIV prevalence will increase the notifications of TB by 0.3%. The magnitude of the coefficient on HIV prevalence is also higher than that of the main regression by 0.2%. Regression (ii) eliminates TB trend and its coefficient of out-of-pocket payments is still negative but not statistically significant. In both regressions, the results suggest that relative to other countries, when HBC countries are examined separately, the impact of HIV prevalence on the notifications of TB is greater than in other countries on average. On average, both models are significant in explaining 46.8% of variation in the notifications of TB based on their R-squared value.

Other measures of TB's Burden

My regression results so far propose that an increase in out-of-pocket payment results in a decrease in the level of TB, measured as notifications of TB. The notifications of tuberculosis are a good proxy for the level of TB in a country. They are, however, inefficient in clearly differentiating the cause of the decline in TB notifications. It is unclear whether the decrease in the number of TB notifications is due to a decrease in TB infections or a decrease in the number of people getting tested. Therefore, I also use TB mortality rate as a measure of the level of TB because it is independent of whether or not people choose to get tested. In Table 10, regressions (i) shows that the coefficient for out-of-pocket payment is positive but neither statistically nor economically significant. Regression (ii) shows the regression result when the trend in TB is eliminated. The results are still positive but not statistically significant. Hence, no conclusions can be drawn from these regressions.

Another measure of the epidemiological burden of TB is its incidence, that is, the estimated number of new cases of TB. It is the same as TB notifications but different because it is an estimated value. In Table 7, regression (i) gives a negative but not statistically significant coefficient for out-of-pocket payments. Regression (ii) shows the results when the trend in TB is eliminated. Although out-of-pocket payment is negative, no concrete conclusion can be drawn because it is not statistically significant.

Income inequality

Tuberculosis is dominant among the poorer populations. Suk's (2009) study on European Union member provides evidence of a negative correlation between public wealth index and TB prevalence rates. Hence, this section controls for inequality in the distribution of income using the Gini coefficient. The results in table 13, regression (i) show a negative and statistically significant coefficient on out-of-pocket-payment. Also, the regression (ii) gives a negative coefficient that is statistically significant on out-of-pocket payments when controlling for TB trend. Both results provide evidence that an increase in user fees decreases the notifications of tuberculosis. This model explains 15% of the variation in TB notifications. The R-squared value for these regressions is ten percentage points greater than that in the main regression result.

V. CONCLUSION

The goal of this paper is to test the hypothesis that user fees increase the notifications of TB. The guiding equation for my analysis is derived from the demand and supply framework that is based on the utility maximization problem of the consumers and the government. The main regression used is the fixed-effects model in which HIV prevalence, working population, life expectancy, carbon dioxide emissions and income are controlled to observe the effect of out-of-pocket payment on the notifications of TB. My main regression shows that an increase in out-of-pocket payment reduces the notifications of TB. This result implies that user fees are effective in rationing the demand for TB services and improving the health status of populations. The Granger causality test provides evidence that the increase in user fees precedes the decrease in the level of TB. Therefore, user fees "granger-cause" the reduction in the burden of TB.

The robustness section evaluates the findings of my main regression result using five approaches. I examine the lagged effect of payments on the notifications of tuberculosis. The combined lag effect is negative and statistically significant. The result provides evidence that an increase in out-of-pocket payment today will decrease future notifications of TB. Also, I examined whether the effect differs with regards to region. All the statistically significant coefficients are negative for user fees and concur with the predictions from theory. Moreover, I substitute TB death rate and incidence rate for notifications of TB. These substitutions are to determine the cause of the decrease in notification rates observed in the main results. None of the coefficients for out-of-pocket payment are statistically significant. As a result I do not arrive at any concrete conclusion. Furthermore, I analyze the effect of user fees on the notifications of TB by reducing the sample size to only high burden TB countries. Although the main regression result is not statistically significant, it still has a negative coefficient on user fees. In my last robustness test, I controlled for inequality in the distribution of income and the results supported the findings in the main regression result.

As a part of my robustness test, I control for the trend in TB reduction over time in the main regression result and in all the robustness tests. The regression results without the elimination of TB trend are very similar to those in which TB trend is eliminated. Overall, the robustness tests suggest that user fees do in fact reduce the notifications of tuberculosis over time. Based on these analyses, I find no evidence that suggests user fees increase TB notifications. In contrast, I find strong and robust evidence suggesting user fees are associated with fewer new cases of tuberculosis.

Limitations and Future Studies

As a limitation, my theory assumes that the government is a monopoly, because it chooses the price of user fees paid. Realistically, it is a monopolistic competitive market. Although the theory was simplified to a monopoly, the data obtained on user fees is not specific to the public institutions. Hence, it reflects the monopolistic nature of the market. Furthermore, I utilized a weak measure for user fees—out-of-pocket payments that is not specific to TB services because of the lack of more specific data. Thus, this weak proxy may diminish the accuracy of my results. Another limitation of the study is the assumption that TB treatment services are normal goods with a downward sloping demand curve. While this can be true, it is also true that people are very insensitive to treatment prices. Individuals will go the extra mile to sell off assets and belongings in order to afford the treatments, so demand is very inelastic.

If given further opportunity for more research, I will use variables like population density to control for the overall quality of the environment since TB is an air-born disease. Moreover, future studies can create models specific to each of the WHO world regions that will effectively capture the results of implementing user fees. Such studies can also incorporate in their theory the strategy used by government in that region to select amount of user fee. These elaborations will inform and enhance the quality of my conclusions.

REFERENCES

Alleyne, Dillon. 2010. The impact of user fees on health costs and health burdens in Jamaica: The cases of diabetes and hypertension. *Social and Economic Studies, 59*(1-2), 91-121.

Ansah, Evelyn. 2009. Effect of removing direct payment for health care on utilization and health outcomes in Ghanaian children: A randomized controlled trial. *PLoS Medicine* 6.

Audibert, Martine and Mathonnat Jacky. 2000. Cost recovery in Mauritania: initial lessons. *Health Policy and Planning,* 15(1): 66-75.

Burnham, Gilbert, Pariyo George, Galiwango Edward, Wabwire-Mangen Fred. 2004. Discontinuation of cost sharing. *Bulletin of the World Health Organization,* 82(3):187-195.

Chawla, Mukesh, and Pellis Randal. 2000. The impact of financing and quality changes on health care demand in Niger. *Health Policy and Planning,* 15(1):76-84.

Gilson, Lucy. 1997. The lessons of user fee experience in Africa. *Health Policy and Planning*, 12(4):273-285.

Griffin, Charles. 1988. User charges for health care in principle and practice. *EDI Seminar Paper series,* no. 37 World Bank: Washington, DC.

Grimard, Franque, and Guy Harling .2004. The impact of tuberculosis on economic growth. *McGill University, Montreal* Working paper .

Gordon-Strachan, Georgiana, Wilma Bailey, Aldrie Henry-Lee, Jasper Barnett, Stanley Lalta, and Dillon Alleyne. 2010. The impact of user fees for preventive health care--jamaica. *Social and Economic Studies* 59, no. 1-2: 123-152.

Heller, Peter. 1982. A model of the demand for medical and health services in peninsular malaysia. *Social Science Medicine* 16, no. 3: 267.

Huber JH. 1993 Ensuring access to health care with the introduction of user fees: a Kenyan example. *Social Science and medicine*, 36(4):485-94.

James, Chris. D. 2006. To retain or remove user fees? Reflections on the current debate in low- and middle-income countries. *Applied Health Economics and Health Policy,* 5(3) 137.

Krutilová, Vertonika. 2010. Impact of user fees in health care system on health care consumption. *Review of Economic Perspectives*, 10(4): 113.

Moses, Stephen. 1992. Impact of user fees on attendance at a referral centre for sexually transmitted diseases in Kenya. *The Lancet*, 340(8817): 463.

Nyonator, Frank and Kutzin, Joseph. 1999. Health for some? The effects of user fees in the Volta region of Ghana. *Health Policy and Planning,* 14(4):329-341.

Soucat Agnes, Gandaho Timothee, Levy-Bruhl Daniel. 1997. Health seeking behavior and household health expenditure in Benin and Guinea: the equity implication of the Bamako Initiative. *Health Planning and Management*, 12(1):137 – 163.

Suk Jonathan, Manissero Davide (2009). Wealth Inequality and Tuberculosis Elimination in Europe. *Center for Disease and Control Emerging Infectious Diseases, 15(11):*1812 – 1814.

Wilkinson, David, Eleanor Gouws, Marlene Sach, and Salim S. Abdool Karim. 2001. Effect of removing user fees on attendance for curative and preventive primary health care. *Bulletin of the World Health Organization,* (79) 7: 665.

Witter, Sophie. 2010. Mapping use fees for health care in high-mortality countries: evidence from a recent survey. *Health and Life sciences.*

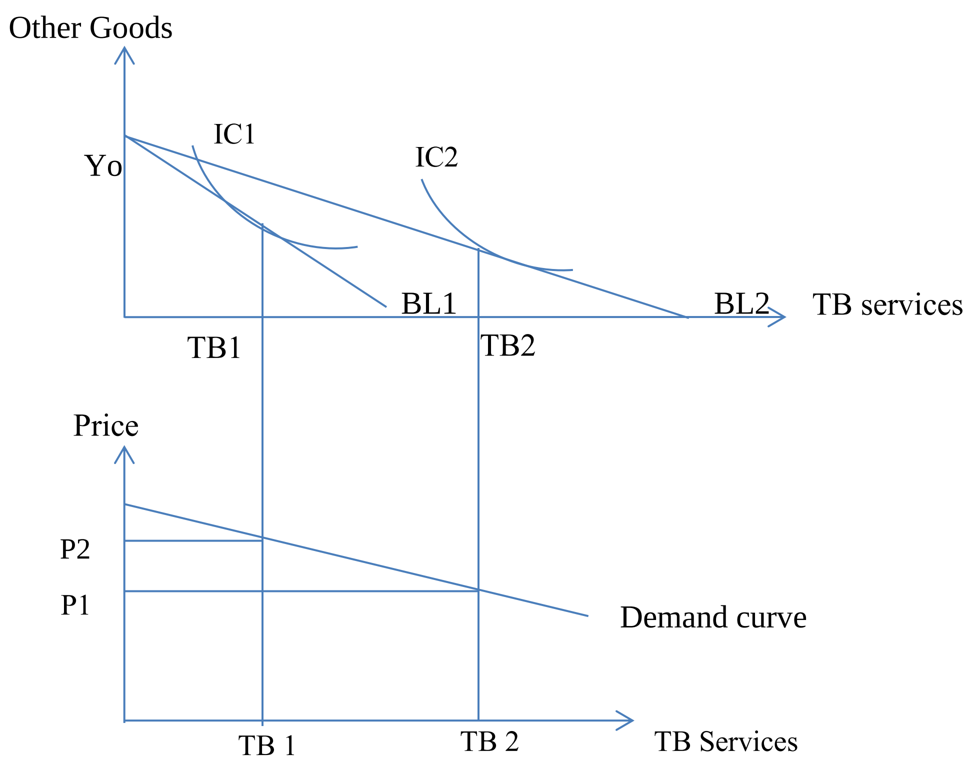
World Bank. 1987. Financing Health Services in Developing Countries: an agenda for reform.

World Health Organization's Tuberculosis Fact Sheet. 2012. *World Health Organization.*

World Health Organization Global Tuberculosis Report. 2012. *World Health Organization.*

FIGURES AND TABLES

Figure 1: Deriving the Demand Curve for TB services



Notes: TB, BL, IC represent tuberculosis, budget line, and indifference curve respectively.

Figure 2: Trade Off Faced by Government

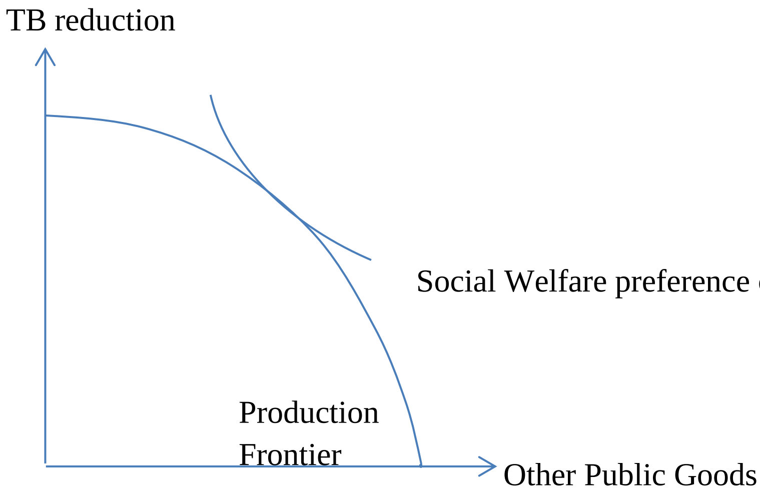
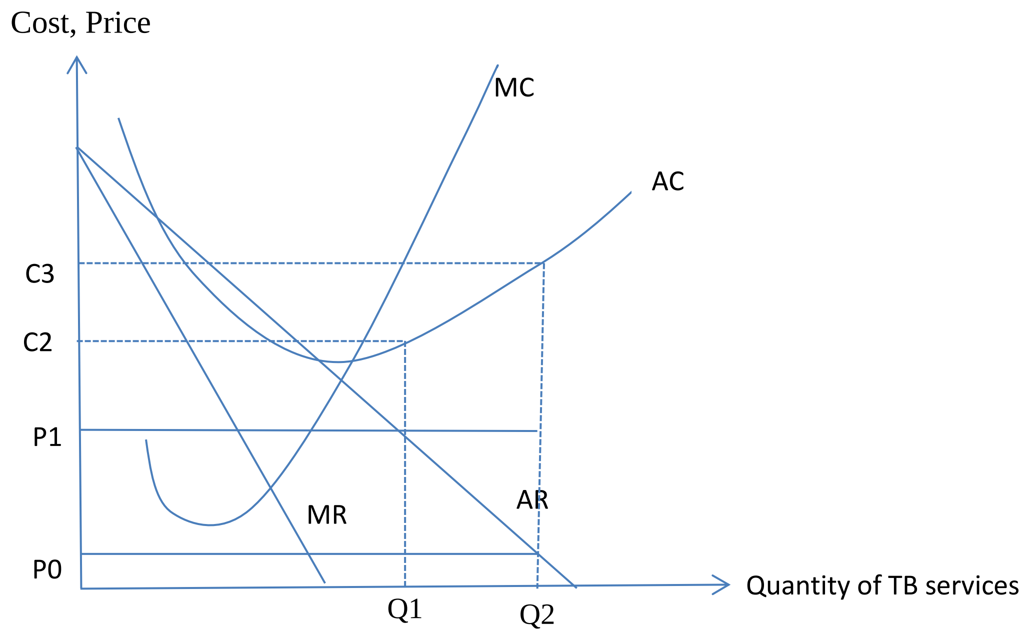


Figure 3: Monopoly Market for TB Services



Notes: MC AC, MR, and AR represent Marginal cost, Average Cost, Marginal revenue and Average revenue.

Figure 4: Graph of Residuals

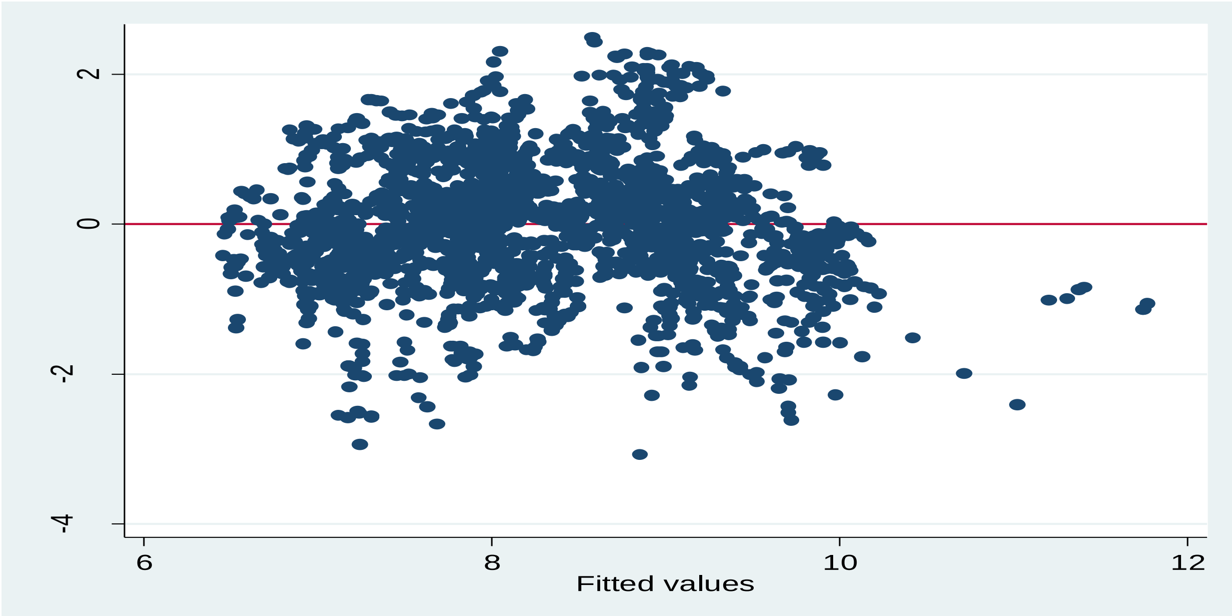


Table 1: Summary of Sources of Data Used

Variables	Units	Source	Primary Source
TB case detection rate	% of incident cases	World Data Bank-WDI & GDF	World Health Organization, Global Tuberculosis Control Report
Out of Pocket Health Expenditure	% of total health expenditure	World Data Bank-WDI & GDF	World Health Organization National Health Account database
HIV Prevalence	% of working population	World Data Bank- Health Nutrition and Population Statistics	UNAIDS and the WHO's Report on the Global AIDS Epidemic
Health Expenditure (total)	% of GDP	World Data Bank-WDI & GDF	World Health Organization National Health Account database
GDP per capita (constant 2000)	USD	World Data Bank-WDI & GDF	World Bank National Accounts data, and OECD National Accounts data files.
Working Population	%	World Data Bank-WDI & GDF	1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Reprot (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Programme, and (6) U.S. Census Bureau: International Database
CO2 Emissions	kt	World Data Bank-WDI & GDF	Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States
TB incidence	per 100, 000	World Data Bank-WDI & GDF	World Health Organization, Global Tuberculosis Control Report.
TB deathrate	per 100, 000	World Data Bank-WDI & GDF	World Health Organization, Global Tuberculosis Control Report.

Table 2: Summary Statistics

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
TB Notifications (per 100,000 people)	1909	74.24	102.53	0.00	854.76
Out-of-pocket payments per capita (1000)	1909	1005.82	1584.08	0.09	13397.20
HIV prevalence	1909	101.04	456.49	4.96	1582.04
GDP per capital (constant 2000)	1909	6406.43	10569.91	54.51	108111.00
Working population (%)	1909	58.38	6.69	44.79	85.52
Carbon Dioxide emission (mt)	1909	95.52	434.05	0.00	634.99
Life expectancy at birth (years)	1909	62.54	11.54	26.81	83.16
Country	142	-	-	-	-

Notes: Units are in brackets; Out-of-pocket payments and GDP are in US dollars (constant 2000).

Table 3: Main Regression Results for New Cases of TB

	Regression Result
Independent Variable	(i)
Ln Out-of-pocket-payment	-0.139*
	(0.0730)
Ln HIV prevalence	0.163**
	(0.0812)
Working population	-0.00967
	(0.0158)
Ln Life expectancy	-0.927
	(0.859)
Ln Carbon dioxide	0.145*
	(0.0759)
Ln GDP	-0.00799
	(0.166)
Constant	11.68***
	(3.217)
Observations	1,909
Number of countries	142
R-squared (within)	0.058

Note: (i) main results. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 4: Results from Granger causality

Test	F-Statistics	Probability
Fees precede	4.13	0.04
Enrollment precedes	1.34	0.2477

Note: Probability represents the probability > F-statistics.

Table 5: Regression Results After Eliminating the Trend in TB

	Regression Results	
Independent Variable	(i)	(ii)
Ln Out-of-pocket-payment	-0.139*	-0.135*
	(0.0730)	-0.0723
Ln HIV prevalence	0.163**	0.188**
	(0.0812)	-0.082
Working population	-0.00967	-0.00144
	(0.0158)	-0.0168
Ln Life expectancy	-0.927	-0.465
	(0.859)	-0.949
Ln Carbon dioxide	0.145*	0.155**
	(0.0759)	-0.0768
Ln GDP	-0.00799	0.0787
	(0.166)	-0.166
year	-	-0.0127
	-	-0.0086
Constant	11.68***	33.59**
	(3.217)	-14.63
Observations	1,909	1,909
Number of countries	142	142
R-squared	0.058	0.068

Notes: (i) Main results, (ii) main results without TB trend. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 6: Regression Results for a Lagged Effect of User Fees

	Regression Results						
Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Ln Out-of-pocket payment	-0.139*	-	-	-	-	-	-
	(0.0730)	-	-	-	-	-	-
Ln Out-of-pocket payment Lag 1	-	-0.138*	-	-	-	-	-
	-	(0.0702)	-	-	-	-	-
Ln Out-of-pocket payment Lag 2	-	-	-0.156**	-	-	-	-
	-	-	(0.0644)	-	-	-	-
Ln Out-of-pocket payment Lag 3	-	-	-	-0.166**	-	-	-
	-	-	-	(0.0743)	-	-	-
Ln Out-of-pocket payment Lag 4	-	-	-	-	-0.180**	-	-
	-	-	-	-	(0.0820)	-	-
Ln Out-of-pocket payment Lag 5	-	-	-	-	-	-0.165**	-
	-	-	-	-	-	(0.0795)	-
Ln Out-of-pocket payment Lag 6	-	-	-	-	-	-	-0.136*
	-	-	-	-	-	-	(0.0706)
Ln HIV prevalence	0.163**	0.142	0.111	0.0958	0.102	0.116	0.0925
	(0.0812)	(0.0963)	(0.0998)	(0.0959)	(0.103)	(0.105)	(0.0984)
Working population	-0.00967	-0.00774	-0.00893	-0.00695	-0.00301	-0.00382	5.85e-05
	(0.0158)	(0.0156)	(0.0155)	(0.0155)	(0.0161)	(0.0161)	(0.0160)
Ln Life expectancy	-0.927	-0.961	-0.980	-1.029	-0.897	-0.591	-0.572
	(0.859)	(0.802)	(0.833)	(0.868)	(0.913)	(0.907)	(0.870)
Ln Carbon dioxide	0.145*	0.176**	0.181**	0.200***	0.173**	0.184**	0.172**
	(0.0759)	(0.0694)	(0.0711)	(0.0719)	(0.0774)	(0.0757)	(0.0692)
Ln GDP	-0.00799	-0.0487	0.00221	0.00905	0.0194	-0.0108	-0.0362
	(0.166)	(0.156)	(0.155)	(0.151)	(0.140)	(0.131)	(0.121)
Constant	11.68***	11.92***	12.15***	12.28***	11.77***	10.32***	10.17***
	(3.217)	(3.010)	(3.100)	(3.216)	(3.287)	(3.239)	(3.128)
Observations	1,909	1,771	1,634	1,498	1,359	1,223	1,090
R-squared	0.058	0.052	0.046	0.045	0.043	0.044	0.036
Number of countries	142	142	142	142	142	142	142

Notes: (i) Current year (ii) lagged by 1 year (iii) Lagged by 2 years (iii) lagged by 3 years etcetera. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 7: Regression Results for a Lagged Effect of User Fees (TB Trend Eliminated)

	Regression Results						
Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Ln Out-of-pocket payment	-0.139*	-	-	-	-	-	-
	(0.0730)	-	-	-	-	-	-
Ln Out-of-pocket payment Lag 1	-	-0.129*	-	-	-	-	-
	-	(0.0690)	-	-	-	-	-
Ln Out-of-pocket payment Lag 2	-	-	-0.143**	-	-	-	-
	-	-	(0.0626)	-	-	-	-
Ln Out-of-pocket payment Lag 3	-	-	-	-0.155*	-	-	-
	-	-	-	(0.0782)	-	-	-
Ln Out-of-pocket payment Lag 4	-	-	-	-	-0.130*	-	-
	-	-	-	-	(0.0759)	-	-
Ln Out-of-pocket payment Lag 5	-	-	-	-	-	-0.0938	-
	-	-	-	-	-	(0.0675)	-
LnOut-of-pocket payment Lag 6	-	-	-	-	-	-	-0.0961*
	-	-	-	-	-	-	(0.0578)
Ln HIV prevalence	0.163**	0.166*	0.137	0.128	0.144	0.125	0.0917
	(0.0812)	(0.0970)	(0.0996)	(0.103)	(0.106)	(0.0997)	(0.0837)
Working population	-0.00967	0.000776	0.000705	0.00666	0.00687	0.0114	0.0167
	(0.0158)	(0.0164)	(0.0159)	(0.0163)	(0.0163)	(0.0159)	(0.0163)
Ln Life expectancy	-0.927	-0.390	-0.208	0.287	0.888	1.204	1.167
	(0.859)	(0.941)	(1.035)	(1.241)	(1.289)	(1.244)	(1.238)
Ln Carbon dioxide	0.145*	0.184***	0.190***	0.191**	0.198***	0.182***	0.161**
	(0.0759)	(0.0704)	(0.0715)	(0.0757)	(0.0735)	(0.0682)	(0.0636)
Ln GDP	-0.00799	0.0361	0.0949	0.117	0.0967	0.0890	0.141
	(0.166)	(0.155)	(0.154)	(0.142)	(0.131)	(0.118)	(0.118)
Year	-	-0.0135	-0.0158*	-0.0190*	-0.0221**	-0.0253**	-0.0270***
	-	(0.00876)	(0.00900)	(0.00985)	(0.0103)	(0.0102)	(0.0103)
Constant	11.68***	34.91**	38.73**	42.74***	46.00***	50.73***	54.31***
	(3.217)	(14.79)	(14.98)	(15.73)	(16.23)	(16.08)	(16.46)
Observations	1,909	1,771	1,634	1,359	1,223	1,090	957
R-squared	0.058	0.063	0.060	0.059	0.063	0.060	0.057
Number of countries	142	142	142	142	142	142	142

Notes: (i) Current year (ii) lagged by 1 year (iii) Lagged by 2 years (iii) lagged by 3 years etcetera. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 8: Regression Results by WHO Regions

	Regression Results					
Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Ln Out-of-pocket-payment	-0.00890	-0.187***	-0.139	-0.0172	-0.120	-0.0318
	(0.137)	(0.0591)	(0.185)	(0.333)	(0.345)	(0.132)
Ln HIV prevalence	0.294***	-0.0623	-0.0136	0.384***	0.626	-0.0743
	(0.107)	(0.118)	(0.0631)	(0.0498)	(0.349)	(0.0664)
Working population	0.0179	-0.0286	0.132***	-0.0693	-0.0946**	0.0356
	(0.0347)	(0.0325)	(0.0316)	(0.0455)	(0.0345)	(0.0356)
Ln Life expectancy	-0.419	-1.595	-8.287***	-5.238***	-15.82*	3.102
	(0.648)	(3.529)	(2.328)	(1.333)	(8.403)	(2.016)
Ln Carbon dioxide	-0.122	0.217	0.108	0.547	1.133*	0.328
	(0.121)	(0.170)	(0.160)	(0.290)	(0.573)	(0.193)
Ln GDP	0.524	-0.270	-0.119	0.382	0.948	-0.668
	(0.312)	(0.289)	(0.252)	(0.741)	(0.878)	(0.496)
Constant	4.290	19.65	36.49***	24.58***	57.95*	-3.895
	(2.694)	(12.89)	(9.005)	(4.931)	(25.65)	(8.570)
Observations	516	401	567	98	132	181
R-squared (within)	0.186	0.219	0.272	0.705	0.377	0.252
Number of countries	40	29	42	7	10	13

Notes: (i) Africa, (ii) Americas, (iii) Europe (iv) South East Asia, (v) Eastern Mediterranean, (vi) West Pacific.
Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 9: Regression Results by WHO Regions (TB Trend Eliminated)

	Regression Results					
Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Ln Out-of-pocket-payment	0.0182	-0.184***	-0.0992	0.371**	-0.0703	9.16e-05
	(0.144)	(0.0632)	(0.170)	(0.128)	(0.250)	(0.0880)
Ln HIV prevalence	0.107	-0.0666	0.0541	0.257***	0.617	-0.0111
	(0.108)	(0.118)	(0.0731)	(0.0486)	(0.340)	(0.0424)
Working population	-0.0394	-0.0358	0.112***	-0.0178	-0.101*	0.0134
	(0.0405)	(0.0352)	(0.0355)	(0.0403)	(0.0489)	(0.0210)
Ln Life expectancy	-1.317	-2.537	-2.286	-10.68***	-17.56	13.33***
	(0.843)	(4.475)	(3.303)	(1.386)	(12.58)	(3.037)
Ln Carbon dioxide	-0.169	0.213	0.0567	0.108	1.176*	0.345***
	(0.122)	(0.172)	(0.164)	(0.123)	(0.566)	(0.0906)
Ln GDP	0.400	-0.314	0.126	-0.993	0.747	-0.362
	(0.259)	(0.351)	(0.287)	(0.953)	(1.335)	(0.459)
Year	0.0395***	0.00725	-0.0399***	0.114***	0.0165	-0.0723***
	(0.0130)	(0.0207)	(0.0147)	(0.0284)	(0.106)	(0.0168)
Constant	-65.09***	10.01	89.06***	-174.1**	33.05	95.11***
	(22.91)	(30.44)	(21.26)	(49.60)	(166.2)	(23.65)
Observations	516	401	567	98	132	181
R-squared (within)	0.249	0.221	0.321	0.820	0.378	0.559
Number of countries	40	29	42	7	10	13

Notes: (i) Africa, (ii) Americas, (iii) Europe (iv) South East Asia, (v) Eastern Mediterranean, (vi) West Pacific. Standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 10: Regression Results for High burden Countries

	Regression Results	
Independent Variable	(i)	(ii)
Ln Out-of-pocket-payment	-0.25	-0.193
	(0.232)	(0.208)
Ln HIV prevalence	0.301***	0.241**
	(0.086)	(0.0918)
Working population	0.0397	0.0234
	(0.0412)	(0.043)
Ln Life expectancy	-0.207	-0.314
	(2.04)	(1.319)
Ln Carbon dioxide	0.0811	0.0166
	(0.298)	(0.313)
Ln GDP	0.409	-0.512
	(0.532)	(0.657)
Year	-	0.0547
	-	(0.0315)
Constant	3.505	-98.02
	(7.143)	(61.07)
Observations	216	216
Number of countries	16	16
R-squared (within)	0.442	0.495

Notes: (i) results, (ii) results without TB trend. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 11: Regression Results Using Tuberculosis Death rate

	Regression Results	
Independent Variables	(i)	(ii)
Ln Out-of-pocket-payment	0.019	0.0278
	(0.0499)	(0.0485)
Ln HIV prevalence	-0.0616**	-0.0303
	(0.0292)	(0.0334)
Working population	-0.0125	-0.0016
	(0.011)	(0.0104)
Ln Life expectancy	-2.431***	-1.822***
	(0.594)	(0.652)
Ln Carbon dioxide	0.0632	0.0698
	(0.0704)	(0.0676)
Ln GDP	-0.294**	-0.197
	(0.145)	(0.138)
Year	-	-0.0160**
	-	(0.0065)
Constant	14.79***	42.36***
	(2.096)	(11.36)
Observations	1955	1995
R-squared	0.243	0.243
Number of countries	142	142

Note: (i) results (ii) results without TB trend. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level

Table 12: Regression Results Using Tuberculosis Incidence

	Regression Results	
Independent Variables	(i)	(ii)
Ln Out-of-pocket-payment	-0.0422	-0.0376
	(0.0484)	(0.0479)
Ln HIV prevalence	0.0246	0.0411
	(0.0257)	(0.0277)
Working population	-0.00393	0.00178
	(0.0108)	(0.0112)
Ln Life expectancy	-2.138***	-1.818***
	(0.5730)	(0.6670)
Ln Carbon dioxide	0.0844	0.0879
	(0.0547)	(0.0543)
Ln GDP	-0.118	-0.0668
	(0.1110)	(0.1100)
Year	-	-0.0084
	-	(0.0062)
Constant	13.79***	28.27***
	(2.0660)	(10.7200)
Observations	1955	1995
R-squared	0.154	0.154
Number of countries	142	142

Note: (i) results (ii) results without TB trend. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table 13: Regression Results Controlling for Inequality

	Regression Results	
Independent Variable	(i)	(i)
Ln Out-of-pocket-payment	-0.165*	-0.179*
	(0.0924)	(0.0919)
Ln HIV prevalence	0.234**	0.245**
	(0.0943)	(0.0950)
Gini coefficient	-0.00734	-0.00595
	(0.00585)	(0.00611)
Working population	-0.0197	-0.00195
	(0.0251)	(0.0289)
Ln Life expectancy	-2.502*	-1.852
	(1.339)	(1.678)
Ln Carbon dioxide	0.125	0.154
	(0.151)	(0.151)
Ln GDP	0.0776	0.162
	(0.214)	(0.212)
Year	-	-0.0152
	-	(0.0126)
Constant	18.61***	44.24**
	(5.016)	(20.73)
Observations	515	515
Number of countries	127	127
R-squared (within)	0.157	0.157

Note: (i) results, (ii) results without TB trend eliminated. Robust standard errors in parentheses.
*** Significant at 1% level, **significant at 5% level, *significant at 10% level.