Quality of Medical Facilities, Health, and Labor Force Participation in Jamaica

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Abstract

Many studies report empirical relationships between adult health outcomes and market returns to work in developing countries. Our extension of these ideas involves explicitly considering how the availability, quality and utilization of health care affects health and labor market outcomes. We develop an econometric model for the demand for health care using a discrete-choice framework, then link it to
regression equations determining health status and labor force participation at
the individual level. Parameters are estimated using three sources of data from
Jamaica, including a unique survey of health care facility characteristics.

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1. Introduction

The potential market and productivity returns to improving adult health in developing countries is often noted as a major economic benefit of improving access to and quality of health care services. Several recent studies have demonstrated the link, mainly in the agricultural sector and in rural areas, between various measures of adult health and market productivity. Pitt and Rosenzweig (1986) have used a profit function approach to measure the effect of family morbidity on farm profits for a sample of farm households in Indonesia. They find no statistically significant effects of the number of sick days on farm profits but they find a strong effect on labor supply. According to Strauss (1986), nutrient intake (a determinant of nutritional and health status) appears to raise the current labor productivity of farm families in rural Sierra Leone. Deolalikar (1988) and Behrman and Deolalikar (1989) both have shown that health directly affects productivity and wage rates in low-income environments. Pitt, et al., (1990), using household data from Bangladesh, also have identified significant pecuniary returns to health as exhibited through linkages between health levels and productivity. All of the above studies rely on nutritional and anthropometric measures as indicators of adult health with the exception of Pitt and Rosenzweig, who also examined the
incidence of morbidity. More recently, Schultz and Tansel (1992) examine the relationship between the incidence and length of morbidity spells on work experience in Ghana and Cote d'Ivoire. They report significant negative effects of morbidity on labor force participation and wages for men in both countries, but not for women.

All of these studies focus on the relationship between adult health and market returns. None of them, however, attempts to link the availability, quality, and utilization of health care to health and market outcomes.¹

This paper attempts to bridge this gap by investigating relationships among labor force participation, health outcomes, and the availability of quality of health care in a developing country. We develop an econometric model to address the demand for health care, then link it to a regression model explaining health status outcomes and labor force participation decisions. The econometric model has two parts to it. First, we estimate a discrete choice model to determine how ill people choose among the various providers of health care. Using the parameter estimates from this model, we calculate the expected value of the best available

¹A number of recent studies model the demand for health care in developing countries using discrete choice models (Akin, et. al., (1985), Gertler and Van der Gaag (1990), and Lavy and Quigley (1992) are just few examples). But in very few, the impact of quality of care on utilization is estimated explicitly. Most importantly however, the related labor supply outcome, work days lost due to illness, is treated most often as an exogenous variable (measuring severity of illness) and not simultaneously determined as our model allows.
medical facility which we then use as a measure of the quality of health care available to each individual. In the second stage, health is allowed to affect labor force participation in a simultaneous equations probit model where the potential endogeneity of reported health is controlled for using a set of instruments that includes the constructed health care quality measure. We use data from the 1989 Jamaican Survey of Living Conditions, the Jamaican 1989 Labour Force Survey, and a sample of Jamaican health care facilities.

2. Jamaican Health Care and Labor Force Data

World Bank (1988) suggests that most Jamaicans enjoy better health than their counterparts in countries of similar income levels. Life expectancy at birth is 74 years, and the crude death rate is 5.5 per thousand. The disease pattern underlying mortality and morbidity in Jamaica resembles that of developed countries, being heavily biased toward chronic diseases. The leading causes of death for adults are cerebrovascular, heart, hypertensive diseases, and malignant neoplasms. The recent pattern of health problems suggests that Jamaica is moving out of an epidemiological environment dominated by infectious disease and malnutrition into one where the disease profile is dominated by the health conditions of adults and elderly. This epidemiological transition may have a direct effect on
adult well being, but it may also lead to economic change through the impact of adult health on labor force participation and productivity. The analysis in this paper is designed to shed light on some of these economic effects. It specifically delves into the interrelationship between health care quality and adult health and their impact on labor force participation.

Jamaica’s health care services are provided free or at nominal charge to all citizens. The government owns and manages 95 percent of the hospital beds in the country. Public health services are delivered through 24 hospitals and 372 primary health care clinics (Lewis and Parker, 1993). Each of the 14 parishes (major geographic subdivisions) has at least one public hospital and over 20 health centers. Private health care is largely ambulatory. More than two thirds of the island’s physicians are exclusively in private practice, while many of the doctors in the public sector have private afternoon practices. This system leads to wide and equitable access: over 90 percent of Jamaicans reside within ten miles of a health center, and 95 percent of all communities are within the same distance (World Bank, 1988).

Our empirical work uses three sources of data to investigate the relationships among labor force participation, health outcomes, and the availability of quality health care. Labor force participation data are gathered in the Jamaican Labor
Force Survey (LFS). The Survey of Living Conditions (SLC) reinterviews a subset of the same households and records health and demographic information. In this study, we merge data from the October 1989, LFS and the November 1989, SLC. Our third source of data is the Health Facility Survey, which is designed (by the Statistical Institute of Jamaica and the Ministry of Health) specifically as part of the Expanded Health Module of the November 1989, SLC. The facility survey, a one-time survey completed in August 1990, is a census of all public health care facilities and a sample of private facilities. This section of the paper introduces the samples and variables used in our empirical analysis.

The Jamaican Survey of Living Conditions (SLC) is a detailed questionnaire designed to record many aspects of households' economic conditions and decisions. The survey provides information regarding recent health experiences, many categories of consumption expenditures, housing characteristics, the availability of public services and demographic characteristics. In this paper, we use the demographic and health information and merge it with the same individuals' labor force participation data from the Labour Force Survey.

Table 1 defines the SLC variables we use and presents summary statistics for them. The first column of numbers are computed based on a sample of 9,840 individuals who report all of the necessary data for the labor force participation
and health outcomes portion of our empirical work. Of the 15,353 individuals included in the LFS data file, we exclude approximately 5,000 children (aged 14 or below). About 500 adults are deleted from the sample because of missing health data, which leaves 9,840 usable observations. Except for being older (the average age in the original SLC sample is 26.32 years), our sample is very similar in other respects to the original sample.

As described in detail in Section 4.1, we require a subsample of the Jamaican SLC to estimate a model to predict how persons with an illness or injury select a type of health care facility to visit. By survey design, only individuals in the SLC sample who report an illness or an injury during the previous four weeks are asked about health facility usage. Therefore, estimation of the health facility choice model is carried out using the ill or injured subsample. In the SLC, 1,355 adults report a recent illness or injury and the type of health care facility visited (including "did not visit" a facility). Some observations, however, fail to provide other relevant information, so 1,309 individuals remain in the database used to estimate modal choices for health care facility visits.\(^2\) In principle, the survey identifies the specific health facility (if any) visited by each individual. Un-

\(^2\)Thirty-six people fail to report their labor market activities and eight fail to report health status. Also, we delete two outlying individuals who report income exceeding a million dollars.
fortunately, only 258 of the 647 people who report visiting a health care facility actually have the facility's name available in the SCF database. This may be due to survey design (visits to private facilities not included in the health facility sample, see below, would not be coded) or because some facility names truly may be "missing." Either way, the sample for whom we actually know the name of the facility visited is too small and potentially suffers from important selection problems. Thus, we effectively can identify only the type and the parish of health care facilities visited by our sample of 1,309 people. It is not surprising for members of the ill subsample to be older and to report worse health than persons in the primary sample.

The third source of data used in the empirical analysis consists of a survey of health care facilities in Jamaica. The facility survey records physical characteristics of the structures, personnel characteristics, a list of services offered by each facility, and an inventory of equipment and pharmaceuticals. Each facility is categorized into one of four types: private primary, public primary, private secondary, and public secondary. Primary facilities are doctors' offices, and secondary facilities are hospitals and large clinics. All secondary facilities, private and public, and all public primary care facilities are surveyed, but the sample includes only a random sample of privately owned primary care health facilities. The facility
sample includes nearly twice as many public clinics and doctors' offices (330) as private ones (156) and three times as many public as private hospitals (23 versus 7). There are 14 parishes in Jamaica, so each parish contains an average of 11.1 private primary, 23.6 public primary, 0.5 private secondary, and 1.6 public secondary health care facilities in the sample.

Looking back at the second column of numbers in Table 1, one can examine the distribution of health care facility visits among who persons that report a recent injury or illness. Private primary facilities are the most popular source of health care in Jamaica, as nearly one-third of the SLC sample report such a visit. On the other hand, very few persons visit private hospitals (secondary types of health care facilities), and public primary facilities are visited slightly more frequently than private secondary facilities. However, more than half of the injured or ill persons in Jamaica do not visit a health practitioner in any care setting.

Some characteristics of health facilities are presented in Table 2. The data reveal some interesting quality differences between public and private health care providers and between primary and secondary facilities. First, public primary and secondary health care facilities have more frequent incidences of leaky roofs, doors with holes, electrical problems, problems with plumbing, and security problems than their privately owned counterparts. Eighty-three percent of public hospitals,
for instance, report security problems compared to none of the eight private hospitals. More than one quarter of public primary facilities report security problems compared to one tenth of the private doctors' offices. On the other hand, there is some evidence that public health care facilities offer more services than private facilities (for example, they more frequently offer immunizations, they have more ambulances, and they maintain a wider selection of pharmaceuticals). Additionally, public hospitals employ a larger number of physicians and registered nurses than private hospitals do. Hospitals, naturally, offer more services than primary facilities, and, while every hospital in Jamaica has electricity (private and public), only 84 percent of private doctors' offices and 74 percent of public ones can make the same claim. Finally, the ages of health care facilities in Jamaica differ substantially by type and by ownership (private versus public). On average, private primary care facilities have been operating for half as long as public ones (10.10 versus 20.56 years). Private hospitals are about seven years newer than public ones on average (23.00 versus 28.70 years).

3. Econometric Model

The econometric model has two parts to it. First, we estimate the determinants of how people choose among health facilities. The parameter estimates from this
procedure allow us to construct a measure of the quality of health care available to each person in our sample. We then use this measure, along with other variables, to estimate the determinants of health and work.

3.1. The Medical Facility Choice

Let $y_{ijk}^*$ be the latent value to person $i$ of choosing the $k$th medical facility of type $j$. We model $y_{ijk}^*$ as

$$y_{ijk}^* = X_i \bar{x}_j + Z_{ijk} \bar{z}^* + e_{ijk} \quad k = 1; 2; \ldots; K_j 
\quad j = 1; 2; \ldots; J_i$$

(4.1)

where $X_i$ are personal characteristics, $Z_{ijk}$ are characteristics of the $k$th type $j$ medical facility in the individual's parish, and $e_{ijk} \sim iid \text{GEV (Generalized Extreme Value)}$. Unobserved variables, such as cost, are captured partially in facility type specific constants (the part common across facilities of that type) and partially in $e_{ijk}$. If we observed the particular medical facility visited, then

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3We assume people only use health facilities in their parish. Primary (private and public) and public secondary health care facilities are located throughout Jamaica. But only three parishes contain private secondary facilities. Thus $K_j = 0$ for private secondary facilities for individuals living in any of the eleven parishes without them.

4We need to assume that inclusion in the sample does not affect the distribution of $e_{ijk}$ (i.e., that there is no sample selection). While this assumption may be unrealistic, there is no reasonable alternative, and it is consistent with other work in the field. See, for example, Alderman and Gertler (1989), Gertler, Locay, and Sanderson (1987), or Mwabu, Ainsworth, and Nyamete (1993).
we could estimate $\bar{y}_j$ and $\bar{o}$ using maximum likelihood or nested logit. However, we observe only the type of medical facility visited. As shown by Dubin and McFadden (1984), the expected value of visiting the best facility of type $j$ is

$$y_{ij}^* = E \max_k y_{ijk}^*$$

$$= X_i \bar{y}_j + @_{ij} + u_{ij}$$

where

$$I_{ij} = \ln \prod_k X_k \exp fZ_{ijk}^* g$$

and $u_{ij} \sim iid EV$ (Extreme Value). The probability of choice $j$ being chosen for a visit is

$$P_{ij} = \exp fV_{ij} g = \prod_k \exp fV_{ik} g$$

where

$$V_{ik} = X_i \bar{y}_k + @_{ik}$$

The log likelihood function is

$$L = \prod_i \prod_j y_{ij} \ln P_{ij}$$
\[ = \sum_{i=1}^{X} \sum_{j=4}^{y_{ij}} V_{ij} \ln j \exp f V_{ij} g^5 \]

where \( y_{ij} \) is the observed indicator of choice, \( y_{ij} = 1(y_{ij}^x > y_{ik}^x \forall k \neq j) \). The score statistics are

\[ \frac{\partial L}{\partial \bar{y}} = \sum_{i=1}^{X} (y_{ij} - P_{ij})X_i; \quad (4.7) \]

and

\[ \frac{\partial L}{\partial \bar{y}} = \sum_{i=1}^{X} \sum_{j=1}^{X} (y_{ij} - P_{ij}) \prod_{k=1}^{X} P_{ijk} Z_{ijk}; \quad (4.8) \]

where

\[ P_{ijk} = \exp f Z_{ijk} g^5 = \sum_{m=1}^{X} \exp f Z_{ijm} g; \quad (4.9) \]

and

\[ \frac{\partial L}{\partial \bar{y}} = \sum_{i=1}^{X} \sum_{j=1}^{X} (y_{ij} - P_{ij}) l_{ij}; \quad (4.10) \]

Estimation is by maximum likelihood estimation or method of moments.\(^5\)

Once \( \bar{y}, \bar{y}, \) and \( \bar{y} \) are estimated, we can construct an estimate of the quality measure of medical care available to each person. Assume an individual chooses the best care available. Then a good measure of quality of care is the expected

\(^5\text{Proper choice of instruments for method of moments causes method of moments and maximum likelihood to be equivalent.}\)
value of the best care available. Since $y_{ij}^{\alpha}$ is the $E \max_k y_{ij,k}^{\alpha}$, a good choice for the quality of medical care is

$$I_i = E \max_j y_{ij}^{\alpha} \tag{4.11}$$

$$= \ln \sum_j \exp V_{ij} g.$$

This measure has the following attractive properties: a) it increases in each $V_{ij}$, b) improvements in bad choices (i.e., where $V_{ij}$ is much smaller than the maximum $V_{ij}$) have very little effect on $I_i$, but c) improvements in good choices have large effects on $I_i$. This measure was used with mixed results by Stern (1993). Alternative simpler measures have some unattractive properties. For example, consider using an "average" facility quality index or any linear function of independent facility quality measures. This alternative has the unfortunate feature of decreasing when a very inferior (and therefore irrelevant) facility is added to the parish. In general, it does not give proper weight to the highest quality facilities. Another alternative is to use an estimate of the quality measure of the best facility. This, though, does not allow for any unobserved variation among individuals in perceived or actual quality across facilities. For example, it assumes that distance from the facility is irrelevant for individual choices. The most significant problem
with using $I_i$ to measure quality is that $V_{ij}$ cannot be measured when there are any $X_i$'s. This is because we can estimate each $\bar{j}$ only relative to a base choice. Thus, what we are actually measuring in equation (4.11) is

$$I_i = \ln X_j \exp V_{ij} X_i \bar{b} \tag{4.12}$$

where $b$ indexes the base choice. In Stern (1993), it was not clear how to choose a base choice. Here, the base choice is not to visit any type of health care facility.

The other problem with using $I_i$ as a measure of the quality of medical care is that one of the $X$'s used in equation (4.11) may be the health or labor force participation of the individual. This causes a problem when using $I_i$ as an explanatory variable in predicting health because $I_i$ then becomes endogenous. We solve this problem by excluding those variables in $X_i$ that are endogenous when constructing $I_i$ in Section 5.2. This is equivalent to measuring expected or average quality for people in poor health because "poor health" was the excluded health category in the facility choice equations.
3.2. Health and Labor Force Participation

This section essentially presents the model described in Stern (1989). Let \( p_i \) be the latent value of working (participating) to person \( i \) and \( h_i \) be the latent measure of health for person \( i \). We model \( p_i \) and \( h_i \) as

\[
p_i = X_{pi} \mu_p + \phi_p h_i + \sigma_p^2
\]  

(4.13)

and

\[
h_i = X_{hi} \mu_h + \phi_h p_i + \sigma_h^2
\]  

(4.14)

A discrete indicator of \( p_i \) is observed, \( p_i = 1(p_i > 0) \). However, we observe a potentially biased indicator of health. Let \( h_{i}^{\text{sr}} \) be a latent measure of self-reported health,

\[
h_{i}^{\text{sr}} = h_i + \phi_p p_i + \sigma_r^2
\]  

(4.15)

and let \( h_i = j \cdot \sum c_j \cdot h_{i}^{\text{sr}} < c_{j+1}, j = 0, 1, \ldots; M, c_0 = 1, c_1 = 0, c_{M+1} = 1 \), and \( c_2 \) through \( c_M \) are parameters to estimate. The value of participating may affect reported health either because it affects true health (as in equation 4.14) or because people use health as an excuse not to work (as in equation 4.15). We cannot identify separately \( \phi_p \) and \( \phi_h \).
The method of estimation is a generalization of Amemiya (1978) and Heckman (1978), described in detail by Stern (1989). The estimation procedure does not require independence of the errors, $\gamma_p$, $\gamma_h$, and $\gamma_r$. First we estimate reduced form equations for $p^{\alpha}_i$ and $h^{\alpha}_i$. We use other reported measures of physical well-being (reported activities of daily living (ADL's)) that are less subject to reporting bias. Then we construct predicted values of $p^{\alpha}_i$ and $h^{\alpha}_i$ using the reduced form parameter estimates and substitute the predicted values into equations (4.13) and (4.14). We can then estimate $\delta_p$ and $\mu_p$ using probit and $\delta_h$ and $\mu_h$ using ordered probit. Standard error construction requires a well-known correction described in Amemiya (1978), Heckman (1978), and Stern (1989).

4. Estimation Results

4.1. Medical Facility Visit Results

There are many choices of personal characteristics and facility characteristics to include in the specification of equations (4.2) and (4.3). Those characteristics that are discussed later in the paper are described in Tables 1 and 2. Based on

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6One might argue that these instruments are not valid in that they are functions of some of the same unobservables that affect health. Excluding these instruments causes the coefficients in the employment equation to be identified only by the exclusion of the health facility quality variable.
preliminary probit and logit regressions, we determined that it was difficult to choose among the facility characteristics. Thus we proceed in two different ways. First, we consider the first five principal components of the facility data. Only the second and third principal components have significant coefficients. Second, we use four aggregated facility characteristics listed at the bottom of Table 2. Only the staff size of each facility is significant and has the expected sign.

Attempts to estimate $\beta$, the $\alpha$'s, and the $\delta$'s simultaneously failed to converge because of the nonlinearity (multiplication) of $\beta$ and $I_{ik}$ in (4.3). Therefore, we modified our procedure to estimate only the $\delta$'s and the $\alpha$'s simultaneously over a grid of values for $\beta$. To choose the best estimate of $\beta$, we evaluated several statistics: the sample log-likelihood values, two sums of squared residuals (one variance-weighted), and two hypothetical Newton-Raphson step sizes (assuming either that $\beta$ was estimated alone or that it was estimated along with all of the other parameters). The final specification and coefficient estimates based on principal components are presented in Table 3. Our selection of $\beta = 0.20$ as the estimate arises because that value yields a large log-likelihood value and small

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7 The facility characteristics were highly multicollinear, and estimates were very sensitive to the specification used.

8 The quality estimates do not change if we include all of the first five principle components.

9 This was based on much experimentation with different specifications of equations (4.2) and (4.3). Including the other three aggregate facility characteristics does not affect computed facility quality significantly.
sums of squared residuals and because hypothetical step sizes for $\beta > 2$ are generally negative while hypothetical step sizes for $\beta < 2$ are generally positive.

The results indicate that a) older people are more likely to use private hospitals; b) women are more likely to use primary facilities and less likely to use secondary facilities relative to men, and c) the better one's health, the less likely one is to use any facility conditional on illness or injury. Further analysis is delayed until Section 5.3. The final specification and coefficient estimates based on state size are presented in Table 4. Results from the two specifications for quality are almost exactly the same.

The estimates in Tables 3 and 4 can be used to construct $I_i$ based on equation (4.11) for each person, which then is used to explain reported health outcomes in the next section. The endogenous health variables in Tables 3 and 4 are excluded from the construction of $I_i$, as was suggested at the end of Section 4.1.

4.2. Health and Labor Force Participation Results

Table 5 presents estimates of the structural coefficients for three different health equation specifications when the principal components of facility characteristics are used to measure health facility quality. The first column presents estimates using the discrete indicator of employment as a regressor without controlling for
endogeneity. Coefficients should be interpreted using equation (4.14), noting that increases in $h_i^*$ imply declining health. As expected, women and older people report being in worse health. Employment has a significant effect on health. This is true even after controlling for endogeneity in the last two columns. This result has two possible interpretations. Either nonemployed Jamaicans use poor health as an "excuse" for not working (see Parsons (1980) or Bazzoli (1985)) or working actually improves their health. Also, the first column implies that improving the quality of medical facilities (MFCVAL) diminishes health.

The second column of Table 5 uses the predicted value of $p_i^*$ (the value of working) based on reduced form coefficients instead of the discrete indicator of employment $p_i$ to control for the potential endogeneity of $p_i$. When the potential endogeneity of labor force participation is controlled for in this way, improving the quality of medical facilities actually leads to improvements in health. The fit for this equation is better as well (as represented by the improvement in the log likelihood). Some of the other coefficient estimates also change, including FEMALE, HHOUS, AGE, and AGE*AGE.

The last column of Table 5 uses the reduced form predictor of $p_i$, $\phi(p_i^*)$ (where $\phi$ is the standard normal distribution function), to control for potential endogeneity of $p_i$ in a different way. This specification looks similar to the specification
using $p^\pi$ except that a) MFCVAL becomes insignificant (but remains negative) and b) the coefficient on the participation variable doubles, and c) the specification does not fit as well as column 2. The coefficient on EMPHATC is larger than on EMPHAT from the previous equation because there is significantly less variation in EMPHATC than in EMPHAT. For the remainder of the paper, we will use the specification in the second column, which provides best fit to the individual-level health data.

Table 6 presents health equation results when MFCVAL depends upon facility sta® sizes. Results are almost exactly the same. However the estimates on MFCVAL become smaller and less significant. Still the preferred specification, the second column of Table 6, has a negative, significant coefficient estimate.

Table 7 presents estimates of the structural coefficients for three different specifications of the employment equation when principal components of health care facility characteristics are used. The first column shows estimates using the discrete indicators of health as regressors without controlling for endogeneity of health. Coefficients should be interpreted using equation (4.13). Being female, married, or in bad health reduces the value of working. Aging increases the value of working up until age 41 and decreases it thereafter.

The next two columns control for the possible endogeneity of health status.
The second column uses the reduced form predicted value of \( h_i^* \) as a regressor, and the third column uses the reduced form predicted values of dummies for the different values of \( h_i \). The results in the third equation are not reliable given the nonmonotone coefficient estimates on the health variables. But the first two equations are very similar implying that endogeneity of the health variables is not a qualitatively significant problem. Estimates based on facility size are almost identical and, thus, are not presented.

The health and employment equations are identified by assuming that MFC-VAL does not directly affect employment and ANNEARN and EMPRAT do not directly affect health. All three variables are generally significant in their respective equations, and the exclusion restrictions seem reasonable. Thus, the identification conditions are satisfied.

5. Conclusions

This paper has demonstrated how a measure of quality of health facilities can be constructed from available data so that it has reasonable properties. In particular, it is increasing in the quality of each relevant health facility, increasing with respect to the addition of new facilities, and weighted toward the best available facilities. Furthermore, it has an appealing, intuitive interpretation: The maxi-
mum expected value of the best visit perceived. We show how to construct this measure and how to estimate the requisite parameters using multinomial logit. Then we use the quality index to help explain variation in health and labor force participation among adult Jamaicans. The results of this paper show that improving the quality of health facilities has a significant but small effect on health and an indirect effect (through health) on labor force participation.

It is essentially impossible to say how to most effectively improve health facilities in Jamaica unless a) data is gathered that can match individuals in the SLC with particular health facilities in the health facility census, b) data is gathered on distances between individuals and all available health facilities, and c) data is gathered on prices of health facility inputs. Another limitation of the SLC data is that the nature of a person's particular illness or injury is unavailable for analysis. Certainly, this information would significantly help to explain a person's choice of facility, especially the type of facility chosen. The collection of such data would increase the value of the current Jamaican data by an order of magnitude both to researchers and to Jamaican policymakers.

\[10\text{ These problems exist for all data sets used in published work from developing countries.}\]
References


