Meeting Sustainable Development Goal 3 in Brazil: an assessment of ability and willingness

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INTRODUCTION

Ensuring healthy lives and promoting wellbeing for all at all ages is the third goal of the Sustainable Development Goals (SDGs). This goal includes targets to further reduce maternal, infant and child mortality, as well as to “end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases”. Health systems are essential for social protection and, as well as contributing to the SDGs for health overall, they also play a key role in promoting equity in access to healthcare, a core principle of Universal Health Coverage (UHC). As part of efforts to achieve UHC, investment in essential primary healthcare delivered through health systems may be particularly important in reducing health inequalities and meeting the goals set out in SDG 3. Whether resources are allocated specifically to realise these goals, however, remains an open question.

The performance of health systems has been a major concern of policy makers for many years. Indeed, many countries have introduced health sector reforms with the explicit aim of improving performance. In Brazil, for instance, PHC has been expanded through the Estratégia de Saúde da Família, (ESF) (family health strategy) to become the largest community-based PHC programme in the world. Municipal governments are responsible for the provision of local ESF services, and financial incentives provided by the federal government encourage municipalities to adopt the ESF, the ultimate goal being to maximise population health.

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1 United Nations Sustainable Development Goal 3
Brazil provides an interesting and important setting for evaluating health outcomes alongside the health systems through which they are realised. Brazil is a middle-income country, which spends 8.3% of its GDP on health\(^5\) – not an insignificant sum. At the same time, it has one of the highest levels of income inequality in the world\(^6\) and, whilst over the past few decades the country has seen rapid improvements in population health overall, there are still stark inequalities in health across income, education, racial and socio-economic groups.\(^7\) In the context of meeting SDG 3, health systems in Brazil could be doing better – but how much better?

Attempts to evaluate the impact of health sector reforms, and to monitor health sector performance over space and time, have been hindered by the lack of agreed-upon methods for quantifying the extent to which scarce health resources are used to meet the goals of the health system. This paper suggests a way of doing this. In particular, the focus of the paper is on describing how health system performance can be measured in terms of meeting one important goal: meeting the targets contained in SDG 3. The paper will then test the hypothesis that underperformance in meeting this goal in the Brazilian context is driven by an unwillingness to distribute resources in such a way to meet SDG 3 and that this unwillingness is largely driven by inequalities in income between socio-economic groups.

**CONCEPTUAL FRAMEWORK**

The framework that follows borrows from empirical microeconomics; specifically, the tools used to estimate production function frontiers. According to William Greene, “the frontier production function is an extension of the familiar regression model based on the microeconomic premise that a production function … represents an ideal, the maximum output attainable given a set of inputs”.\(^8\) With the setting of this ideal comes the theoretical proviso that all observations fall below it. As such, estimation of the production frontier is generally used as a means to another analytical end: the analysis of technical efficiency. Analysis of technical efficiency in the microeconomic sense refers to the degree to which producers are successful in allocating the inputs they have at their disposal to produce certain outputs in an effort to meet

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\(^5\) Data refers to 2014. WHO GLOBAL HEALTH EXPENDITURE DATABASE. http://apps.who.int/nha/database/ViewData/Indicators/en

\(^6\) GINI INDEX WORLD DEVELOPMENT INDICATORS http://data.worldbank.org/indicator/SI.POV.GINI

\(^7\) Davide Rasella, Diane Borges Machado, Marcelo Castellanos, et al. *Assessing the relevance of indicators in tracking social determinants and progress toward equitable population health in Brazil*. 9 Glob Health Action (2016)

some specified objective. This objective could be to minimise the number of inputs to produce a given output, (input-approach) or to maximise output with a given number of inputs (output-approach). By means of estimating the production function a measure of efficiency naturally emerges since what it corresponds to is the distance between the actual observation and the estimate of the expected ideal.

In the case of measuring the extent to which health systems in Brazil are using available resources to meet SDG 3, the same notion of efficiency can be applied. Given that municipal-level data has been widely applied to evaluate health policy, systems and outcomes in Brazil previously, here, each municipality can be treated as a decision-making unit that ‘produces’ health under the behavioural assumption that it operates to maximise health (output) given its ability to do so (inputs). Maximum expected health at different levels of resource availability can then be predicted and it is these expected values that set the frontier. A signal of efficiency, or performance, can then be measured as the difference between the observed and expected level of health.

Figure 1: Health production frontier

The standards against which municipalities can be measured are provided by the frontier in Figure 1. For example, it is expected that for a municipality with available resources of $x_A$, the level of health should be at level $y_A$. Therefore, actual health at any point below the frontier, such as $y_B$, might tell us something about the extent to which a municipality is unwilling to use its
available resources to provide basic health goods, services and facilities to meet SDG 3: that is, the distance between the observed level of health and the level set by the frontier, \( y_A / (y_B + y_A) \).

Whilst the revealed estimates of underperformance might be interesting in and of themselves, they do not satisfy the main aims of this paper. Instead, the ambition of the paper is to evaluate the factors driving this underperformance and in particular the extent to which inequality is playing a part.

**EMPIRICAL STRATEGY**

Essentially, there are two main methodologies for measuring efficiency: the mathematical (non-parametric) approach, and the econometric (parametric) approach. The two techniques have both virtues and limitations in their respective bids to envelop data and there is no prescriptive rulebook for which method is best.\(^9\) The preferred methodology here is a panel data stochastic frontier model that allows for cross-municipality heterogeneity in several ways. The essential form of the stochastic production frontier model is:\(^10\)

\[
\begin{align*}
\text{Health}_i & = f(\text{Expenditure}_i, \text{Education}_i) + v_i - u_i \\
& = f(X_i) + v_i - u_i
\end{align*}
\]  

(1)

where \( i = 1, \ldots N \) and \( t = 1, \ldots T \). \( N \) is the municipality and \( T \) is the year. The dependent (outcome) variable HEALTH is yet to be defined. There is still some conceptual work to be done on defining what SDG 3 is, as well as how it can be captured with respect to what kind of health is being ‘produced’ in the model. Possible indicators could include life expectancy at birth, healthy life expectancy or mortality from specific diseases, such as communicable, maternal, neonatal, and nutritional disorders or those from ambulatory care sensitive conditions (ACSCs). \( X_i \) is the set of inputs, which are defined here as available financial and human resources. Municipal-level data on total health expenditure per capita (public and private) and either the literacy rate or mean years of schooling (depending on data availability) will be collected to measure these inputs. Since the production function under consideration is stochastic, the error term has two components: \( v_i \) is the random component, which represents the stochastic noise.

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\(^9\) See, e.g., Id. at 112-114.
effect in the production function, and \( u_i \) in this case represents the inefficiency effect. Estimation and analysis of \( u_i \) is the central focus of the analysis.

The two inputs defined above are obviously important determinants of a municipality’s ability to produce health. However, in measuring the efficiency with which resources are used to deliver good health outcomes across municipalities, there are likely to be other important covariates besides the inputs specified that could also influence the shape of the frontier and/or the efficiency distribution. For example, there might be environmental factors over which the municipality has little to no control that nevertheless facilitate or impede the municipality’s efforts to produce health. If this heterogeneity is left out of the model, the \( u_i \) will be capturing not only inefficiency but will also be capturing any of these time invariant environmental factors, hence the estimate of \( u_i \) will likely be overestimated. Accordingly, the basic production function in (1) is augmented with two additional time invariant covariates (\( z \)'s) that are likely to shift the production function:

\[
z_i = [PopDen_i, Tropics_i]
\]

where POPDEN is the municipality’s population density and TROPICS is a dummy variable for whether the municipality is in a tropical location. These two variables are included based on the assumption that delivery of basic primary health care will be more difficult in municipalities that are more sparsely populated and that tropical municipalities are likely to have higher prevalence of infectious disease. Finally, time effects will be controlled for with year-specific dummy variables:

\[
t = year_1, year_2, year_3, year_T
\]

The augmented form of the production function will be:

\[
y_i = \alpha + X_i'\beta + z_i'\gamma + t'\theta + v_i - u_i
\]

To investigate the extent to which inequality is related to the inefficiency term, an inequality indicator will be placed in the mean of the inefficiency distribution, whilst also controlling for municipal income:
\( \mu_i = \delta_0 + \delta_1 \text{ineq}_i + \delta_2 \text{LogIncome}_i \) \tag{5}

where INEQ is the municipal GINI and LOGINCOME is the logged municipal per capita gross domestic product (GDP).

**POTENTIAL ISSUES AND IMPLICATIONS**

This paper intends to present some specific empirical results on inefficiency in the delivery of health care to meet SDG 3 and the extent to which inequality might be playing a part in driving the inefficiency. There are, however, likely several limitations to such a study and as a result any possible findings should be handled with care. The quality and availability of the data is the first and most obvious limitation. In attempting to measure the effect of inequality in driving inefficiency, it is quite possible, even probable, that other time invariant ‘unwillingness’ factors are at play. For instance, the extent to which municipal citizens are able to voice their concerns and how accountable the municipality is to those concerns, or how effective the municipal government is in setting and implementing health policy, to name just a couple. However, without sufficiently disaggregated data it is not possible, for now at least, to account for these factors in the current model. Besides, from a technical perspective, whether these factors should enter the model in the mean of efficiency and/or as drivers of production also remains an open question and is one that will not be addressed here. As a consequence, if these other factors are important drivers of inefficiency in health performance, their effect will be masked by the inequality effect and thus the inequality effect will be overestimated. Moreover, whilst the foregoing framework relies on a production function type approach, it is not obvious whether this approach is indeed the best way to assess the effectiveness of health systems in meeting SDG 3. It is not clear, for instance, that actual health outcomes do indeed result from a production function process, as described in standard microeconomics. As such, the methodology presented is more a provocation for further debate on how best to approach assessment of performance of health systems in the context of meeting the Sustainable Development Goals.