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Estimating unbiased economies of scale of HIV prevention projects: A case study of Avahan

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ABSTRACT

Governments and donors are investing considerable resources on HIV prevention in order to scale up these services rapidly. Given the current economic climate, providers of HIV prevention services increasingly need to demonstrate that these investments offer good 'value for money'. One of the primary routes to achieve efficiency is to take advantage of economies of scale (a reduction in the average cost of a health service as provision scales-up), yet empirical evidence on economies of scale is scarce. Methodologically, the estimation of economies of scale is hampered by several statistical issues preventing causal inference and thus making the estimation of economies of scale complex. In order to estimate unbiased economies of scale when scaling up HIV prevention services, we apply our analysis to one of the few HIV prevention programmes globally delivered at a large scale: the Indian Avahan initiative. We costed the project by collecting data from the 138 Avahan NGOs and the supporting partners in the first four years of its scale-up, between 2004 and 2007. We develop a parsimonious empirical model and apply a system Generalized Method of Moments (GMM) and fixed-effects Instrumental Variable (IV) estimators to estimate unbiased economies of scale. At the programme level, we find that, after controlling for the endogeneity of scale, the scale-up of Avahan has generated high economies of scale. Our findings suggest that average cost reductions per person reached are achievable when scaling-up HIV prevention in low and middle income countries.

1. Introduction

The UNAIDS investment approach for an effective response to HIV/AIDS proposes the scale-up of HIV prevention for key populations as one of its core interventions (Schwartländer et al., 2011). However, resources for expanding HIV prevention to all who may benefit for it remain scarce. Due to the recent flat-lining of development assistance for health; increased attention has been placed on identifying efficiency gains in HIV prevention in low and middle income countries. Recent global resource estimates of HIV prevention are based on the assumption that efficiency of services can improve with scale-up through economies of scale (Schwartländer et al., 2011). Yet, little is known about the existence and strength of these. This paper therefore aims to fill this gap by assessing the extent of the effect of scaling up HIV prevention interventions on average cost; and by doing so, to quantify the economies of scale (the decrease in average cost resulting from an increase in programme size) and diseconomies of scale (the increase in average cost when the programme becomes too large).

Our analysis is applied to the Avahan initiative implemented in India, the largest HIV prevention project conducted globally and funded by the Bill & Melinda Gates Foundation (BMGF). Under the Avahan Initiative, NGOs were provided grants through state lead partners (SLPs) to build a relationship with high-risk populations in order to provide HIV prevention services. Each peer educator provided services to about 25–50 people, sharing prevention information, distributing supplies (condoms and lubricants) and providing referral for the management of sexually transmitted infections (STI). Community mobilisation, advocacy and enabling environment activities varied across the sites and included the

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formation of self-help groups, various drop-in centre events, skills training, legal literacy workshops, police and stakeholder sensitization, crisis response teams and access to social entitlements.

The Avahan initiative was implemented by 138 NGOs, supported by 6 SLPs and by pan-Avahan capacity building partners, contracted by the BMGF in the 4 study states (Andhra Pradesh, Karnataka, Tamil Nadu, and Maharashtra). SLPs provided technical assistance to develop programme strategies, developed communication materials, enhanced the expertise of NGO staff, provided supportive supervision and supported the purchase and distribution of commodities. At the national level, Avahan developed over-arching programme strategies and organised annual partners meetings to coordinate with Indian authorities. The national level office also developed and maintained a computerised monitoring and information system; provided financial oversight; and monitored programme evaluation.

Avahan achieved an exceptionally rapid pace of scale-up of HIV prevention services; going from 22,000 high-risk populations reached in December 2003 to 280,000 in December 2007 (Bill and Melinda Gates Foundation, 2008). According to the monitoring information system, 725,040 high-risk persons (female sex workers, their clients and men who have sex with men) were reached between 2004 and 2007, 177 million condoms were distributed and 529,381 STI visits were provided. Extensive research has been conducted to evaluate the impact and cost-effectiveness of the Avahan programme. Pickles et al. (2013) reported a decline in FSW HIV prevalence and between 142 and 2092 female sex workers (FSW) HIV infections averted per district, with two-fold to nine-fold more among FSW clients. Correspondingly, Vassall et al. (2014) found a mean incremental cost per HIV infection averted of US$785 and a mean incremental cost per DALY averted of US$46. Future anti-retroviral treatment (ART) cost savings over the lifetime of the FSW cohort exposed to Avahan were estimated to be over US$ 77 million.

Despite the policy interest in this area, to date there are very few papers examining the determinants of average costs of HIV services in low and middle-income countries. Some recent studies (Marseille et al., 2012; Menzies et al., 2012; Rosen et al., 2008) have presented evidence regarding the relationship between HIV treatment and hospital size. Using a sample of Zambian hospitals, Marseille et al. (2012) found that when the number of patient-years of ART increases by 1, the average total cost decreases by 0.2 points of logarithm. Menzies et al. (2012) from a sample of 54 clinical sites in five African countries found that when patient volume is doubled (from 5000 to 10,000 patients), the average cost decreases by 28%. Other studies examined the relationship between scale-up and cost of HIV prevention (Dandona et al., 2005; Guinness et al., 2007; Guinness et al., 2005; Kumaranayake and Watts, 2005; Marseille et al., 2007) but these papers did not manage to quantify the extent of economies of scale due to the small sample size of the data sets used. A more recent study has made an attempt to estimate economies of scale of Avahan considering a 2-year period (Chandrashekar et al., 2010) but the statistical method used did not allow to estimate a causal effect of scale on the average cost.

During the scale-up of Avahan, we collected an extensive data set on the cost of Avahan from the 64 districts of Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu states. In total, 138 Avahan NGOs were costed over 4 years from 2004 to 2007. This is the largest dataset on HIV prevention costs available globally. Additionally, since we are interested in estimating economies of scale of the whole programme, above level costs (i.e. programme administration costs, programme communication costs, state level partner costs, BMGF level costs and Pan-Avahan capacity building partner costs) were estimated; which is something that has rarely been done before.

Although this data set provides a unique opportunity to investigate the extent of economies of scale, there are substantial methodological challenges in quantifying the level of economies of scale. In fact, while some previous papers have been informative regarding the main drivers of average cost of ART and HIV prevention services, they have failed to accurately establish a causal effect between scale and average cost (endogeneity bias). There are several reasons why the estimation of economies of scale was biased in previous studies.

Firstly, it is conceivable that endogeneity bias may occur due to the omission of pertinent variables in the analysis. The longitudinal nature of our data allows the use of a panel estimator with NGO fixed effects, which accounts for unobserved NGO time-invariant characteristics that are likely to be correlated both with the NGO size and its average cost. However, the use of the panel fixed effects estimator will not correct for biases resulting from the omission of time-variant unobserved variables. Secondly, a further potential source of endogeneity is the simultaneous relationship between NGO size and average cost. The NGO size (or scale) is expected to influence average costs, which can result in the presence of economies and/or diseconomies of scale. However, one could argue that average cost may also affect NGO size since NGOs that have a lower average cost will be able to expand coverage to key populations more easily. Ignoring this simultaneity bias results in an artificially overestimated coefficient associated with NGO size, which in turn results in an overestimation of economies of scale.

Controlling for all drivers of average cost can address these issues, but given that in reality it is not possible to control for all the determinants of average cost, appropriate empirical strategies are required to infer causality and obtain unbiased estimates of economies of scale.

Finally, a last source of endogeneity could be due to random measurement error. In fact, scale is measured by the number of persons reached by the Avahan NGO, collected via the NGO's routine monitoring system. Random measurement error on the estimation of scale will lead to an attenuation bias i.e. to an underestimation of its coefficient. In addition to the endogeneity bias, there could be another source of bias. Since we are interested in estimating economies of scale of the whole programme, the estimation of NGO average cost requires the allocation of above-level costs (i.e. programme administration costs, programme communication costs, state level partner costs, Bill and Melinda Gates level costs and Pan-Avahan capacity building partner costs) to Avahan NGOs costs. Although, we used several methods to allocate these costs (review of programme records, expenditures reports and interviews with BMGF Avahan and SLP staff), the allocation of the above-level costs can have an effect in the estimation of economies of scale.

For the above reasons, this study aims to investigate the causal effect of scale on average cost and to estimate unbiased economies of scale.

2. Avahan design and funding mechanism: implications for the analysis of economies of scale

Broadly, the extent of economies of scale observed in HIV prevention programmes may be explained by the design of the services offered, the funding mechanism that may discourage or encourage the realisation of economies of scale and the extent of above service (programme) costs. Economies of scale are commonly found to result from the: (1) existence of fixed costs, (2) learning by doing, (3) lower input prices due to high bargaining power of firms and (4) opportunities for specialisation. The industry analysed in this paper, is however slightly different from other industries, primarily due to the fact that NGOs do not