The (Potential) Role of Economic Policy in Combating Neglected Tropical Diseases: A Case Study of Schistosomiasis in Uganda

Edward Whitney

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Overview

Despite decades of efforts by policymakers, NGOs, and other concerned actors, one stylized fact remains true: prevalence of Neglected Tropical Diseases (NTDs) persists around the world (Ogongo et al., 2022; World Health Organization, 2015). The 2nd most common NTD in the world after Malaria is Schistosomiasis, and it is widely considered to be a infectious disease of poverty (World Health Organization, 2015; Centers for Disease Control, 2018). In many countries a poor household is more likely to lack proper sanitation and access to adequate health care (Stevens 2014), both of which have been shown to be correlated with Schistosomiasis prevalence (Grimes et al. 2014). In addition, Schistosomiasis and similar diseases can negatively impact both the accumulation process and the stock of an individual's health capital, making it even more difficult for vulnerable and poor households to avoid being trapped in a state of poverty (Bonds et al. 2010).

Previous studies have shown empirical relationships between aggregate measures of economic activity and disease burden. Gallup and Sachs (2001) identify correlations between country-level economic growth and malaria prevalence. Cole and Neumayer (2006) find that health impacts total factor productivity. Ismahene (2022) find that infectious diseases can hamper economic growth and trade in developed and developing countries.

Turning to studies that are closely linked to the present study, Bonds et al. (2010), Ngonghala et al. (2014), and Garchitorena et al. (2017) express model parameters in systems of disease dynamics as functions of aggregate measures of economic activity. Using a general Susceptible-Infected-Susceptible (SIS) model of infection, Bonds et al. (2010) identify two stable equilibria—one that is characterized by high income and no disease prevalence, and one that is characterized by low income and high disease prevalence—and a critical threshold that divides the parameter space of the model between the two stable equilibria. Ngonghala et al. (2014) further develop this approach using an aggregate production function; capital accumulation is expressed as a function of disease prevalence and disease transmission as a function of aggregate income. Using a similar modeling approach, Garchitorena et al. (2017) separately model diseases by the degree to which they are either environmentally transmitted or transmitted between individuals.

This study builds upon these methods with two important additions. First, I couple a system of disease dynamics for Schistosomiasis with a computable general equilibrium (CGE) model of a small economy. The CGE model allows me to account for differences in sectoral-level contributions to overall output, which is not possible using aggregate measures of output. This heterogeneity can be of first-order importance when the amount of labor employed in a particular sector, such as fishing, correlates with disease transmission. The CGE model can also account for market imperfections, which aggregate measures of economic activity are unable to portray.

Second, I explicitly account for exposure time in the system of disease dynamics. This addition is critical when labor time in one sector is correlated to exposure to the disease. It is generally accepted that behavioral decisions—along with socioeconomic status, gender, and even ethnicity (Moira et al., 2007)—play a role in transmission of diseases like Schistosomiasis. In many communities where Schistosomiasis is prevalent, specific economic sectors such as fishing represent both a significant source of income for the local economy and a significant source of exposure time to the parasite that causes the disease. In these settings, including a measure of exposure time is necessary to understand whether and how policy shocks could influence welfare outcomes via disease dynamics.

Using an example to highlight the importance of these two additions: consider a change in fisheries management policy that results in a relaxation of restrictions on fishing effort. For simplicity, assume that this policy change results in an increase in labor demand (and thus output) in the fishing sector. Ignoring possible price effects, this would result in an increase in aggregate output. If one were to simulate the impact of this policy change using a model built with an assumption that disease prevalence declines over time as aggregate income increases, the results might suggest that such a policy change would unambiguously lead to an decrease in disease prevalence. However, the amount of fishing labor, and therefore exposure time to the disease, has actually increased. This increase in exposure time could dampen, or perhaps even reverse, the reduction in disease prevalence accruing from the increase in aggregate output.

The importance of the GE model in this setting stems from the ability of this modeling approach to capture both direct and indirect effects of policy interventions, particularly when experimental designs are infeasible. Examples of previous country-level studies using a GE model to examine the impact of health on labor productivity include Rutten and Reed (2009) and Verikios et al. (2013). Applying a local economy-wide impact evaluation (LEWIE) model of the local economy to a range of research questions, Taylor and Filipski (2014) provide estimates of: the value that a natural resource brings to a local economy; how migration flows can alter local economy impacts of policy interventions; and the impact of cash-transfer programs on non-beneficiary households. More recent studies have coupled a LEWIE model with dynamic models of fish stocks. Manning, Taylor, and Wilen (2018) show how fisheries management policies intended to reduce overfishing can actually result in increased fishing effort. Gilliland, Sanchirico, and Taylor (2019) examine the impact of a cash transfer program in the Philippines, revealing that the transfers lead to an increase in pressure on the local fish stock as a result of the increase in household incomes.

This study also offers unique perspective on the role that economic policy might play in disease mitigation efforts. For diseases like Schistosomiasis, efforts to combat the disease have largely focused on reducing prevalence in human hosts via the implementation of mass drug administrations (MDA) of inexpensive treatments such as Praziquantel. Integrated approaches to management of Schistosomiasis prevalence have combined MDA programs with other methods, including: environmental interventions, such as molluscicides or reintroduction of natural predators; improved WASH facilities; and information-based interventions. Results from previous studies demonstrate the importance of a multidisciplinary approach to combating prevalence of the disease (Castonguay et al., 2020; Sun et al., 2017; Inobaya et al., 2014). However, the potential role that economic policy can play as a means to influence behavior in this context has not been adequately investigated to date.

In this study, I examine how economic policy interacts with prevalence of the disease of Schistosomiasis. To do this, I combine a general equilibrium model of an economy with a system of equations that characterize the dynamics for the disease. I model labor employed in each sector as a function of disease prevalence. In the epidemiological component, I model the exposure rate parameter as a function of aggregate output, while including an explicit measure of exposure time. To account for the relationship between fishing effort and the fish stock, I also include a dynamic model of the fish stock targeted by the local fishing industry. Using this coupled model, I simulate the impact of two different types of policy shocks and identify how disease prevalence changes in response to these policy shocks. I also investigate which features of the local economy are important factors in the observed changes of disease prevalence.

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