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

Edward Whitney

Current version: May 14, 2024

Abstract

Despite decades of efforts by policymakers and NGOs, global prevalence of neglected tropical diseases (NTDs) persist due to the complicated relationship between the disease dynamics, human behavior, and the natural environment. In this dissertation, I investigate how targeted policy shocks can have ancillary consequences across the human-natural environment, with a focus on how such policy shocks affect local prevalence rates of Schistosomiasis (Schisto), the 2nd most common NTD.

I construct a novel coupled model of the human-natural environment for a small economy in the Ugandan region of Lake Victoria in Africa. I characterize the interconnectedness of the three domains of the human-natural environment—economic, public health, and biological—by defining four links between a computable general equilibrium (CGE) model of the local economy, an epidemiological model that represents the dynamics of Schisto, and a biological model that represents the growth process of the fish stock targeted by fishers in the economy. Firstly, I account for the role of public investment in disease prevention and treatment by modeling two of the epidemiological parameters as functions of aggregate income in the local economy. Secondly, I include a novel measure of exposure time to the disease, which accounts for the relationship between fishing labor and disease prevalence. Thirdly, I model the supply of effective labor as a function of disease prevalence, which accounts for the impact of infection on labor productivity. Lastly, I account for the critical relationship between fish stocks and fishing effort by modeling growth of the fish stock as a function of total harvest.

Using originally collected survey data, I develop the baseline model by estimating production function parameters, expenditure shares, and demographic characteristics for households in the local economy. Baseline household infection rates and the level of the fish stock are obtained under the assumption that the coupled model is at steady state within and between the three components. The baseline model serves as a counterfactual to the results

obtained from the simulated impact of three types of policy shocks over a study period of ten years. The first policy shock is an annual exogenous increase of 1% in total factor productivity (TFP) for the oil palm sector, an important cash crop for the local economy. The TFP policy shock targets the economic domain and is representative of the types of public-private investments made in the local oil palm sector over the past twenty years. The second policy shock, a 25% reduction in fishing capital that is sustained over the 10-year study period, targets the biological domain and represents a fisheries management policy (FMP) to regulate fishing effort in order to reduce overfishing and increase future returns to fishing effort. The third policy shock targets the public health domain and is modeled as an annual decline of 19% in the mortality rate of the parasite that causes the disease. This policy shock represents community-wide programs (mass drug administration, or MDA) for treating Schisto infection, a common approach to disease management in many Schisto-affected countries.

I find that each policy shock has ancillary consequences for outcomes in the non-targeted domains. In the case of the TFP shock, large-scale, public-private partnership investments to increase cash crop yields can produce the ancillary benefit of reducing disease prevalence rates. However, they may not be sufficient for incentivizing labor reallocation away from activities correlated with disease transmission. In the case of the FMP shock, policies designed to relieve pressure on fish stocks may have the unintended consequence of increasing exposure time to the disease, thereby increasing disease prevalence rates above the counterfactual baseline. MDA programs can provide significant reductions in disease prevalence for the duration of the program, but without proper market incentives, income-generating activities associated with disease transmission may drive a resurgence in infection rates in the absence of such treatment programs. Additionally, MDA programs can offset the ancillary costs of FMP shocks for outcomes within the public health domain when implemented concurrently, while MDA-TFP concurrent shocks can produce ancillary benefits for the public health and biological domains. Additionally, labor market frictions reduce households' ability to take

advantage of growth in a cash crop sector when Schistosomiasis is present.