

The Macroeconomics of Pandemics in Developing Countries: an Application to Uganda

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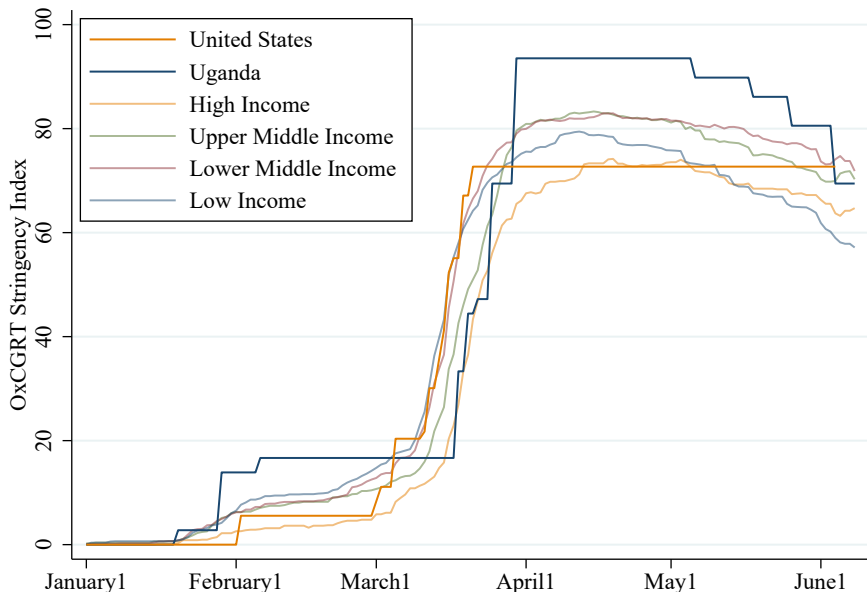
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Lockdown stringency across countries



Motivation

- Similar measures against COVID-19 pandemic across countries
- Early models of the pandemic justified widespread restrictions
 - Eichenbaum et al. (2020); Farboodi et al. (2020); Glover et al. (2020)
- Emerging evidence of economic hardship through lockdowns
 - Mahmud and Riley (2020); Moscoviz and Le Nestour (2020); Brac (2020)
- Development economists critical of chosen policies
 - Ray and Subramanian (2020); Barnett-Howell and Mobarak (2020); Ravallion (2020)

⇒ Do mortality risks differ across countries?

⇒ Do welfare-optimizing policies differ across countries?

Predicting infection fatality rates for COVID-19

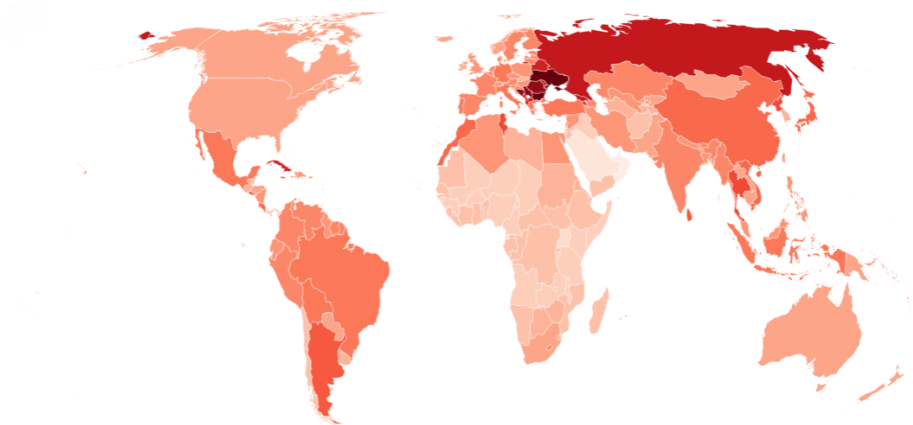
- How to estimate the share of infected that may die from the disease (IFR) in a country if one doesn't know...?
 - ... the true number of COVID-19 infected
 - ... nor the true number of COVID-19 deaths
- We rely on medical data from high-income countries and account for different...
 - ... age-sex distributions
 - ... comorbidities
 - ... health system capacities
- Using Bayes Rule, we can estimate the IFR conditional on age (a), sex (s) and comorbidities (c)

$$cIFR = P_{las}(d|c) = \frac{P_{las}(c|d)}{P_{las}(c)} P_{las}(d)$$

Predicted infection fatality rates for COVID-19

Based on demography, comorbidities, and health system capacity

0 0.022



Source: Ghisolfi et al (2020)

Do welfare-optimizing policies differ across countries?

- We build on recent contributions on welfare maximizing policy in the United States (Eichenbaum, Rebelo, Trabandt, 2020)
- We calibrate and extend their model to better reflect dimensions important in developing countries
 - Lower incomes (GDP/capita at \$710 in Uganda, \$54,000 in US) & subsistence constraints
 - IFRs calculated for Uganda (age, comorbidities, health system)
 - Access to vaccines
- How do implications of the model differ when using different valuations of life?

Model

- ERT model combines epidemic and economic components
- Epidemic part is a **Susceptible-Infected-Recovered** model (t=1 week)

$$S_{t+1} = S_t - \pi_i S_t I_t$$

$$I_{t+1} = (1 - \pi_r) I_t + \pi_i S_t I_t$$

$$R_{t+1} = R_t + \pi_r I_t$$

$$D_{t+1} = D_t + \pi_d I_t$$

- How much agents consume and work affects infections

$$I_{t+1} = (1 - \pi_r) I_t + \underbrace{\pi_{i1} (S_t C_t^S) (I_t C_t^I)}_{\text{Infections from consuming}} + \underbrace{\pi_{i2} (S_t N_t^S) (I_t N_t^I)}_{\text{Infections from working}} + \underbrace{\pi_{i3} S_t I_t}_{\text{infections from random interactions}}$$

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Key assumptions of the model

- Agents' consumption cannot fall below a certain level

$$u(c_t, n_t) = \ln(c_t - \bar{c}) - \frac{\theta}{2}n_t^2 + \bar{u}$$

- Agents realize the likelihood and dangers of getting infected
 - voluntary reductions in economic activity to reduce infection risk

$$\text{Susceptible: } U_t^s = u(c_t^s, n_t^s) + \beta [(1 - \tau_t) U_{t+1}^s + \tau_t U_{t+1}^i]$$

$$\text{where: } \tau_t = \pi_{s1} c_t^s (I_t C_t^I) + \pi_{s2} n_t^s (I_t N_t^I) + \pi_{s3} I_t$$

$$\text{Infected: } U_t^i = u(c_t^i, n_t^i) + \beta [(1 - \pi_r - \pi_d) U_{t+1}^i + \pi_r U_{t+1}^r]$$

$$\text{Recovered: } U_t^r = u(c_t^r, n_t^r) + \beta U_{t+1}^r$$

- But they neglect their contribution to spreading the epidemic
 - potential efficiency gain through lockdown policy

Model

- The government sets a containment rate
 - 'measures aimed at reducing interactions' which affect consumption
 - modeled via agents' budget constraint $(1 + \mu_{ct}) c_t = w_t n_t + \Gamma_t$

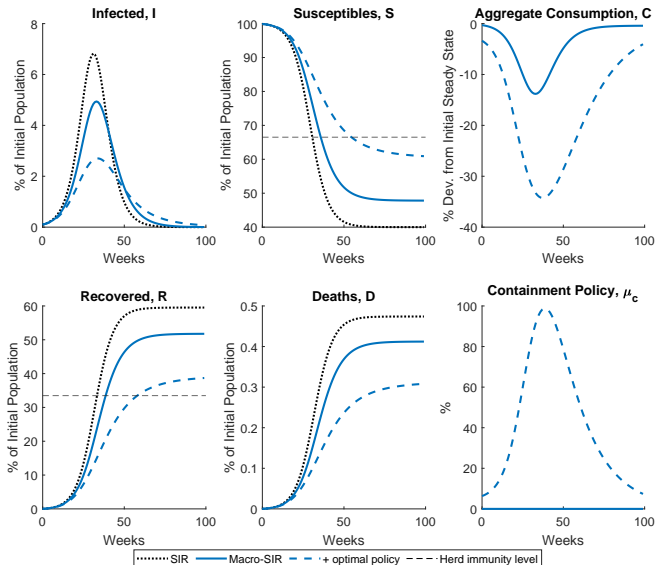
⇒ What timepath of containment maximizes aggregate utility?

Calibration

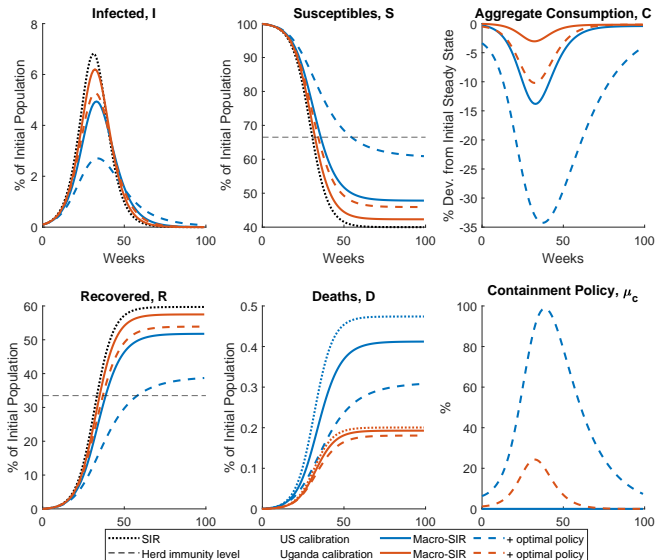
	Uganda	United States
Income/year	\$535	\$58,000
Hours worked/week	50	28
Subsistence level	\$200	\$0
Value of statistical life	\$31,000 ^a	\$9.6 million
IFR	0.33%	0.79%

$$^a VSL_{US} * \frac{GDP_{UG}}{GDP_{US}} * \frac{Health\ Spending_{UG} / GDP_{UG}}{Health\ Spending_{US} / GDP_{US}}$$

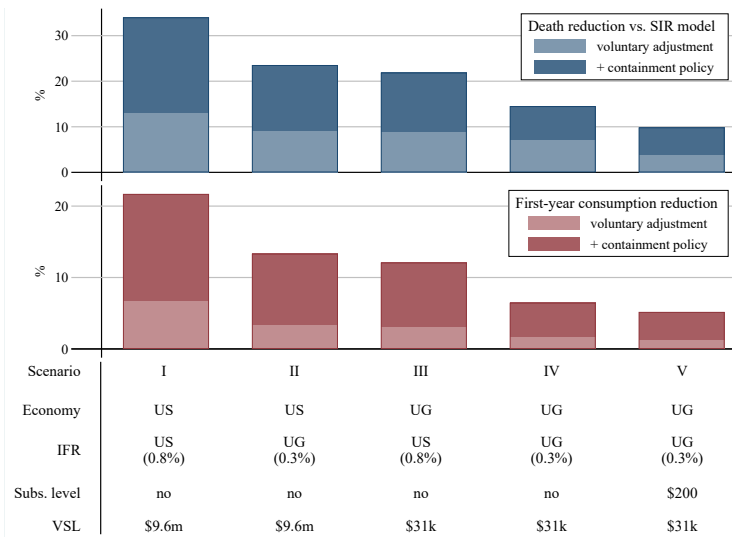
Benchmark calibration to US



Calibration to Ugandan economy & IFR



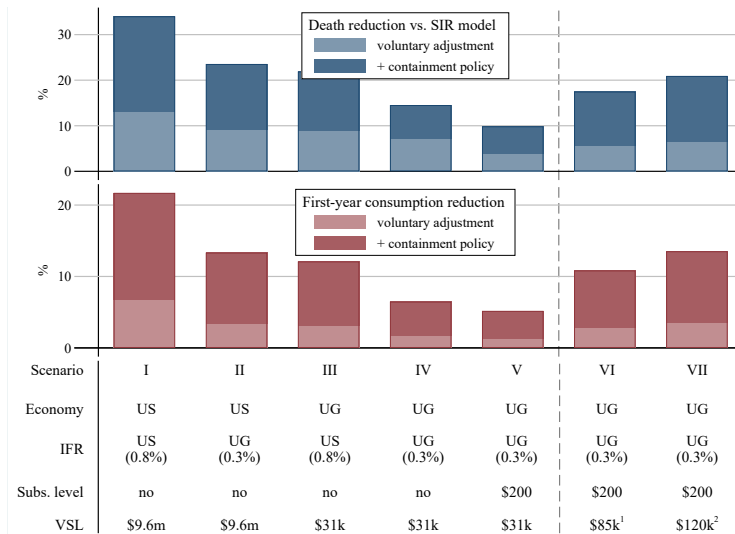
Summary of calibration steps



Waiting for a vaccine?

- How to think of a valuation of life?
 - Lost utility.
 - Is there a relevant number to target?
 - Revealed preferences by authorities?
 - For the US we have such a number: \$9.6 mill.
 - For Uganda: scale to spending on health per capita.

Valuations of life



¹ proportional to GDP/capita wrt US

² following Viscusi and Masterman (2017)

Conclusion & next steps

- Based on a simple economic framework, the same logic that justifies strict containment policies in the US suggests more lenient measures in poorer and younger countries
- So why do we see lockdowns everywhere?
 - Uncertainty around the epidemic - what should measures be going forward?
 - Do individuals fear the virus more than necessary, and thus demand strong action?
 - Do governments have different preferences over the relation between deaths and utility of the living?
- A caveat: VSLs

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Waiting for a vaccine?

- What if governments imposed strict lockdowns because they think a treatment or a vaccine may come?
- So far in the model, the only way out of the epidemic is herd immunity
- How does optimal policy change if we hope for a vaccine to arrive?
- Agents now expect that in every period, a vaccine may become available with a certain probability

Waiting for a vaccine?

