How Should Policy Responses to the COVID-19 Pandemic Differ in the Developing World?

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The World Bank
June 23, 2020

How Policy Should Differ in Developing Countries?

Our approach: a quantitative general equilibrium heterogeneous-agent incomplete markets model with uninsurable income and health risks.

Key reasons for different policy responses:

1. Younger populations
2. Less fiscal capacity
3. Larger informal sector
4. Weaker public health infrastructure
5. More hand-to-mouth households

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Quantitative Results from Our Model (So Far)

- Blanket lockdowns much less effective in developing countries
  - Save around half as many lives per GDP lost
- Yet blanket lockdowns still better than no lockdowns
- Age-dependent policy even more effective in developing countries
  - Save more lives per unit of GDP lost
  - Lower fiscal & economic cost of shielding old, since so few of them

The Macroeconomic Model

Model Outline

Households

- uninsurable income and health risks
- accumulate assets endogenously, face credit constraints

Epidemiology

- SICR with age heterogeneity as in Glover et. al. (2020)
- Contagion externalities, productivity losses, and mortality

Sectors

- Formal: "skilled production"
- Informal: "unskilled production" with limited state purview

Governments

- Tax and transfer subject to limited fiscal capacity

Households and Preferences

- Two "age groups": young (ω) and old ($1-\omega$)
- Preferences (of the living):

$$\mathbb{E}\left[\sum_{t=0}^{\infty}\beta_j^t\left\{\log(c_t)+\bar{u}\right\}\right]$$

- β_j is discount factor of age group j, where $j\in\{y,o\}$
- $\bar{u}$: flow utility of being alive

Permanent Productivities and Idiosyncratic Shocks: Roy Meets Aiyagari

- Individuals endowed with vector of permanent productivities $\{z, 1\}$ in formal and informal sectors, as in Roy (1951)
- Formal sector productivity $z \sim G$
- Individuals face idiosyncratic productivity shock as in Aiyagari (1994)

$$\log v_{t+1} = \rho_v \log v_t + \varepsilon_{t+1} \quad \text{with} \quad \varepsilon_{t+1} \overset{iid}{\sim} F(0, \sigma_v)$$

- Individuals choose sector each period

Production and Firm Profit Maximization

- Final good technology (Ulyssea 2018):

$$Y = L^{\alpha} K^{1-\alpha}, \quad 0 < \alpha \leq 1$$

$$K = K^{D} + K^{F}$$

$$L = \left[A L_f^{\frac{\sigma-1}{\sigma}} + L_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

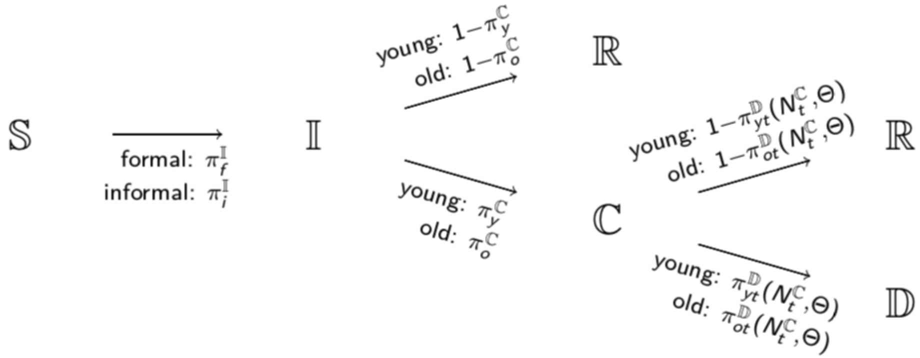
- A is the exogenous productivity of formal sector (Caselli-Coleman, 2006)

Assets and Individual's Budget Constraint

Individual's cannot borrow ($a' \geq 0$) and face constraint (assuming healthy, no lockdown):

$$c + a' \leq \mathbb{1}_{\{s=i\}} w_i v + (1-\tau)\mathbb{1}_{\{s=f\}} w_f z v + (1+r)a + T$$

Health States and Transitions



Hospital Capacity

- Θ is maximum ICU capacity per capita ($0 < \Theta < 1$)
- Probability of receiving an ICU bed is $\min\{\frac{\Theta}{N_t^{\mathbb{C}}}, 1\}$
- Fatality rate $\pi_{jt}^{\mathbb{D}}$:

$$\pi_{jt}^{\mathbb{D}}(N_t^{\mathbb{C}}, \Theta) = \begin{cases} \pi_j^{\mathbb{D}} & \text{if assigned ICU bed} \\ \kappa \times \pi_j^{\mathbb{D}} & \text{if not assigned} \end{cases}$$

- κ governs the impact of hospital overuse on fatality rate

Lockdown Technology

Lockdown lowers productivity and infection rate for those in the formal sector

- Productivity z goes down to $\lambda_w z$, $0 < \lambda_w \leq 1$
- Probability of becoming infected goes down by fraction $1 - \lambda_h$ $(0 < \lambda_h \leq 1)$
- Lower λ_w and λ_h means stricter lockdown

Quantitative Analysis

Quantitative Strategy

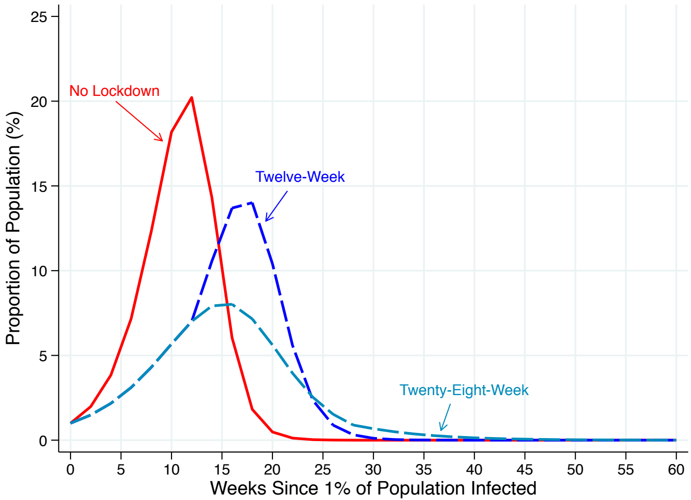
- Solve for stationary distribution of model and calibrate two versions: "advanced economy" and "developing economy"
- Pandemic introduced as "MIT shock" – no one saw it coming (actually realistic!) but perfect information since .
- Solve full transition path in both economies under various lockdown policies

Parameters Varying between Advanced and Developing Economies

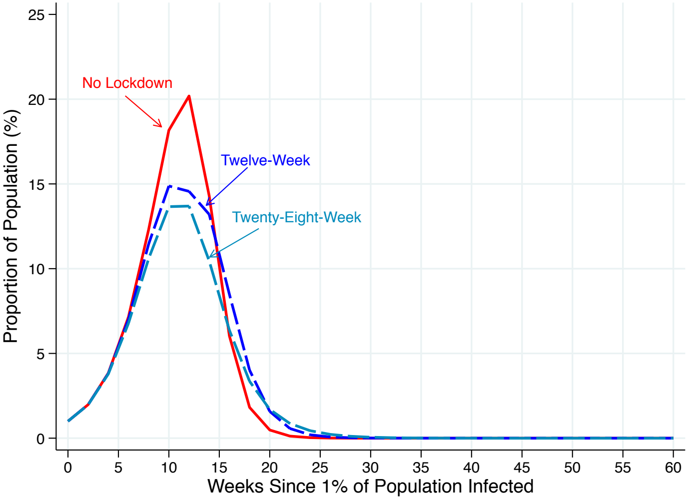
Var	Description	Advanced Economies	Developing Economies	Source or Target
A	Formal sectors TFP	3.0	0.15	1% labor informality in US
$\bar{u}$	Flow value of being alive	$11.4\bar{c}^{US}$	$11.4\bar{c}^{DEV}$	Glover et al. (2020)
χ	Spread b/w borrowing and lending	0	0.66%	Donovan (2019)
τ	Marginal tax rate	0.25	0.15	Besley and Persson (2013)
Δ	Iceberg cost in tax collection	1	2.22	Dzansi et al. (2013)
$\bar{B}$	Lockdown emergency transfers	1%	0.1%	Lockdown transfer programs
ω	Share of young in population	73%	92%	2018 ACS / World Bank
Π	Int' aid / natural resources revenue	0	10% of GDP	World Bank
Θ	Hospital capacity per capita	0.00042	0.00011	Glover et al. (2020) / WHO

Economic Calibration Epidemiological Calibration

Simulated COVID-19 Infection Rates, Advanced Economy



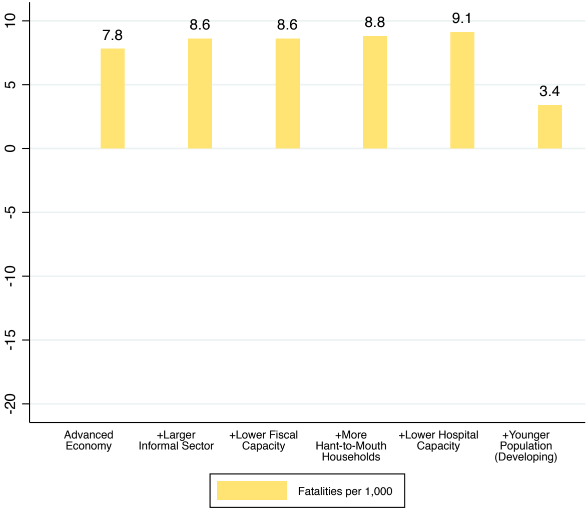
Simulated COVID-19 Infection Rates, Developing Economy



Model Predictions: Effects of the COVID-19 Pandemic

	Lifetime Welfare (%)	GDP (%)	Fatalities per 100,000 People
Advanced Economies			
No Lockdown	-8.3	-1.8	$1,102$
Twenty-Eight-Week Lockdown	-5.5	-18.2	778
Panel B: Developing Economies			
No Lockdown	-4.1	-1.1	412
Twenty-Eight-Week Lockdown	-3.6	-8.2	340

Counterfactuals: Cumulative Contributions (28-Week Lockdown)



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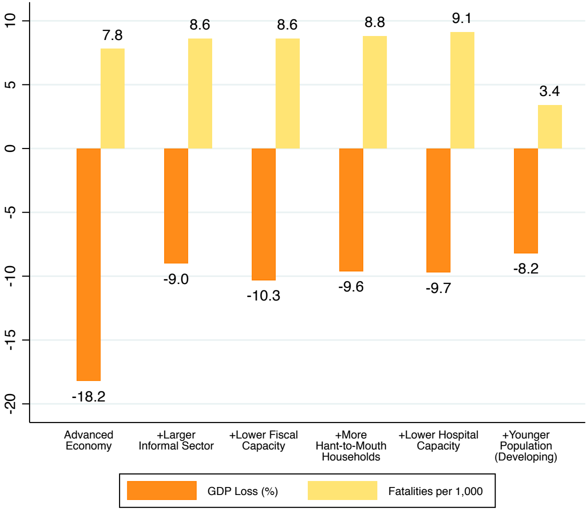

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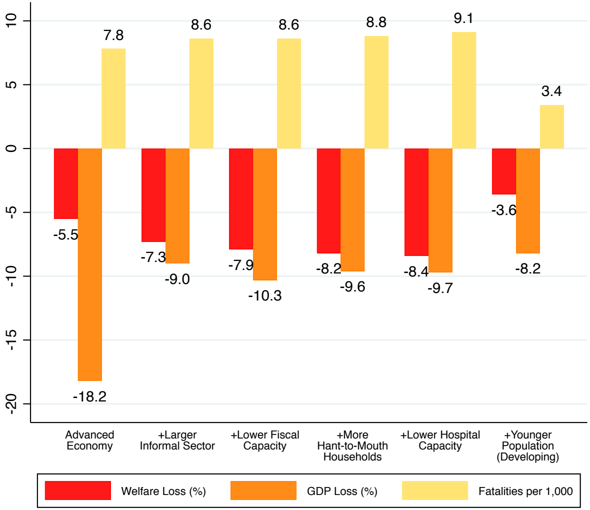

Age-Dependent Lockdowns a.k.a. “Shielding the Elderly”

- Highly heterogeneous effects by age suggest role for age-dependent policies
- Studied in U.S. by Acemoglu, Chernozhukov, Werning and Whinston (2020), Bairolyia & Imrohoroglu (2020) and others
- Model as lockdown only of old, with transfers only to old

Lives Saved per 100,000 People for every Point of GDP Lost

	Advanced Economy		Developing Economy	
	Blanket Lockdown	Age-dependent Lockdown	Blanket Lockdown	Age-dependent Lockdown
Twenty-Eight-Week	19.8	54.0	10.2	95.2

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→ More potent in developing economy since only 8% old, compared to 27% in advanced economy, and enough fiscal capacity for transfers to old

Conclusions and Future Work

- Blanket lockdowns better than nothing in dev. economies, but not real effective
- Case for "shielding the old" rather than blanket lockdowns even stronger in developing countries
- Lots of caveats and better data needed to draw firmer conclusions
- Future work: adding back children, intergenerational household structure, policy analysis of school openings

Calibration of Economic Parameters

Var	Description	Value	Source / Target
r^F	Exogenous interest rate	0.0006	Pre-COVID T-Bills rate 1.5%
ϕ	Shape-parameter of Frechet distribution G	2.7	Lagakos and Waugh (2013)
ρ_v	Persistence of idiosyncratic income shock	0.91	Floden and Linde (2001)
σ_v	St.Dev of idiosyncratic income shock	0.04	Floden and Linde (2001)
α	Labor share	0.6	Gollin (2002)
β_y	Discount factor for the young	0.9984	Glover et al. (2020)
β_o	Discount factor for the old	0.9960	Glover et al. (2020)

Returns

Calibration of Epidemiological Parameters

Var	Description	Value	Source or Target
η	Effect of infection on productivity	0.8	Asymptomatic cases
κ	Impact of hospital overuse on fatality	2	Glover et al. (2020)
λ_w	Effect of lockdown on productivity	0.68	Blandin and Bick (2020)
λ_h	Effect of lockdown on infection rate	0.75	U.S. cumulative infections
$\pi_y^{\mathbb{C}}$	Rate of young entering $\mathbb{C}$ from $\mathbb{I}$	3.4%	Ferguson et al. (2020)
$\pi_o^{\mathbb{C}}$	Rate of old entering $\mathbb{C}$ from $\mathbb{I}$	19.9%	Ferguson et al. (2020)
$\pi_y^{\mathbb{D}}$	Rate of young entering $\mathbb{D}$ from $\mathbb{C}$	2.8%	Ferguson et al. (2020)
$\pi_o^{\mathbb{D}}$	Rate of old entering $\mathbb{D}$ from $\mathbb{C}$	10.9%	Ferguson et al. (2020)
$\beta^{\mathbb{I}}$	Behavior-adjusted infection generating rate	2.0	Peak Infection Rates

Returns