A Macroeconomic Model of Healthcare Saturation, Inequality & the Output-Pandemia Tradeoff

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This paper:

- Present evidence on health care saturation

- Propose a macro model of the pandemic and its effect on income inequality by highlighting the role of health care saturation, instead of SIR/SEIR dynamics

- Model of entrepreneurs and workers with Stone-Geary preferences; COVID-19 triggers a spike in subsistence health care demand that is increasing in utilization

- Output-pandemic trade off due to utilization externality
  - Firms do not internalize the effect of economic activity on utilization

Key findings

- Pandemic worsens income and consumption inequality;

  health care consumption comes closer to subsistence driving up the relative price of health goods

- Lockdowns needed to mitigate surges in health care prices and to push economy away from subsistence health care limit

- Optimal policy includes lockdowns and transfers to workers

- Policy implications based on calibration to US economy:
  - strict lockdowns or large transfers come close to the optimal policy
  - weak lockdowns and small transfers are the worst policy option

COVID-19: Jump in subsistence demand

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..... Resulted in price spikes

Ventilator 80%

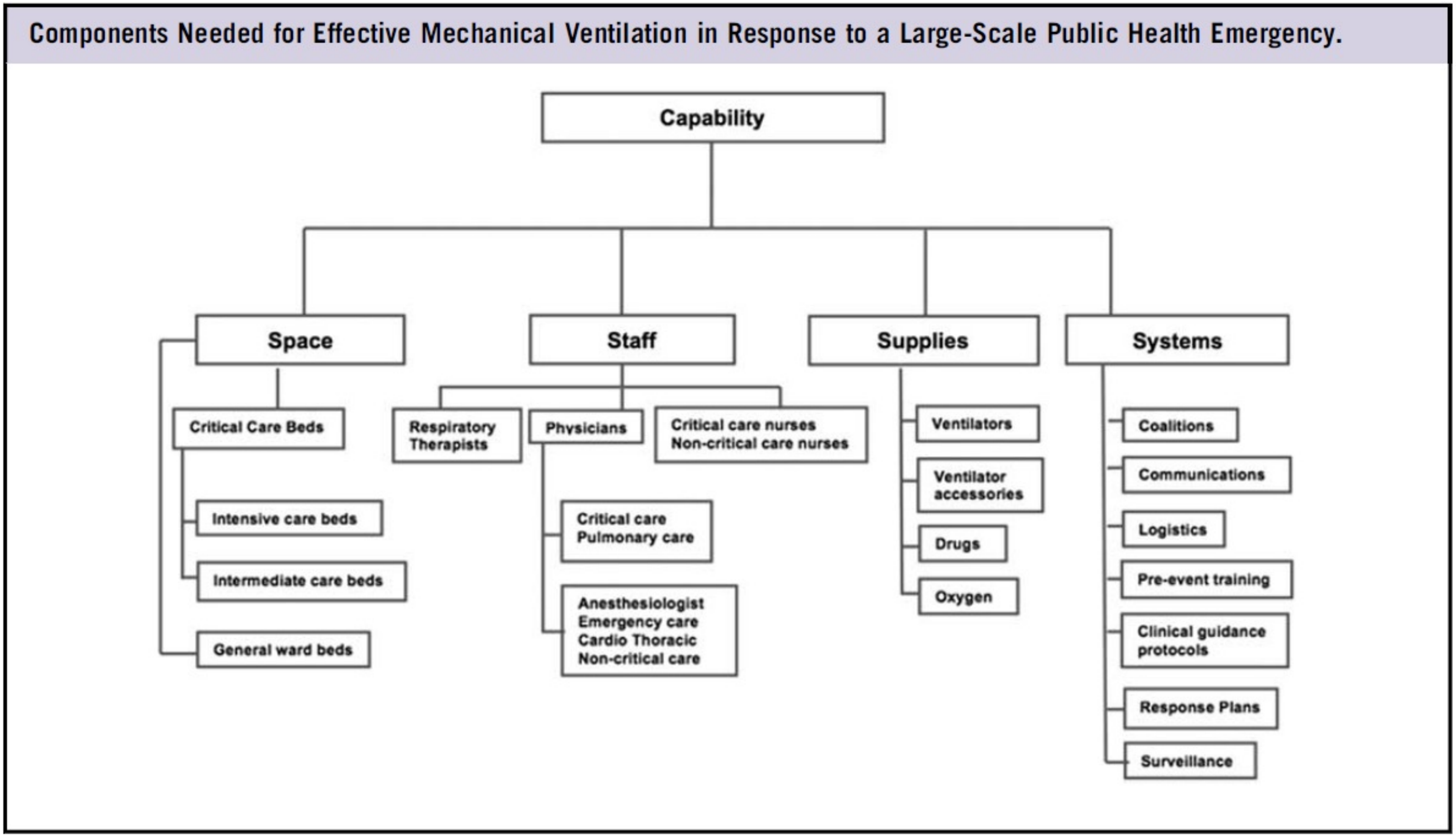
Clorox 660%

Masks 6,136%

Medical care 4.4%

Handwipes 1,294%

Critical factors in COVID treatment



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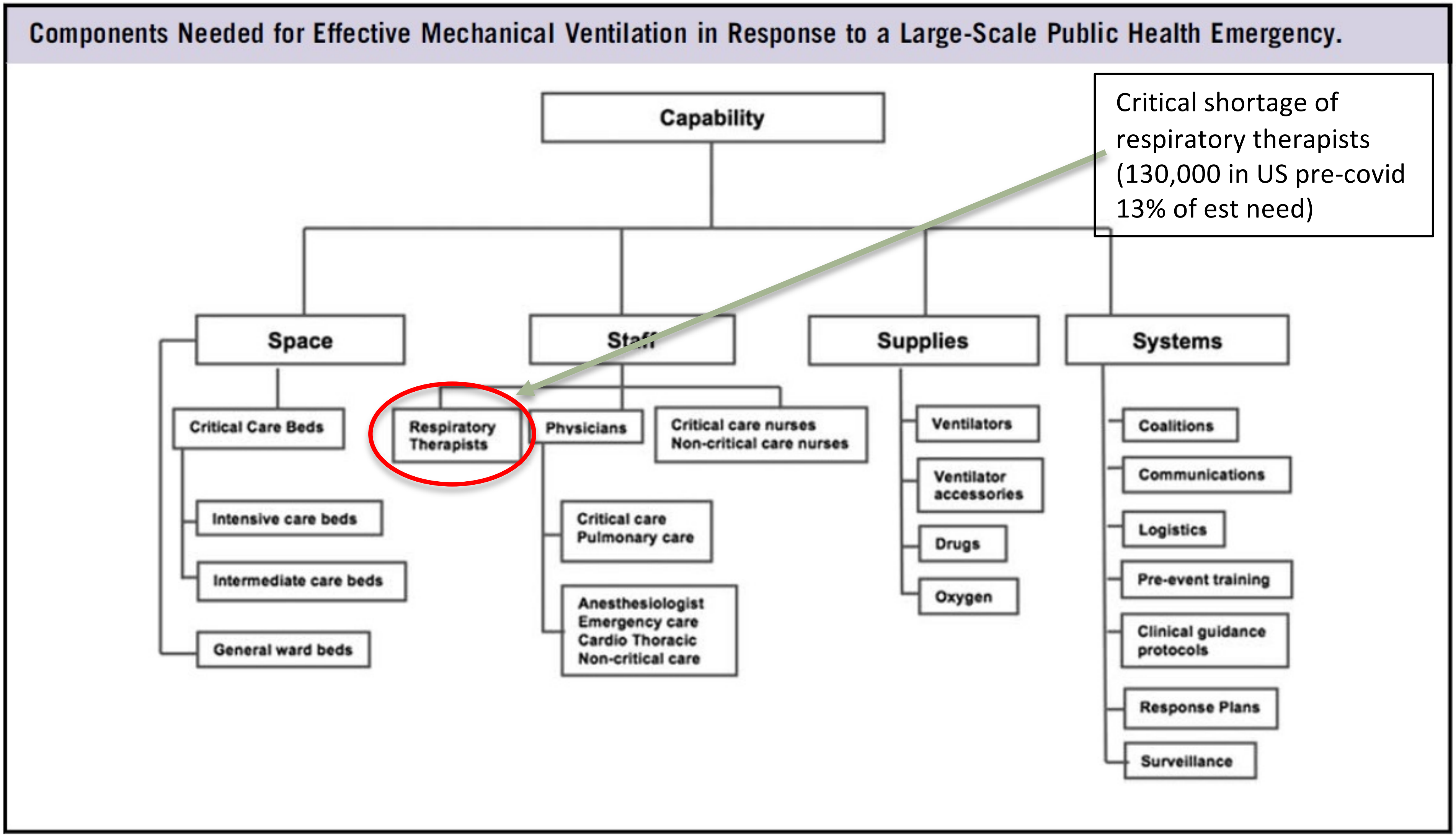

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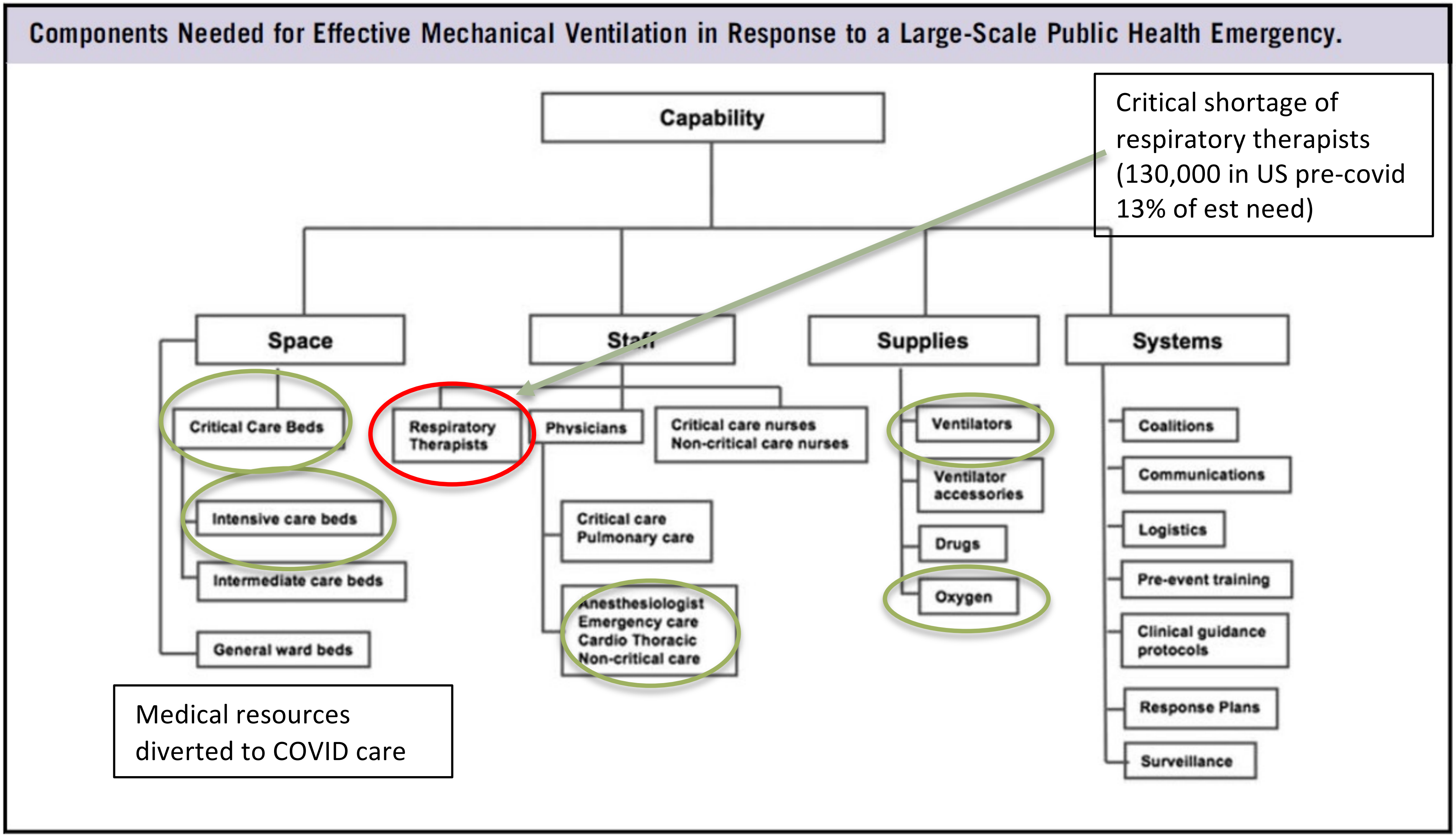

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Health system saturation

New York City

London

Mexico City

Health system saturation

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Mexico City

Excess mortality

During COVID surges, death rates from all causes relative to the past were 10 to 150 times higher

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Lockdowns

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Excess mortality

During COVID surge, death rates from all causes relative to the past were 10 to 150 times higher

Lockdowns

Economic contraction

The importance of health care saturation measures

Decline in output 2020 Q2

Cross-section of 35 countries

- SIR variables (case rate, death rate) are statistically significant.
- Non-SIR variables proxying for differences in health system capacity are significant, even after controlling for the SIR variables
- Non-SIR variables have greater explanatory power.
- Stringency of lockdown also explains decline in output.

New cases more deadly when health care is saturated.

Health care saturation leads to lockdowns, which reduce economic activity

The importance of health care saturation measures

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Increase in excess deaths

Panel of 50 states (by week)

- interaction of new cases and % ICU bed utilization explains excess death rate over time
- SIR variables alone do not explain excess deaths.
- Rolling regressions confirm that when ICU capacity is limited, new cases have a larger impact on excess deaths

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A Macro Model of the Pandemic

- Stone-Geary utility w. subsistence demand for health:

$$\bar{h}_t = h^{\star} + f(m_t K)$$

  - Pandemic causes a jump that is larger at higher utilization
  - Difference between supply and subsistence demand measures degree of saturation of health system

- Entrepreneurs and workers (the former own all the capital in NH sector and the endowment of the H sector)

- Output-pandemic tradeoff: lower utilization (lockdown) prevents saturation but reduces factor demands & output
  - Utilization externality: firms do not internalize that lower utilization relaxes health system saturation

DCE Optimality Conditions

- Factor allocations, output and agg. consumption independent of agent heterogeneity and $f(m_t K)$

$$\alpha(m_t K)^{1-\alpha} L_t^{\alpha-1} = w_t = L_t^{\omega-1}$$

$$(1-\alpha)(m_t K)^{-\alpha} L_t^{\alpha} = \chi_0 m_t^{\chi_1 - 1}$$

- Relative prices and individual consumption allocations are not

$$\frac{1-a}{a} \frac{c_t^1 - \frac{(l_t^1)^\omega}{\omega}}{h_t^1 - \bar{h}_t} = p_t^h = \frac{1-a}{a} \frac{c_t^2 - \frac{(l_t^2)^\omega}{\omega}}{h_t^2 - \bar{h}_t}$$

$$\bar{h}_t = h^\star + f(m_t K)$$

$$\left(l_t^1\right)^{\omega-1} = w_t = \left(l_t^2\right)^{\omega-1}$$

Effects of the pandemia on DCE

1. Shifts between two constant levels (P, NP)
2. Relative price rises: $p_t^{\star hP} > p_t^{\star hNP}$
   – Upper bound as workers approach subsistence health demand
3. Income inequality worsens (value of health goods rises)
4. Income effects worsen consumption inequality

$$c^{\star 1P}(p^{\star hP}, h^\star + f(m^\star K)) > c^{\star 1NP}(p^{\star hNP}, h^\star)$$

$$c^{\star 2P}(p^{\star hP}, h^\star + f(m^\star K)) < c^{\star 2NP}(p^{\star hNP}, h^\star)$$

5. Excess health demand falls for both agents but more for workers because of income effects (health inequality worsens, workers closer to subsistence demand)
6. Ratio of marginal utilities rises: $\Omega^{\star P} > \Omega^{\star NP}$

Planner's optimality conditions

- Same labor condition as DCE:

$$l_t^1 = l_t^2 = L_t = \left(\alpha (m_t K)^{1-\alpha}\right)^{\frac{1}{\omega-\alpha}}$$

- <u>Redistribution:</u> optimal excess consumption (MU) ratio

$$\frac{h_t^1 - \bar{h}_t}{h_t^2 - \bar{h}_t} = \Omega^{sp} \qquad \frac{c_t^1 - \frac{(l_t^1)^\omega}{\omega}}{c_t^2 - \frac{(l_t^2)^\omega}{\omega}} = \Omega^{sp} \qquad \Omega^{sp} \equiv \phi/(1-\phi)$$

- <u>Externality:</u> optimal m internalizes higher soc. cost

$$(1-\alpha)\left(\frac{L_t}{m_t K}\right)^\alpha = \chi_0 m_t^{\chi_1 - 1} + \boxed{\frac{1-a}{a}\frac{(C_t - \frac{L_t^\omega}{\omega})}{H - \bar{h}_t} z_t f'(m_t K)}$$

  – As in DCE, *planner's aggregate allocations do not depend on heterogeneity but now they depend on f'(mK).*

Optimal policy during pandemia

1. Optimal lockdown (limit on utilization):

$$m_t \leq m_t^{sp} \quad \textit{for } t\textit{=0,...j,} \qquad\qquad m_t \leq \bar{m} \quad \textit{for } t\textit{>j.}$$

2. Optimal transfers to workers:

$$TR_t^{sp,P} = \gamma_2 \left[\left\{ \frac{C_t^{sp} - \frac{(L_t^{sp})^\omega}{\omega}}{1+\gamma_1(\Omega^{sp}-1)} + \frac{(L_t^{sp})^\omega}{\omega} + p_t^{h,sp} \left(\frac{H - h^* - f(m_t^{sp}K)}{1+\gamma_1(\Omega^{sp}-1)} + h^* + f(m_t^{sp}K) \right) \right\} - (L_t^{sp})^\omega \right] \quad \textit{for } t = 0, ..., j,$$

Quantitative Results

- Calibration to U.S. data (quarterly frequency).
- $f(mK) = \theta mK$.
- Observed lockdown: $\theta^{OL} = 0.0918$ matches actual NH-GDP drop of -8.8% from 2020Q1 to 2020Q2 in the SP problem

Variable	No Pandemic	Pandemic		
		DCE	SP	DCE(m^{sp})
Ω	3.46	16.46	3.46	9.54
$\bar{h}$	0.09	0.65	0.56	0.56
TR/GDP (%)	14.5	14.5	27.22	14.5
		% change from no pandemic		
Y^{NH}	2.01	0	-8.84	-8.84
m	1.00	0	-15.2	-15.2
p^h	0.35	157.76	101.10	101.10
c_1	3.2	51.91	-4.93	30.54
c_2	1.59	-26.07	-6.57	-24.138
h_1	2.19	-6.02	-28.25	-4.35
h_2	0.70	4.71	22.08	3.40
Welfare Gains		n.a.	0.82 (0.33)	n.a.

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  drop of $-$ blem

Without intervention, the pandemic results in increased income inequality, and a spike in pH.

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The social planner reduces utilization by 15% and implements transfers from agent 1 to agent 2.

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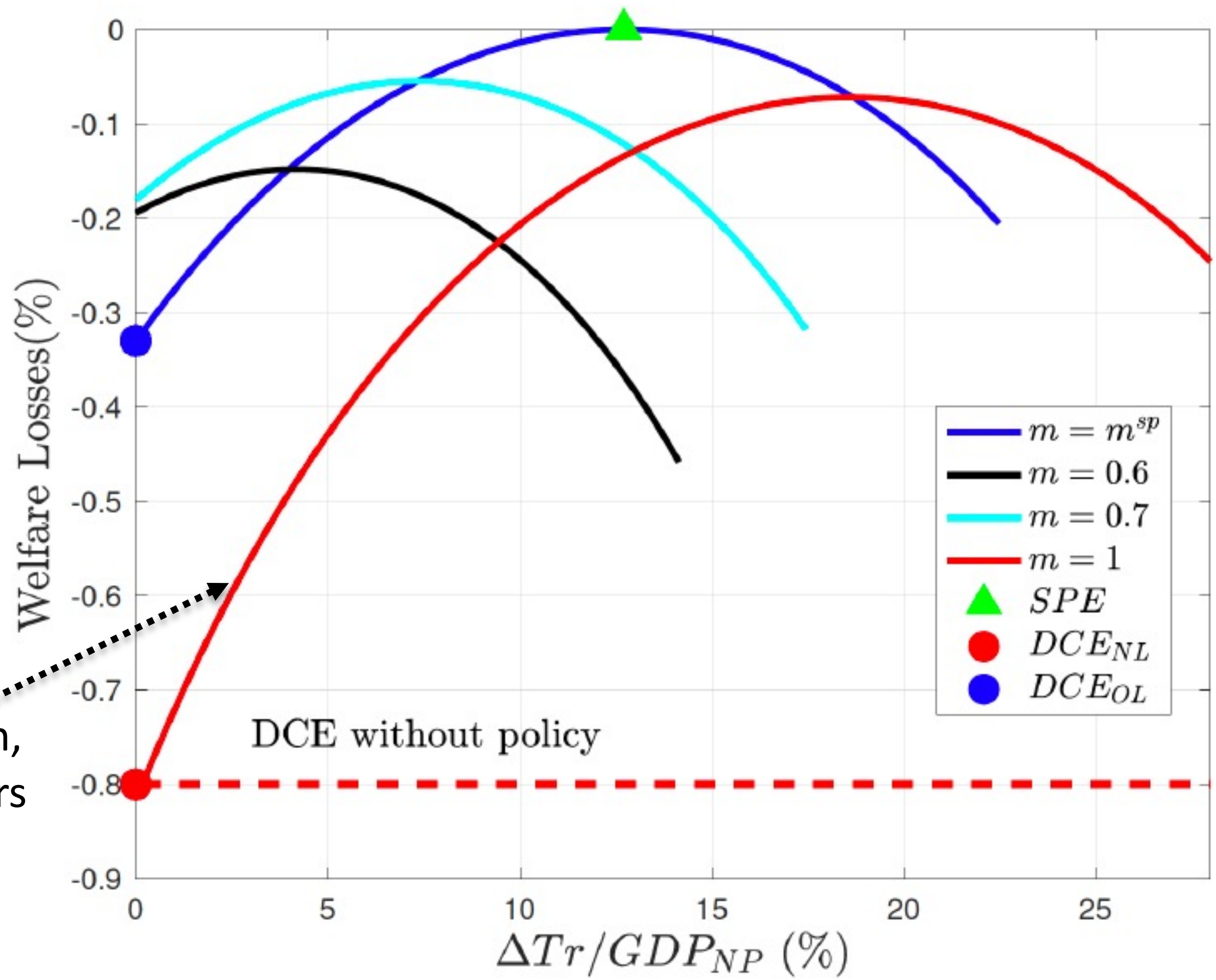
Welfare Costs of Deviating from Optimal Policies



no lockdown,
only transfers

What are countries doing?

- On average, EMs and LDCs responded to COVID-19 with weaker lockdowns and smaller fiscal interventions than AEs (the worst combination in the model)
- March to September 2020, average increase in transfers/GDP (IMF Fiscal Monitor)

AEs	9.9%
EMs	4.4%
LDCs	3%

- 53 country panel
  - Correl (log pc income, mobility) = -0.2
  - Correl (log pc income, transfers) = 0.5

Conclusion

- We proposed a macro model to study the pandemia in which the saturation of the health system is the key driving force
  - Utilization externality is key to the output-pandemic tradeoff
  - Inequality matters because workers are closer to the subsistence level of health than capitalists in the pandemic
- The optimal policy mix includes both lockdown and transfers, which leads to substantial social welfare gains.
- This paper is a first step in a research agenda exploring the saturation of health systems as the engine of macro models of the pandemia.