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Immunity-driven Comparative Advantage and its Palliative Effect on Social Health and Inequality – A Theoretical Perspective

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Abstract

We propose a model of "trade" between high income and low-income groups where the rich being scared of the spread of infection hires the poor to engage them in exposure-intensive outdoor activities as workers in the household industry. People who endure hardships and sustain exposure to unhygienic conditions may develop stronger immunity to fight the ongoing pandemic than members of the privileged class. The low-income group has greater endowment of immunity to income and for the rich it is lower. If such exchange takes place, essentially less immune people are withdrawn from exposure intensive activities and are being substituted by more immune workers. Thus, the spread and fatality will reduce with such a trade. The greater is the inequality, the more would be demand for labor for such work resulting in greater volume of such trade between low income and high-income workers. Thus, spread of the disease will be lower for countries where inequality is high. Later under a general equilibrium setting, we show that, ceteris paribus, a pandemic with a significant threat of infection and fatality would mean greater demand for poor workers; their income would rise and inequality would decline. If the pandemic increases demand for the top skilled, such as the case with virtual activities and derived demand for low skilled, relative wage for the top and bottom would increase.

JEL-Codes: D500, I180, J310, L800, N300, O100.
Keywords: Covid, Exposure-intensity, Gig economy, Wage Inequality, Herd-immunity, Comparative Advantage, Welfare, General Equilibrium

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1. Introduction and Background Motivation

The purpose of this paper is to build up a theoretical model based on a novel interpretation of the comparative advantage argument to show how pandemic can influence to reduce the *degree* of inequality during pandemic. There are several studies that discuss bi-directional causality between inequality and pandemic, that is, how pandemic affects (worsens) inequality and vice versa (Gupta, Woda and Malani 2021, Stantcheva 2021, Deaton 2021, Fereira 2021, Dev and Sengupta 2021, etc.). However, our argument is from a different angle where income inequality opens up trade between classes—rich having higher income and the poor informal gig workers having developed better herd immunity--due to rich's avoidance of exposure to contagion and such trade may contain the spread of pandemic and eventually inequality would decline. With the rise of 'gig economy' in a broader sense, the scope of such mechanism cannot be overlooked (see Hasija et al. 2020, Handerson 2020, Alvarez de la Vega et al 2021). ILO (2021) has estimated that apart from unemployment working-hour losses have been mainly due to rise in *shorter work-hours and inactivity* (even if employed to some extent). In fact, the ILO study shows that lowest working-hour losses (6.7%) in low-income countries in all income groups (compared to 8.3% to 11.3% for upper middle and high-income nations) can be attributed to the greater importance of informal employment, agriculture, and the necessity to work hard for survival. Guo et al. (2022) shows that rebounding quick recovery of the informal sector (mostly not work-from-home mode) happened during post-lockdown phase in China's severely affected provinces despite initial vulnerability. That, in fact, helped easing the pain in the gig economy via mitigating poverty and inequality impacts. A recent paper by Dingel and Neiman (2021) offered statistical evidence that "lower income economies have a lower share of jobs that can be done at home. 37% of jobs in the US can be performed entirely at home." As income level rises, more work from home (WFH) takes place in the skilled sector via online professional services etc. That is true within countries in LDCS like India with software boom so that virtual work flourishes and WFH booms, and then the demand for inactive or unemployed workers for Work-Outside-Home (WOH) increases; hence is the emergence of gig informal sector. Thus, our conjecture that in LDCs rich/ skilled workers can employ more

"inactive" workers to do outside-household chores and hence, scope of acquisition of herd-immunity, is quite evident.

Therefore, the building block hypothesis of the paper is that people who have to endure extreme hardships, sustained exposure to unhygienic conditions, poor nutrition and extraordinary amount of physical labor and continue to evolve surviving under tough conditions may have stronger immunity to fight the ongoing pandemic than members of the privileged class. Although it is difficult to get universal and precise scientific evidence of this phenomenon, there is growing volume of work corroborating such claim. If this assertion is correct, then following the framework of Marjit, Pant and Huria (2020) developed in a different context we propose a model of "trade" between high income and low income groups where the rich being scared of the spread of infection hires the poor to engage them in *exposure-intensive* outdoor activities as workers in the household industry. The low-income group has greater endowment of immunity to income and for the rich it is lower. Each class may not know their exact immunity levels whereas for the poor it might be employment and income that is more important relative to their concern for exposure to pandemic. But, if such exchange does take place, essentially less immune people are withdrawn from exposure intensive activities and are being substituted by more immune workers. Thus, the spread and fatality will go down with such a trade. In other words, a social planner would have allocated more immunity-endowed people to outdoor chores and market for such services takes the allocation towards that optimal level. This is the first result of our paper.

The second result is that greater is the inequality, more would be demand for labor for such work and greater volume of such trade between low income and high-income workers. Thus, spread of the disease will be lower for countries where inequality is high.
Both these results are proved in a partial equilibrium environment where inequality is exogenous as rich and poor workers earn exogenously given wages.

The third result is about how such a trade affects inequality, which is endogenous in a general equilibrium setting. Ceteris paribus, a pandemic with a significant threat of infection and fatality would mean greater demand for poor workers, their income would rise and would lead to a decline in inequality.

Now we proceed to look at the existing studies and empirical findings, which motivate our theoretical work. Ferreira (2021) has presented strong supportive evidence that "the mortality burden of the pandemic is positively correlated with national income per capita, despite the superior health and public prevention systems in rich countries." Deaton (2021) also documented that—irrespective of measurement index---on average, richer countries had larger economic contractions than the poorer ones, and reduction in inequality (falling income gaps) between countries during 2020s attributed to the pandemic. There are many recent works, which point towards the immunity and fatality linkage. Broad evidence of huge gap in fatality rates between the rich and poor nations is a case in point. (See Figure-1). In fact, a BBC news report summarizes recent studies in the Indian sub-continent that—contrary to conventional wisdom—India with large population only accounts for 10% of the world's deaths from Covid-19 with case fatality rate below 2%, staving off the severe impacts.[1] Equal susceptibility to pandemic irrespective of exposure to microbiome, autoimmune response of populations across regions is too simplistic conjecture. The prime driver is the 'herd immunity' developed among the poor (a large number of people at the bottom of the pyramid) as opposed to the 'restricted secured immunity' among the rich who are relatively less exposed. Truly, the percentage of fatality or people with Covid-19 infections is much less in say, Africa, India and Sri Lanka than in the advanced industrialized nations such as, the US, Germany, Austria, or others. Chatterjee et al. (2020) provides evidence that the variability of Covid-19 death rates depends on demographic character and '*prevalence of auto-immunity*' irrespective of higher GDP and Human Development Index (HDI). In particular, they find that (page 2): "that the incidence of communicable diseases correlated negatively while demography, improved hygiene and higher incidence of autoimmune disorders correlated positively with Covid-19 mortality and were among the most plausible factors to explain Covid-19 mortality as compared to the GDP of the nations." This *autoimmune effect* is related to the '*killer-cell immunoglobulin receptor (KIR)*'. Recently, a New York Times Report also discusses the role of exposure to pathogens, younger age, prevalence of diseases like malaria, HIV, Ebola giving extra protection due to antibodies,

[1] The report authored by Soutik Biswas (November 2, 2020) can be accessed at: https://www.bbc.com/news/world-asia-india-54730290

and exposure to open atmosphere as one of the reasons behind low death rates in Africa, West Africa (Sierra Leone).[2] Kumar & Chander (2020) is another study to show that number of death per million population are much higher in the rich nations (USA and Western European nations) compared to the poor ones (Asian and African countries) despite better health infrastructure, healthy life span, and WASH (Water-Sanitation-Health) conditions. To explain this, the authors highlight the roles of exposure to microbial diversity contributing to immune response. Gupta, Woda and Malani (2021) argues that the inequality rate has dropped in India, although overall globally the poor might have suffered vis-a-vis the rich by other factors. Investment returns kept on increasing in India, mainly helping the well to do and disruptions in demand and supply chains have badly affected the poor. But our purpose is to identify a channel which can produce somewhat interesting and counter-intuitive results and in *a novel way* propose the use of the *comparative advantage argument*.

To put succinctly, society that is more unequal will have lower incidence of pandemic although at the initial equilibrium the severity will likely to be felt hard. On the other hand, with much less rich-poor divide, the converse is true (Perry et al. 2021). Why? The underlying reason might be the differences in the degree of immunity across the rich and the poor classes in a country (or, across the countries) having differences in the extent of exposure. Supposing that the relatively poor enduring greater hardship to sustain their livelihood develop greater immunity against exposure to pandemic, and the rich is endowed with greater earning capacity than greater hardships. In this essay, we will offer a framework to capture such mechanism with effects discussed above. Although Covid-19 has inspired a wide-range wave of researches grappling some of the issues like contact-intensity and its adverse socio-economic impacts, closure of economic opportunities to developing nations, this aspect is not at all addressed. As mentioned by Galiani (2022), 'pandemic economics' is emerging as an upcoming field covering aspects of behavioral responses, interventions, consumption habits, international cooperation, etc., and theoretical and applied work would facilitate understanding of incentives and optimizing behavior of individuals. Of course, our analytical conjecture is novel in its approach

[2] https://www.nytimes.com/2022/03/23/health/covid-africa-deaths.html?action=click&module=RelatedLinks&pgtype=Article Trying to Solve a Covid Mystery: Africa's Low Death Rates

while it is consistent with statistically evident stylized facts. Next section provides the theoretical underpinning. The third section offers the model. Fourth section provides a general equilibrium one-sector framework underlying the key result of the third section and subsequently extends it into two sectors. Last section sums up.

2. The Framework: Underlying Rationale

In this section, we consider the outline of the model. Consider two types of people in a society—rich (haves) and poor (have-nots) with some middle-income status people are lying in between this extreme stratification. This is true for most of the countries. Given the facts (on which more to follow on stylized facts) that world inequality is high with big divide between the rich and the poor in any economy and the household decision-making at the micro level are also different. This is true for a large cross-section of countries as well as for households within any country. Empirical regularities corroborate the differences in the behavioral pattern of the rich and the poor households. For example, Galiani (2022) mentions about endogenous voluntary behavioral responses of individuals due to attitudes towards risk, social distancing, and stringency. Kubota et al. (2021) has presented evidences of heterogeneous consumption responses driven by financial status (wealthy and hand-to-mouth). There are studies that considered economic losses due to pandemic-led disruptions across different groups of people in integrated SIR (Susceptible-Infected-Recovered) model to show how people reduce consumption and work to reduce chances of exposure or infection affecting the economy (Eichenbaum et al. 2020, Acemoglu et al. 2020).

With the onslaught of pandemic-induced effects, these behavioral differences are reflected with variations determined by income-levels (absolute as well as relative sense). In fact, the rich has higher marketable value of life with more values been ascribed to the leisure as physical labor is costly for them with different trade-offs between valuing hardships and comfortable living with labor-leisure choice (depending on their relative position in the income scale). With Covid-19, they are withdrawn from the system as the apprehension about contact-intensity spreading the infection (and hence, fatality) makes them cautious to prevent spread. Therefore, they delegate their jobs more to those in the bottom rung of the ladder (the poorer cohorts) who needs to strive to make both ends meet for survival. With higher income and

purchasing power, the rich outsources many jobs (e.g., household chores or even outside day-to-day work) previously performed in their less-preferred relatively free time-slot to the poor who have no choice otherwise. Thus, the poor are more exposed to the environment ridden with pandemic calamities.

Suppose at the initial starting pre-pandemic point (or, equilibrium) the rich and the poor has a survival rate known to them due to biological conditions and constellation of health-nutrition endowments governed by their status, opportunities, income levels, and wealth and bequests determining their resources—biological, mental, and economically determined—the poor with totally different constellation of factors but at a lower level. Now, as the pandemic strikes with havoc, the rich could afford to continue with their occupations or can retreat to avoid contacts for social distancing.

On the contrary, the poor—without such prior endowments and facing hardships in post-pandemic—will initially restrict their spheres of activities but after some point of time, will eventually has to undertake their jobs and as more work is outsourced by the rich (withdrawn from some mundane activities with less rewards and implicit health hazard costs). For the poor, these opportunities open the door for 'lucrative' income gain in times of despair for survival. This will generate a type of 'trade among classes'.[3] In case of pandemic, proliferation of online activities occurred primarily due to the rich and upper middle class who could afford to order virtually. At the same time, the poor or the down-trodden –despite using smartphone and free Wi-Fi-services thank to ICT boom say in India, or Africa—hardly uses online platform due to high implicit or delivery costs and time-cost, but they deliver those products in the vicinity or at the doorsteps.

Usually in more unequal society with huge inequality, it is statistically proven that the underdogs –despite low income, dilapidated household conditions, less scope for medical service, and proliferation of informal sector activities with generation of incomes in odd-jobs—has an "auto-immune" system with '*immunoglobulin killer receptor*'. This results in "optimally benevolent" combinations of antibodies and thus, helps them fighting the new virus or variants

[3] Consumption requires time and ample evidences exist for intra-household 'trade' in different social context such as Brexit, etc. (Marjit, Huria and Pant 2020, Roy 2005).

whose antibodies are yet to be overpowered. This is lacking in the rich class. The rich class with higher value of time (due to higher wage per hour) prefers 'time-saving', and hence, will shift (reallocate) works to others with free or extra hours with a lower wage so that the net income gain is positive. With pandemic and especially after vaccination drives, the poor develops more 'herd immunity' than the rich do. All these information are, however, unknown to both the classes without prior knowledge. In the process, the rich are surviving doing on-line activities and almost no exposure, but the poor are developing herd immunity with exposure enabled by their 'inherent traits of auto-immunity'. These *ability-differences* as well as *immunity-differences* will trigger trade between them—rich 'importing' time-saving services while 'exporting' income from services with higher-value. Thus, tilting towards time and health saving work generate gains for each other. Thus, endowment of acquired immunity could attenuate the economic losses of adverse pandemic shocks.

All these boil down to the a priori hypothesis that: (i) the more unequal a society is, the higher is the herd immunity; (ii) the higher is the herd immunity, the less is the incidence of pandemic inflicted death and fatality; (iii) overall immunity in the system with more inequality will prevent further spread of the infectious disease. We could therefore, envisage a U-shaped type of relationship between "incidence of pandemic-hardships" (fatality or death rates on Y-axis) and "degree of inequality" (Gini coefficient proxy) within an economy or across economies with different per capita income (X-axis). Stylized Facts are presented below to show the relationship between Gini index, per capita income (PCGDP) and death or fatality rates. Figure 1 shows positive relationship between PCGDP and fatality rate.

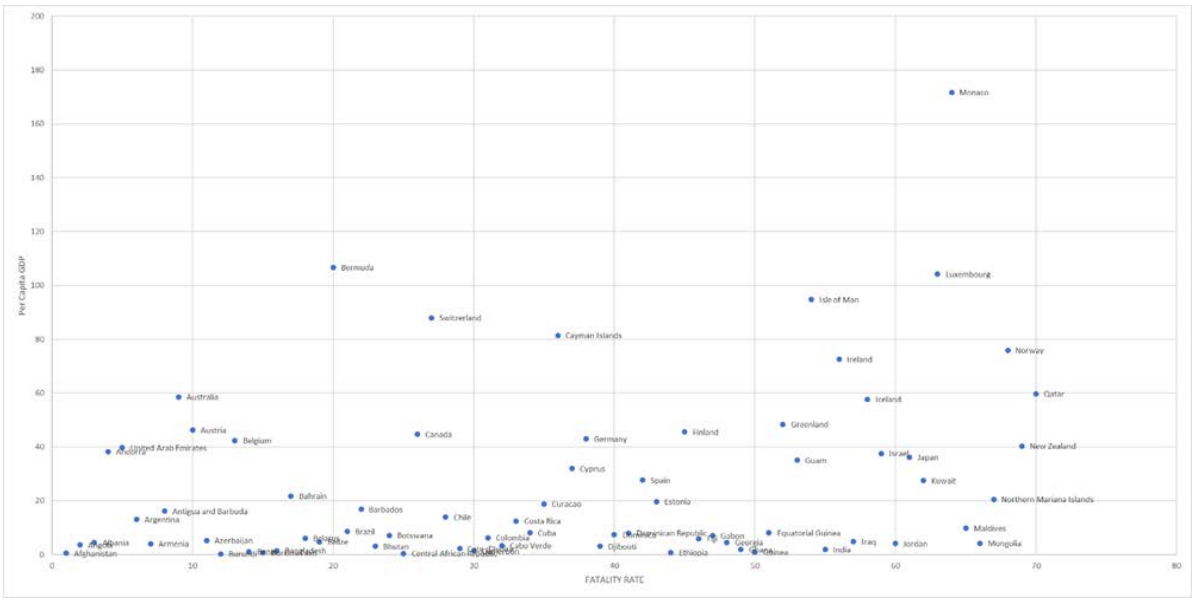

Figure 1: *GDP per capita and fatality rate.* ***Source:*** *Authors' calculations*

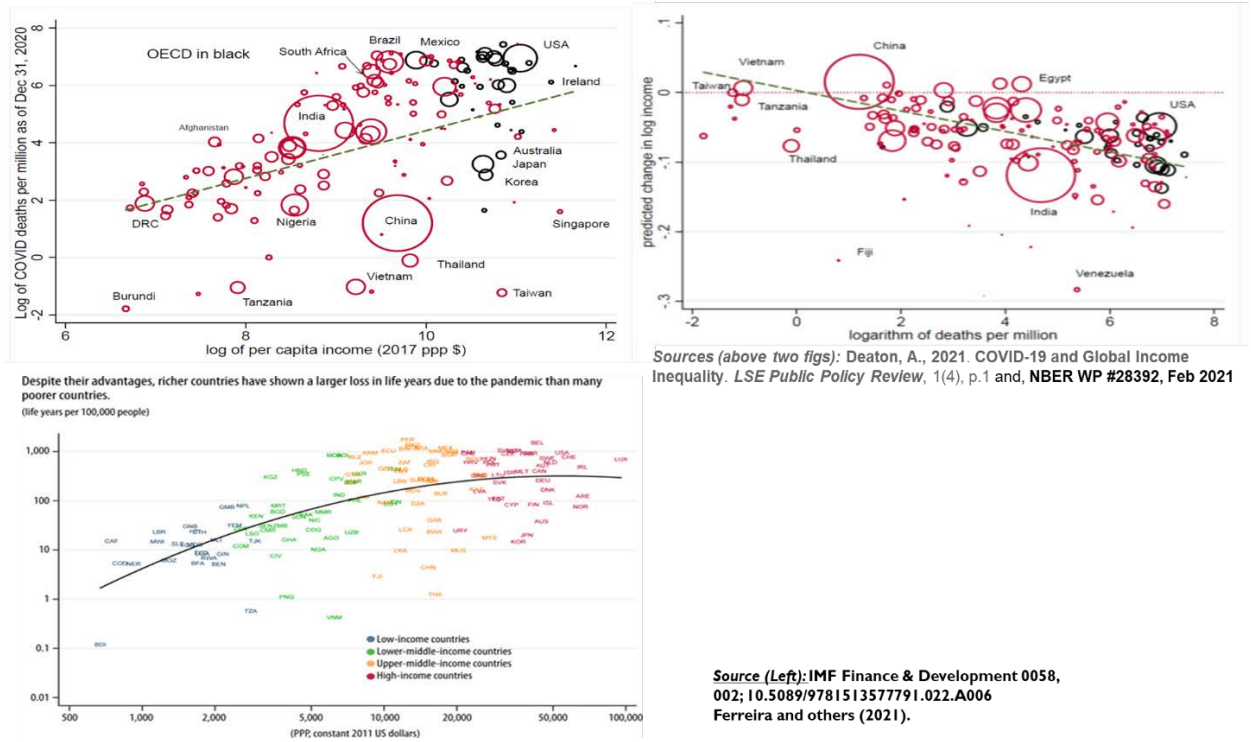

Figure 2: *Relationship between GDP per capita and fatality (loss of life).* ***Source:*** *Deaton (2021) and Ferreira (2021a)*

It is evident that there are huge gaps between high and low Gini groups though intra-group variations are quite low. Below, we present two tables from a secondary source, viz.,

Table 2 of Davies (2021a&b) a widely cited one, where columns for covid-19 death rates and mean income Gini show an inverse relationship.

Table 1: Gini coefficient and fatality rate of composite regions

Region	Geographic Description	Number of Countries	Share of Population (%)	Share of Total Deaths (%)	Mean Gini Coeff.	Mean Pov1.90 Headcount Ratio (%)
EAP	East Asia & Pacific	10	29.8	2.1	38.1	1.5
EurNA	Europe & North America	39	14.6	51.3	35.9	0.7
LAC	Latin America & Caribbean	23	8.7	31.5	48.2	4.1
MENACA	Middle East, North Africa & Central Asia	23	7.7	5.8	35.1	5.8
SAsia	South Asia	6	24.7	6.9	36.7	18.2
SubSah	Sub-Saharan Africa	40	14.6	2.4	41.4	45.6
ALL	All regions	141	100.0	100.0	38.6	12.5

Sources: Economic inequality and Covid-19 death rates in the first wave: A cross-country analysis by Davis (2021) in Covid Economics: Vetted and Real-Time Papers, **Issue 73, 23 March 2021, CEPR Press**

Table 2: Gini coefficient and fatality rate of countries for OECD, non-OECD, and other composite groups of regions

	% Share of World …				Mean Poverty Rate		
Country Group	Population	COVID-19 Deaths	COVID-19 Cases	Mean Income Gini	Pov	Pov5.5	SocPov
OECD	18.5	59.7	37.7	33.2	0.5	3.0	13.8
Non-OECD	81.5	40.3	62.3	40.3	17.9	51.1	31.8
East Asia and the Pacific	29.8	2.1	2.4	37.1	5.3	29.7	21.5
Europe and North America	14.6	51.3	35.1	31.9	0.8	4.6	13.8
Latin America and the Caribbean	8.7	31.5	34.0	46.1	6.3	29.5	26.8
Middle East, North Africa and Central Asia	7.7	5.8	8.1	33.9	5.5	35.0	21.6
South Asia	24.7	6.9	14.6	34.6	9.3	62.8	25.4
Sub-Saharan Africa	14.6	2.4	5.8	44.1	37.8	79.5	45.7
All countries	100.0	100.0	100.0	38.5	13.6	39.1	27.2

Notes: Means for the Gini coefficient and poverty rates are unweighted. For definitions and sources, see Table 1. COVID-19 = coronavirus disease 2019; OECD = Organization for Economic Co-operation and Development.

Sources: Economic inequality and Covid-19 death and cases in the first wave: A cross-country analysis by Davis (2021) in Canadian Public Policy December 2021 , pp. 1-17, https://doi.org/10.3138/cpp.2021-033

For example in Table 1, Gini values rise from Europe North America (35.9) to 48.2 (LAC) or, SAsia (36.7), or Africa (41.4), “share of total deaths” fall from 51.3 (EurNA) to 31.5 (LAC), to further 6.9 (SAsia) and 2.4 (SSAfrica). Similarly from Table 2, we observe that as mean income Gini goes up from 33.2 (OECD) to 40.3 (non-OECD), %-share of world for Covid-19 deaths fall from 59.7 to 40.3. Same pattern follows for other composite regions. South Asia and Africa had 6.9 and 2.4 % death rates respectively while their Gini values are 34.6 and 44.1 resp., quite higher than Europe and North America (31.9) with higher death rate of 51.3%. Combining the

composite regions' data on Mean income gini and Covid-19 death rates, despite a small sample size, we find by fitting a simple linear regression line—as postulated—an inverse relationship between Gini index and share of deaths in total (i.e., fatality rate). See Figure 3 below.

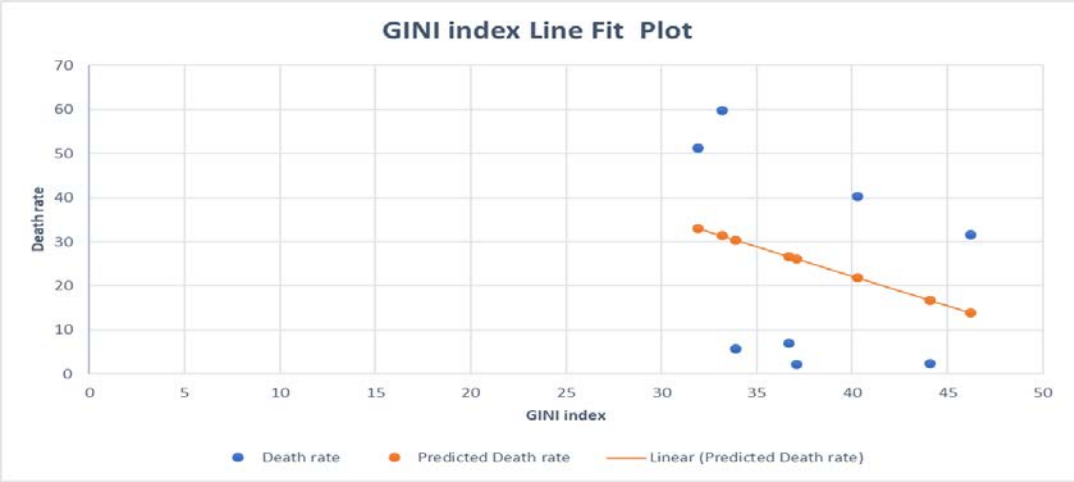

Figure 3: *Relationship between Gini Index and fatality (loss of life).* ***Source:*** *Authors' calculation.*
That brings us to our theoretical analysis in the next section.

3. Theoretical Perspective

Consider a small open economy with two types of workers, namely skilled (S-type) with higher wage due to higher marginal productivity and higher income, and unskilled or low-skilled ones (L-type) with relatively lower wage reflecting lower returns to skill. Most of the latter categories are working in the sectors with lower employability and hence, they work in informal sector with lower wages. Formal sector workers in these groups are protected by minimum wage. There is no open unemployment due to the existence of informal sector employment. Such segmented labor market has been analyzed in the literature by Carruth and Oswald (1981), Agenor and Montiel (1995) Marjit (2003), Beladi and Marjit (2003), Beladi et. al (2012), Chaudhuri and Mukhopadhyay (2014), Marjit, Ahuja, Pandey (2021) etc. In the wake of the pandemic— due to the rise of gig economy with online-delivery services and odd jobs are available to the unskilled workers those which higher income endowment will not opt for. Among the reservoir of the unemployed workers may be hired for household chores at a lower wage than the minimum wage. Marjit , Pant and Huria (2020) have explored in detail its implications for trade, immigration and wage gap. In this framework, such outsourcing of jobs

means that the low-wage workers are exposed to the pandemic via outdoor activities, which could otherwise be performed by the richer group.

As explained above, the poor or the low-skilled facing more exposure will have (relatively) higher endowment of immunity (threshold) but lower endowment of income or, wage. On the other hand, the rich with higher income endowment will naturally try to avoid exposure due to different perceptions of risks (i.e., risk-attitudes) affecting their behavior (see Abel et al. 2021, Shachat et al. 2021, Galiani 2022). Thus, two classes will engage in some kind of trade based on comparative advantage in income vis-à-vis acquired or herd immunity with the unskilled having comparative advantage in facing onsite exposure possibility due to acquired-immunity-endowment and the skilled benefitting from not getting exposed. The mechanism is based on the assumption that for each unskilled household, there are some employed and some are unemployed who will be allured to get the jobs which skilled household will not like to work because of exposure.

Notations are as below:

W_s: wage of the skilled

$\overline{W}$: minimum wage or some legalized wage rate for the unskilled.

W: wage rate at which the unemployed will be working so that $W_s > \overline{W} \geq W$.

P: Price of good x or the numeraire. The economy is price-taker in the world market

$\overline{S}, \overline{L}$: Skill and unskilled endowments,

x_i: Consumption of only one composite good for i[th] class where $i \in \{s, L\}$.

u_i: Utility function for i[th] class where $i \in \{s, L\}$ where $u_i' > 0, u_i'' < 0$,

e_i : Pandemic-threat related transaction costs due to apprehension of exposure or psychology of risk-aversion where $i \in \{s, L\}$, these are prior information to both types of agents. $0 < e_i < 1$

$L_e < L$ is total employment. Each low-income household is partially employed with spare time to work. $\frac{L_e}{L}$ hours is employment rate or span of working hours and hence, $(1 - \frac{L_e}{L})$ is duration of unemployment or unemployment rate. People go to market to buy single consumption good (assuming away online but even with online purchase they need people for delivery)

Now, $u_s = u[x_s - e_s x_s]$ (1)

$u_L = u[x_L - e_L x_L]$ (2)

Obviously, rise in e_i reduces utility and with fixed income, budget-constraint, or wage, x_i is fixed units. Original budget-constraints are given by: $W_s = P.x_s$ and $W = P.x_L$

Benchmark equilibrium without trade of works across classes or substitution of works is given by:

$$u_{s0} = u_s[\frac{W_s}{P}(1-e_s)] \quad (3)$$

$$u_{L0} = u_L[\frac{W}{P}(1-e_L)] \quad (4)$$

Now the rich can allure the poor to go to markets on their behalf and save 'e_s'. The poor can use their unemployed time to perform that job on a contractual or temporary basis.

Let 'l' be the number of unemployed workers (or, unemployment duration hours) in the poor household who are available to carry on the substituted works from the skilled rich. So, we write:

$$u_s = u[x_s(1-e_s(1-l))] \quad (5)$$

Thus, with $l = 0$, we are back with (1) above. Also, $u[.]$ is an increasing function of $l, u'(l) > 0$.

S-type maximizes (5) subject to $W_s = Px_s + W.l$ (6)

From first-order-conditions, $\frac{1-e_s(1-l)}{x_s e_s} = \frac{P}{W}$ (7)

Thus, $\frac{1-e_s(1-l)}{e_s} = \frac{Px_s}{W} = \frac{W_s - Wl}{W} = \frac{W_s}{W} - l$ (8)

On simplification, $2e_s l = \frac{W_s}{W}e_s - (1-e_s) \Rightarrow\ l^* = \frac{1}{2}[\frac{W_s}{W} + (1-\frac{1}{e_s})]$ (9)

From (9), $l^* = l^*(\frac{W_s}{W})$ (10)

$+$

It gives labor demand ($l^* = l^d$). Therefore, "l_d" is an upward sloping function of relative wage of the skilled and the unskilled types—see Figure 3. $\frac{\partial l^*}{\partial e_s} = \frac{1}{e_s^2} > 1$ ($0 < e_s < 1$) implying that the

more is the exposure-related transaction cost, the higher is demand for the low-skilled workers. As 'e_s' is high during pandemic, given labor-supply, 'l^d' rises causing 'W' to rise, translating into palliative effect, i.e., decline on inequality (alike Gupta, Woda and Malani 2021). However, our contribution lies in showing the underlying mechanism behind their stylized evidences. See Figure 4—below

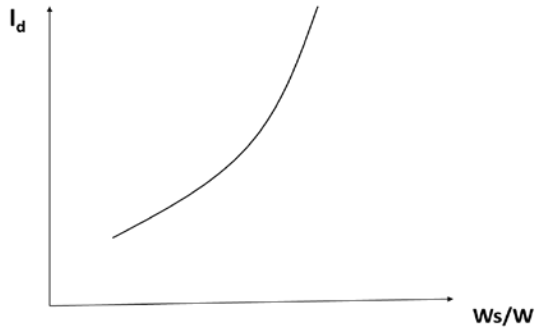

Figure 4: *Relationship between unskilled labor demand and skill-unskilled relative wage*

For a given $\overline{W}$ (legalized wage floor) if W_s rises, higher inequality will lead to hiring of those unskilled workers with free hours to work with even a wage $W \leq \overline{W}$. Similarly, with given W_s if W is much lower, then also same consequences would follow. In fact, in many countries with such reserve pool of low skilled unemployed or underemployed labor, the S-type individuals often negotiate a contract with $W \leq \overline{W}$, especially under Covid-19. By hiring more L-type, as the loss is minimized by the S-type cohorts it improves private benefits. Here, $l^* > 0 \Rightarrow u_s^* > u_{s0}$. By way of minimizing loss via delegating works to the otherwise unemployed workers, private welfare of the rich people is augmented. Labor reallocation will have a mitigating effect on the economic losses of Covid-19 led loss of output.[4]

For L-type, $u_l^* = u[x_l^*(1-e_L) - e_L l^* x_s^*]$. Note that L-type does not choose l^* or x_s^*. Since $x_L^* > x_{L0}$, for low-enough e_L, $u_L^* > u_{L0}$. Usually, for L-type workers "e_L" is low. Here also private welfare of the poor L-type is increased as they have extra income generated enabling their purchasing power for extra consumption.

[4] Of course, increase in such 'non-regular' and/or, 'gig or sharing economy' work with independent contracts depends on several factors, like propensity to assimilate them, or availability of such works, no labor market frictions, or market failures. However, we assume way such things without having any implications for our major thesis. Livelihood of affected workers is inextricably dependent on manifold factors.

Having derived the conditions for increasing private benefits through shifting works, we now turn to the case of Social Welfare (SW) in the economy. Private optimizing choice might be different from a societal perspective. Let 'V' be the SW-function for three classes—rich S-type, poor L-type with employment and other L-types sitting idle, such that:

$$V = u_s.S + u_{Le}.L_e + u_{Ll}.L_l = u_s[x_s(1-e_s(1-l)].S + u_{Le}[x_{Le}(1-e_L)].L_e + u_{Ll}[x_{Ll}(1-e_L) - e_{Ll}.x_s].L_l$$

Note that the total welfare of the unskilled is separated between those who are already employed and the newly employed in the household sector. We could aggregate that since we said each is working during their unemployed hours. Thus,

$$V = u_s[x_s(1-e_s(1-l)].S + u_L[x_L(1-e_L)(1-e_{Ll}.x_s)].L \qquad (11)$$

Here, $u_s^* > u_{s0}, u_L^* > u_{L0}(\,for\ e_L \simeq 0),$ as $x_L^* > x_{L0}$. Therefore, $V^* > V^0$ (QED).

However, the loss due to pandemic is separate due to differences in acquired immunity and survival after exposure. Let *Z* = Health-related loss. True loss parameters are $\tilde{e}_s, \widetilde{e_L}$ which are unknown beforehand because nobody knows their survival chance or stages of immunity and their levels.

$$\text{Z} = \tilde{e}_s.Sx_s(1-l) + \tilde{e}_L.x_L.L + \tilde{e}_L.l.x_sL = x_sl[\tilde{e}_L.L - \tilde{e}_s.S] + \tilde{e}_s.Sx_s + \tilde{e}_L.L.x_L \qquad (12)$$

Hence, we can compare:

$$Z^* - Z_0 = x_s^*l^*[\tilde{e}_L.L - \tilde{e}_s.S] + \tilde{e}_s.Sx^*_s + \tilde{e}_L.L.x^*_L - \tilde{e}_s.Sx_{s0} - \tilde{e}_L.L.x_{L0}$$

$$= x_s^*l^*[\tilde{e}_L.L - \tilde{e}_s.S] + (x_s^* - x_{s0})\tilde{e}_s.S + (x_L^* - x_{L0})\tilde{e}_L.L = \text{A} + \text{B} + \text{C} \qquad (13)$$

In (13), if $\widetilde{e_L} < \widetilde{e_S}$ due to immunity issue and endurance of hardships for the L-type vis-à-vis the S-type, the first term A< 0. In addition, B< 0 as the rich has to pay $Wl.L$ extra now to avoid pandemic threat. So, x_s^* falls with fixed W_s. But $u^* > u_0, x_L^* > x_{L0}$. Overall, $Z^* < Z_0$ is feasible.

4. A General Equilibrium Foundation

4.1 Core Model

Preceding section demonstrates how starting from an initial equilibrium (benchmark) with highly skewed wage inequality sudden exogenous pandemic shock could generate a palliative impact on the social welfare—that is, diminish the damaging impact through a mechanism generating internal work-substitution—via interplay of relative endowments of

acquired immunity and high wage income across two (broad) rich and poor classes. However, the demand for "l" and wages are determined in the general equilibrium system in this one-sector model as below.

Let $a_{jx} \forall j \in \{S, L\}$ be the unit labor requirements for x-sector so that we can write (assuming Perfect competition, constant returns to scale, and DMR) the P=Average Cost relation as:

$$W_s a_{sx} + \overline{W} a_{Lx} = P \qquad (14)$$

P (=P_x) is given for the price-taker small open economy. Full-employment condition for S-worker is:

$$a_{sx} X = S \qquad (15)$$

As mentioned before, every household in L-type has some employed workers working for the legalized wage rate and some unemployed ones who are available to work at any wage rate for survival. They can work at any $W < \overline{W} < W_s$ for large informal sector in a typical less developed economy. S-type hires them so that we write:

$$L_x + l_s . S = \overline{L} \qquad (16)$$

where $a_{Lx} X = L_x$. In this model, given P and $\overline{W}$, W_s is determined from (14). Given S, X-level is determined from (15). Using (16), plugging in X, S, given $\overline{L}$, we get l_s as labor supply for household activities of skilled workers. 3 equations determine 3 variables, viz., W, W_s and 'l_s'. Using (10), from $l_d^*(\frac{W_s}{W})$, once W_s is determined , 'l_d' will fall with rising W. 'l_d' is equated with 'l_s' in Fig-4 to determine *W* . This completes the determination of equilibrium values of variables in the GE system. Typically a richer economy will have *lower* amount to 'l_s' and it is likely to have lower degree of inequality than developing countries. This *tends* to increase 'l_d' as per our model analyzed above. Size of household industry will be lower there and hence pandemic should lead to greater infection and spread as the trade volume between low income and high-income workers will be less. See Figure 5.

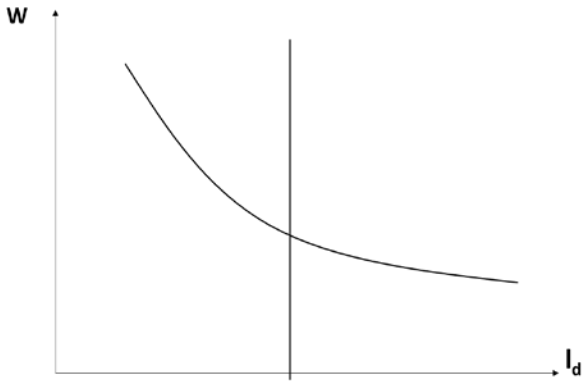

Figure 5: Relationship between unskilled labor demand and relative wage

Broadly speaking, in an economy three kinds of employability exists, viz., in the virtual or online sector, informal gig economy and traditional manufacturing sector. A consequence of phenomena as couched via the effects in the GE system could lead to bimodal inequality in the presence of a 'gig economy' already prevalent due to digitization (ICT) led on-demand virtual platforms (see Marjit, Mandal, and Nakanishi 2020). Although initially gig economy emerged for the knowledge sector with skilled workers engaged in web-based work platform, location-based platform (using physical world through digital applications) also flourished. With pandemic, the demand for workers increased with short-term contracts to fit the pandemic needs (customer-centered) to avoid exposure[5] (Hasija, Padmanabhan, and Rampal 2020; Alvarez de la Vega et al. 2020, Henderson 2020). Based on 'Online Labor Index' of Oxford University's measure of gig economy Umar et al (2022) shows positive effect on the informal activities with rise in average daily tasks or jobs and platform economy[6]. Typically, due to apprehension of exposure-intensity demand for high-skilled online professional services or technology sector with IT specializations are winners while others deemed non-essential contracts experienced lack of demand (Stephany et al. 2020). In this case, bipolar inequality could occur. The GE model could be easily extended to show such effect in the next section.

4.2. Extension

[5] See Gig apps for a pandemic economy: Part time, no commitment https://economictimes.indiatimes.com/tech/tech-bytes/gig-apps-for-a-pandemic-economy-part-time-no-commitment/articleshow/85587830.cms?from=mdr and Surprise Boom of Gig Economy at Wittenborg University, https://www.wittenborg.eu/gig-economy-rises.htm

[6] https://ilabour.oii.ox.ac.uk/

Here we consider two types of skilled workers—high and medium, and as before, unskilled ones with wages W_s, W_m, W respectively. Medium skilled ones are absorbed in the Y-sector (gig) along with the unskilled workers so that we can write:

$$W_s a_{sx} + \overline{W} a_{Lx} = P_x \qquad (14a)$$

$$W_m a_{my} + \overline{W} a_{Ly} = P_y \qquad (17)$$

Full-employment condition for M-worker is: $a_{my} Y = M$ (18)

Further, supposing Z is the informal (non-traded) sector: $a_{Lx} X + a_{Ly} Y + a_{Lz} Z = \overline{L}$ (19)

With pandemic S-type and M-type hires services from L-type for free unemployed work-hours so that: $a_{Lz} Z = l_s S + l_m M$ (20)

$$a_{Lx} X + a_{Ly} Y + (l_s S + l_m M) = \overline{L} \qquad (19a)$$

It is a 2-sector-3-factor specific factor structure where Eq. (14a) and (17) determine W_s, W_m (given $\overline{W}$). Eq. (15) and (18) determine X and Y, and (19a) determines '*W*'. For equilibrium in the market for services of such workers: $l_s^d = l_s^d(W_s/W) = l_s$ (21)

and $l_m^d = l_m^d(W_m/W) = l_m$ (22)

Therefore, from (19a), (21) and (22), we get:

$$a_{Lx} X + a_{Ly} Y + [l_s^d(W_s/W) S + l_m^d(W_m/W) M] = \overline{L} \qquad (23)$$

Simplifying, $l_s^d(W_s/W) S + l_m^d(W_m/W) M = \overline{L} - [a_{Lx} X + a_{Ly} Y]$ (23a)

Suppose $W_m = \overline{W_m}, \widehat{W_s} > 0$ as $\widehat{P_x} > 0, P_y = \overline{P_y}$. Thus, left-hand side of (23a) will rise and $\widehat{\frac{W_s}{W}} > 0$ must happen, and for equilibrium $\widehat{\frac{W_m}{W}} < 0$, $\widehat{W} > 0$. $\widehat{W}_s > \widehat{W} > 0 = \widehat{W}_m$ Overall, $\frac{W_s}{W}$ must rise and $\frac{W_m}{W}$ must fall. $\frac{W_s}{W_m}$ also rises. Polarized between high and low-skilled workers the medium-skilled workers are sandwiched. Figure 6 illustrates the mechanism.

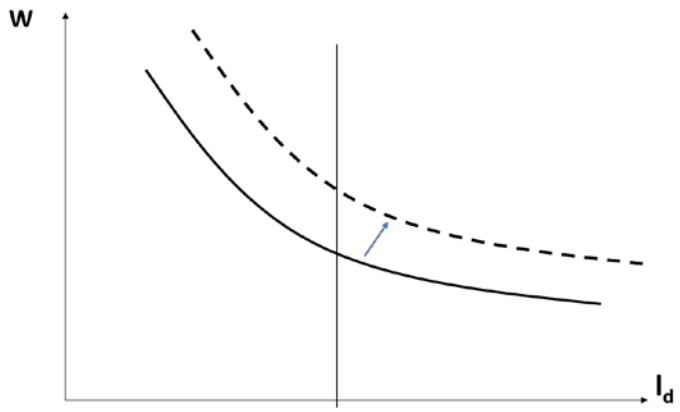

Figure 6: Comparative-statics effect of rise in demand for gig informal workers

This kind of polarized impact is possible due to any kind of exogenous adverse shocks with bimodal distribution in the labor market (Beladi, Marjit and Broll 2011). The informal gig sector provides services to the high and medium-skilled workers and the wages of the skilled and low-skilled rises at the expense of the medium-skilled workers. Gupta, Malani and Woda (2021) demonstrates that occupational recoveries after pandemic are quicker for the low skilled informal workers than the formal sector workers. Also, it is true that in professions that use virtual platforms have been relatively unaffected or flourished during pandemic. Here we demonstrate that rising demand for workers in household industry by the top skilled people can lead to a polarized impact by increasing informal wage. Growing top skilled wage would pull up the informal wage, but the mid skilled workers need to wait to recover occupational losses.

5. Concluding remarks:

Although public policy priority for the government would be to provide better health infrastructure, sanitation, and social security net in times of pandemic, however, given the status quo in terms of existing inequality in opportunity, this can have an impact beneficial for the social welfare. There are inequalities in wages among different types of workers (rich and poor) in different industries in both the advanced and underdeveloped economy. In addition, for workers performing in the unskilled sectors wages are sometimes different among these types of workers with roughly the similar levels (low) of skills. As the workers perform similar kind of works and they are paid differently, the rich could take advantage of the workers with unemployed work hours to perform works on their behalf. The threat of pandemic and risk of exposure induces the rich types to hire the low-skilled ones with no work or free hours, to do

some daily chores for which the rich has higher opportunity costs of sacrificing higher wages if they perform by themselves. By dint of such arrangements, the immunity of the poor with more exposure and some natural immunity enables them to undertake the works delegated by the high skilled professional workers and earn some income, consume more, to improve their private welfare. At the same time, the rich workers improve their welfare by minimizing their losses by transferring the works to the unskilled. Overall, by this reallocation of workers in the wake of pandemic-driven responses pre-existing inequality does not aggravate the existing social welfare under the pandemic due to immunity-factor; rather, it mitigates the supposedly adverse impacts of inequity or, economic losses without further aggravating it.

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