THE LUXURY OF LOCKDOWN

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Abstract

Regression analysis based on data from Oxford COVID-19 Government Response Tracker dataset and the World Bank datasets for 169 countries suggests that containment policies have, in general, a significant role in reducing the pandemic's fatality rate across all countries. However (i) there is at least a three weeks lag in realising the impact, (ii) the effectiveness increases with per capita income and, more specifically, (iii) workplace closure is ineffective in low-income countries. The analysis of data from Demographic and Health Survey (the DHS Programme) and IMF Policy Tracker indicates that developing countries are unlikely to have the basis required for effectively adopting stringent lockdown measures and instead would need to consider specifically targeted lockdown policies.

JEL Classification: H12, I18.

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1. Introduction

COVID-19 is a highly infectious disease because coronavirus spreads with relative ease. It is contagious even when carriers are asymptomatic and, in the early stages of the epidemic, on average one carrier can pass on the virus to more than two people (Sanche, 2020). The current pandemic has led to widespread morbidity and mortality as well as causing severe disruption of social, political, and economic aspects of daily life. Governments around the world have responded with unprecedented measures, imposing strict social distancing and lockdown rules, to suppress the spread of the virus. The early evidence suggests that, on the whole, these policies have helped in limiting the spread of the virus (Hartl et al., 2020; Castex et al., 2020).

Disease mitigation strategies require informed decision-making to ensure a balance between the protection of the vulnerable from disease and the maintenance of global economic activity. There are two essential actions involved in dealing with the pandemic in a country: (i) controlling the spread of the disease, and (ii) caring for the patients (Shiva, 2020). While these two actions are interdependent and should be taken simultaneously, the first is directly managed by the policy authorities and involves the design and implementation of containment policies (and managing their impact on the economy) whereas the second falls on the country's health care system (over and above its normal daily service provision). A country's ability and readiness to cope with extreme lockdown measures dictate the nature of containment policies it can accommodate, and the existing capacity of its health care system and the speed with which it can be expanded determine the extent to which it can care for pandemic patients while providing its routine services.

In deciding to impose strict social distancing and lockdown rules, governments assess a trade-off between maintaining a certain level of economic activity and the costs of a rapidly spreading virus. The aim of these highly restraining policies is to minimise the spread of the virus and reduce subsequent fatalities, but their successful implementation requires the ability to put in place practical policies that help preserve people's livelihood. In advanced economies this is feasible given resources at their disposal and, in fact, governments in high-income countries have put in place extreme fiscal (and monetary) policy measures to strengthen the public health services and to mitigate economic and social consequences of such policies. But less developed and developing countries face a very different situation due to severe budget constraints, weak infrastructure, limited health care capacity, relatively large share of the informal economy, overcrowded towns and similar development-related factors. Despite this, many such countries also chose to enforce relatively stringent lockdown measures. There is already an emerging literature whose findings casts doubt on the effectiveness of lockdown measures in low-income countries. Among the existing studies, IGC (2020), Glassman et al. (2020) and Dercon (2020) provide evidence based on mainly descriptive analysis of the available information while Castex et al. (2020) use statistical methods to quantify the impact of lockdown policies on disease transmission in different countries. Overall, there is evidence

that per capita income, health expenditure and trained medical staff, as well as population density and size, are likely to play a role in determining the effectiveness of underlying policies.

In this paper we have used data from 169 countries to investigate the impact of containment policies on fatalities on a global scale and have examined the extent to which their effectiveness across countries varies with their per capita income. Our regression analysis suggests that containment policies have a significant direct effect in reducing the fatality rate across all countries, beyond that achieved via reducing rate of infection. But we also find that (i) in general it takes at least three weeks for this effect to be realised, (ii) the effectiveness reduces with per capita income and, more specifically, (iii) in low-income countries workplace closure is completely ineffective. The latter finding is also supported by our feasibility analysis which shows that low income and lower-middle income countries are unlikely to have the minimum basis needed for effectively adopting stringent lockdown measures such as workplace closure. The sources of data used in this paper are briefly described in Section 2, Section 3 explains our statistical methodology and reports the results of our regression analysis, Section 4 considers the feasibility of containment policies in three countries chosen from different per capita income groups, and Section 5 concludes the paper.

2. Data

The main dataset used in our regression analysis is the Oxford COVID-19 Government Response Tracker (OxCGRT). This is a panel dataset which records – starting on 1 January 2020, for 169 countries and on a daily basis – information on a range of government responses to the crisis, including: *closures of education establishments* (all primary and secondary schools and colleges and universities); *closures of nonessential workplaces*; *cancellations of public events*; *restrictions on gatherings*; *closures of public transports*; *campaigns for informing the public*; *staying at home restrictions*; and *domestic* and *international travel restrictions*. Hale et al. (2020) have used these nine indicators to construct a *stringency index* which varies between 0 and 100 and reflects the strictness of government policies implemented to reduce the chance of being exposed to the virus and hence to reduce the number of infected individuals and subsequent fatalities. This dataset also records daily infection and mortality statistics across the countries. In addition, in order to take account of country specific characteristics – such as level of per capita income, per capita expenditure on health and population – in our analysis, we make use of the World Bank databank (WB, 2020).

The summary statistics for the relevant variables are provided in Tables 1 and 2. Table 1 shows that there is a clear difference between countries when they are classified into the four per capita income groups as suggested by the World Bank (low, lower-middle, upper-middle and high). This data is also presented differently in Figure 1 to highlight a relative comparison and stress the fact that poorer countries have, on average, a larger population size that is much younger, with more vulnerable employment and relatively very limited healthcare provision. Nevertheless, as Table 2 reveals, the average infection and mortality rates in poorer countries

happen to be below that of the rest. The reason for this seems to lie, at least partly, in their approach to implementing the containment policies: they score an average stringency index which is above that of high income countries and has a lower variability and, while their activities on testing practice and contact tracing are relatively lower, they appear to have followed a relatively strict workplace closure practice. This conclusion, as well as those derived from our regression analysis in the next section, are based on the assumption that data quality and testing intensity are not very different across the countries in the sample and should therefore be qualified by taking account the fact poorer countries face sever challenges in both respects.

It is worth noting that amongst the ingredients of the index '*workplace closure*' is probably the strictest, and is likely to be more effective since it drastically reduces physical contacts outside the household.[1] The recorded data show that, on average, 23 days after the outbreak most of the countries in the sample (109 out of 169) had shut down nonessential businesses. There are, however, good reasons to question the effectiveness of this policy in low-income countries. For instance, according to ILO criteria, a large part of employment in these countries can be classified as informal with no binding work contracts and protection of workers' rights[2] – based on the existing estimates, this figure is about 80% of total employment. In such settings, *recommending closure* would simply not work while *requiring closure* would most likely put the workers and their families in great difficulty, therefore forcing them to find ways of bypassing the restrictions. It is also likely that closing markets and nonessential businesses, limiting harvesting and restricting movements push most households into further severe poverty and result in famine. This is particularly worrying since on average about 40% of the population live below the poverty line. In the light of this, our aim in the Section 3 is to examine how the effectiveness of policies differ across groups of countries with different income groups.

In our case studies in Section 4 we focus on the feasibility of lockdown and used data from the following datasets to shed further light on the actual situation in representative countries within each group:

(i) The Demographic and Health Survey (DHS) programme collects individual and household level data on population, health, HIV, and nutrition through more than 300 surveys across 90 countries (ICF, 2020).

(ii) IMF Policy Tracker (IMF, 2020) compiles key national policy responses to COVID-19 pandemic.

3. The impact of containment policies

Denoting the value of *stringency index* of Hale et al. (2020) in country i on day t (the number of days since recording started) by $z_{i,t}$ and using $x_{i,t}$ to refer to the corresponding number of

infected patients recorded over the period up to t, the following distributed lag regression equation could be used to estimate the overall impact of the ingredient policies on the rate of infection

$$\Delta\log(x_{i,t}) = \beta_x + \sum_{s=0}^{q} \alpha_s z_{i,t-s} + W'_{i,t}\gamma + \varepsilon_{i,t}, \tag{1}$$

where $W_{i,t}$ is the vector of relevant country-level conditioning variables – such as introduction and nature of testing practice and existence of contact tracing that do not feature as components of z. α_s captures the impact of z after s days and we expect the total effect of z on rate of change of x, i.e. $\sum_{s=0}^{q} \alpha_s$, to be negative where the maximum lag-length q is determined empirically. The regression equation (1) could be interpreted as a statistical, stochastic, generalisation of the basic version of the theoretical *SIR* model initially proposed by Kermack and McKendrick (1927). The model is usually specified in continuous time τ and divides a constant population into three components consisting of *susceptible* (denoted by $S(\tau)$, are individuals who are exposed to infection), *infected* (denoted here by $x(\tau)$, are individuals who have already caught the disease and can transmit it to those who are susceptible – in the literature $I(\tau)$ is commonly used to refer to this class of individuals), and the rest (denoted here by $R(\tau)$, refers to those who have recovered or are resistant, and cannot catch or transmit the disease). $R(\tau)$ and $x(\tau)$ are assumed to evolve according the behavioural differential equations $\dot{R} = \gamma x$ and $\dot{x} = \beta S x - \dot{R}$ where a dot is placed over a variable to denote its derivative with respect to time, γ and β are constant positive coefficients, and the system of differential equations is completed by adding $\dot{x} + \dot{R} + \dot{S} = 0$ which imposes the assumption of constancy of population.[3] These behavioural equations imply $\frac{\dot{x}}{x} = \beta S - \gamma$ which in discrete time can be written as $\Delta\log(x_t) = \beta S_t - \gamma$. However, when S_t is very large and can be treated as a constant (subject to unpredictable random deviations) relative to the rest of the variables and parameters involved – as is the case at the initial stage of a nationwide, large population, pandemic such as COVID-19 – we can approximate $\beta S_t - \gamma$ by a positive constant coefficient, β_x say, and use the regression equation $\Delta\log(x_t) = \beta_x + \varepsilon_t$ where the stochastic disturbance term ε_t embodies the effect of all unrelated factors and the sample of observations for estimating β_x is based on random draws from a given population. When the sample involves a panel consisting of a number of countries indexed by $i = 1, \ldots, n$, which follow a set of containment policies with different emphasis and intensity and also differ in their main characteristics as explained in Section 2, the regression ought to be conditioned on the relevant county-specific factors as in (1) above so as to avoid introducing a bias in the regression residuals due to omitting shifts between countries. The estimated values of β_x and α_s therefore

reflect the *average responses* of the dependent variable to the corresponding explanatory variables across the countries within the sample.

Let $y_{i,t}$ denote the number of daily deaths recorded up to day t in country i. The relationship between $x_{i,t}$ and $y_{i,t}$ can then be quantified by estimating the following distributed lag regression equation

$$\Delta \log(y_{i,t}) = \beta_y + \sum_{s=0}^{p} \varphi_s \Delta \log(x_{i,t-n-s}) + V'_{i,t}\vartheta + \xi_{i,t}, \tag{2}$$

where the dependent variable is a measure of fatality rate, $V_{i,t}$ is the vector of relevant country-specific conditioning variables – such as population's health condition, national healthcare provision, income, poverty and inequality measures that do not feature as components of z, but excludes those that are accounted for in the index z – and it is assumed that there is a window of p days, which start n days after being infected, during which death from infection could occur – see Castex et al. (2020) and Wagner et al. (2020) and note that in practice p and n can be allowed to be determined by data.

In principle, the effect of z on x as well as on y could be worked out by estimating the above regression equations jointly. However, the fact that accurate data on x are not available undermines the robustness of estimates obtained in this way and it is more efficient, and informative, for our purpose to directly estimate a regression equation that is based on combining equations (1) and (2), which can be written as

$$\Delta \log(y_{i,t}) = \theta + \sum_{s=0}^{q+p} \eta_s z_{i,t-n-s} + \Omega'_{i,t}\delta + \sum_{s=l}^{k} \lambda_s \Delta\log(x_{i,t-s}) + u_{i,t}, \tag{3}$$

where $\Omega_{i,t}$ is the augmented country-specific characteristics vector which combines $V_{i,t}$ and $W_{i,t}$, $u_{i,t}$ is the augmented disturbance term, and $\Delta\log(x_{i,t-s})$ are included to control for the effect of excess variations in the infection rate where the lag l and duration k are allowed to be determined by data so as to reduce any serial correlation in the residuals.[4] The pattern of the estimated values of coefficients η_s and their statistical significance should reveal the nature of the overall impact of policies in reducing fatality beyond that captured by infection rates and moderated by other country-specific variables.

The sample of observations used in estimating the regression equation (3) is based on combining OxCGRT and WB datasets explained in Section 2. In order to determine the nature of the impact of $z_{i,t-n-s}$, we estimated (3) allowing for different lag structures and found that including more than one lag was problematic, mainly due to strong multicollinearity arising from the fact that the values of this index do not vary much from one day to the next. In Table

3 we report the coefficient estimates of the impact of the index based on including one lag only, denoted by $z_{i,t-m}$, for different lag length m. The statistical performance of the regression is best when m is set to four weeks and the statistical significance of coefficient estimate of $z_{i,t-m}$, $\hat{\eta}_m$, also reaches its highest level at that lag. The value of $\hat{\eta}_m$ however is rather small and implies that, on average, a 10 unit increase in the index is associated with a reduction of around 1% in fatalities, once we have controlled for variations in infection rates and other relevant factors. In order to ensure that $\hat{\eta}_m$ is as robust as possible, when estimating equation (3) we also took into account the following:

- Since data on elements of Ω_i are not available in daily frequency, we replaced Ω_i with country dummies (set to unity for country i and zero otherwise) and used the fixed effect estimator as in standard panel regressions.
- In the above specifications we have assumed for simplicity that the effect of z is linear but this need not necessarily be the case. Hence we experimented with both quadratic and logarithmic specifications as well, to capture any nonlinearity that might exist in the way the policy effect carries through, but opted for the linear specification after comparing the statistical performance of the underlying regressions.
- Because the pattern of time trend could differ across countries, we also tried including country-specific trend as well as a general time trend term. To capture any nonlinearity in trend we allowed for a cubic trend component.
- Given that data consist of daily observations and there is likely to be a systematic difference in the way individuals react to policies, for instance due to their cultural habits, we introduced week-day dummies to capture any daily variations unexplained by other factors.
- Finally, we also tried including a general time fixed effect to capture any daily shifts – on average across all countries – which other factors cannot account for.

Having found a significant effect associated with the stringency index, we now turn to our main objective of testing whether this effect is homogenous across countries with different per capita income. This is particularly motivated by current debates on the effectiveness of containment measures in lower-income countries (Castex et al., 2020; Ray and Subramanian, 2020; Baldwin, 2020; Nemzoff et al., 2020). To carry out the test, we used the income classification reported in Table 1 and created country-type dummy variables $IG_{i,t}^{j}$ to represent income groups, where the $j = 0,1,2,3$ respectively represents 'low income', 'lower-middle income', 'upper-middle income', and 'high income'; thus, $IG_{i,t}^{j} = 1$ if country i is within income group j and $IG_{i,t}^{j} = 0$ otherwise. We augmented the previously estimated regression equation with these dummies and their interaction with $z_{i,t-m}$, therefore using the following modified version of regression equation (3),

$$\Delta \log(y_{i,t}) = \theta + \eta_m z_{i,t-m} + \sum_{j=1}^{3} (\mu_j + \rho_j z_{i,t-m}) IG_{i,t}^{j} + H'_{i,t}\pi + \omega_{i,t}, \quad (4)$$

where, based on the previous results, we set the lag length m to 4 weeks. The vector $H_{i,t}$ comprises the rest of the (control, or conditioning) explanatory variables as explained above and $\omega_{i,t}$ is the random disturbance term. We have excluded $IG_{i,t}^{0}$ and used the low income group as the base group. The estimated effects of the index, based on panel fixed effect estimation of (4), reveal that the impact of z remains statistically significant but the corresponding *average marginal effects* (AMEs), represented by $\hat{\eta}_m + \hat{\rho}_j IG_{i,t}^{j}$ which are reported in Table 4, imply that containment policies are more effective the higher is per capita income; $\hat{\eta}_m + \hat{\rho}_j IG_{i,t}^{j}$ for the low and lower-middle income groups is significantly smaller than those of the upper-middle and high income groups. Put differently, our data does not support the hypothesis that containment measures affect fatality rates similarly across all countries, regardless of their per capita income levels.

To put our empirical finding in a more relevant context, it is worth noting that one of the main reasons for introducing containment measures is to slow down the speed of transmission so as to allow sufficient time for a health service system with a given capacity to prepare for caring for COVID patients with critical and severe symptoms while maintaining a target level for its regular services to non-COVID patients – see Shiva (2020). In this sense, therefore, one could argue that the ultimate effect of containment measures is to reduce COVID related fatalities and the containment policy could be seen as strategically essential in a country which can afford it. But this interpretation is not particularly relevant in a typical poor country which faces serious challenges in imposing effective social distancing, have already-overstretched hospitals and very limited capacity to rapidly scale up health care provision. For example: in a recent survey of 47 African countries undertaken by WHO (2020) revealed that there were on average nine intensive care unit beds per one million people; Roberton et al. (2020) estimate that a reduction in coverage of basic life-saving interventions of 15% for 6 months in low and lower-middle income countries is likely to lead to additional 253500 child deaths and 12190 maternal deaths; Maclean and Marks (2020) calculate that there are fewer than 2000 working ventilator units to serve hundreds of millions of people in public hospitals across 41 African countries, compared with more than 170000 units in the US; and Ismail et al. (2020) and Smith et al. (2020) find that investing in oxygen equipment instead of ventilators or ICU rooms is a more cost-effective strategy and a much quicker option in low- and middle-income countries.

Given that the stringency index represents the weighted average of a range of different policies, it is also important to explore the difference in the impact of its main ingredients across countries. As explained in Section 2, amongst these ingredients *workplace closure* is

probably the most effective measure and was adopted, on average, at the same scale by lower income countries but there are good reasons to doubt its sustained effectiveness in lower income countries. However, as can be seen from Table 2, *workplace closure* data used in constructing the stringency index consists of four types – '*no closure*', '*recommend closure*', '*require part closure*' (except some sectors or categories of workers) and '*require full closure*' (except essential workers) – and it is important to distinguish between these when checking the role of the policy. To investigate this, and to quantify the extent to which impacts of closure policies vary across countries within different income groups, we identify, and control for, countries in different income groups adopting one or more of the underlying policies. Consider the dummy variables $LD_{i,t}^{c}$ where the superscript $c = 0$ corresponds to the base policy of '*no closure*' and $c = 1,2,3$ respectively represent '*recommend closure*', '*require part closure*', and '*require full closure*'; thus, $LD_{i,t}^{c} = 1$ when country i has adopted policy c and $LD_{i,t}^{c} = 0$ otherwise. These dummies together with $IG_{i,t}^{j}$ income group dummies, and their interactions, are then included in the regression equation, forming an augmented version of equation (4) that enables capturing the role of specific policies in different country groups. However, since $LD_{i,t}^{c}$ dummies pick up the effect of *workplace closure* component of the *stringency index* z_i, we replace it with a new index, $\tilde{z}_i$, which excludes *workplace closure* and is based on a weighted average of the remaining eight policies instead (see Table 2 for a basic comparison of z_i and $\tilde{z}_i$), and therefore estimate the regression equation

$$\Delta \log(y_{i,t}) = \theta + \tilde{\eta}_m \tilde{z}_{i,t-m} + \sum_{j=1}^{3} (\tilde{\mu}_j + \tilde{\rho}_j \tilde{z}_{i,t-m}) IG_{i,t}^{j} + \sum_{c=1}^{3} (\varphi_j + \sigma_{j,m} \tilde{z}_{i,t-m}) LD_{i,t}^{c} + H_{i,t}' \tilde{\vartheta} + \tilde{\omega}_{i,t}, \quad (5)$$

where we have put a "~" over $\eta, \mu, \rho, \vartheta$ and ω to distinguish them from those in equation (4). Table 5 reports the values of the relevant AMEs based on coefficient estimates of equation (5) obtained with the lag length m fixed at 4 weeks. These support our conjecture that the impact of *workplace closure* on fatalities is not universal and depends on a country's economic development level, here approximated by its per capita income: a total shutdown of workplace is effective in all but low-income countries where all types of work closure policies are found to be statistically insignificant. In order to ensure that these results are not specific to fixing the lag length m at 4 weeks we also checked the AMEs obtained when it is set to 3, 5, 6 or 7 weeks which supported the same conclusion.[5]

Our findings are consistent with the narrative in the related literature that questions the usefulness of the strategy when a country's policy authorities decide to emulate other countries' approach in dealing with the pandemic. When policies are not modified to take account of the country's economic strength, well-being, welfare provision and indigenous cultural

characteristics, people are likely to either ignore them or find ways around them, rendering the policies ineffective. Baldwin (2020) warns that "*if the implied wellbeing losses involve hunger and/or outrageous inequalities, the intolerance could manifest itself quickly and chaotically*" (pp. 1).

Our results also highlight the importance of using 'smart' or 'targeted' lockdown policies on the grounds that country-specific conditions call for designing particular policies that work better given underlying circumstances. An example of a targeted policy for India is outlined in Ray and Subramanian (2020), where they argue against a comprehensive lockdown and propose their 'reasonable alternative' whereby young adults are allowed to work while elderly members of households are insulated and cared for by their own families. Ferguson et al. (2020) explain that targeted social distancing such as putting in place more stringent measures for the elderly might be a more appropriate strategy even in high-income countries. Glassman et al. (2020), IGC (2020), and IASC (2020) further provide practical guidance for a range of alternative realistic pandemic policy responses for low income countries and Broadbent et al. (2020) develop and propose a customisable framework and policy decision tool. In Section 4, therefore, we try to illustrate below by example how a basic feasibility assessment can reveal useful information on identifying and targeting a policy in different countries.

4. Feasibility of containment policies

There are two main requirements, or necessary conditions, for successfully implementing a lockdown policy which imposes strict home isolation to achieve maximum social distancing via reducing, as much as possible, contacts with non-family members: (i) state's ability to enforce the underlying rules; and (ii) households' actual capacity to abide by those rules. Of these, clearly, the latter is more problematic since blanket imposition assumes that all households can tolerate the economic and psychological pressures that rapidly develop in such situations. In fact, the risks involved are considerable and policy authorities are, in general, keen to have an assessment of their feasibility in this context. However, it is understood that these risks are very likely to be amplified in low income countries which face a severe shortage of hygiene farcicalities – e.g. in 2015, only 15% of sub-Saharan Africans had access to basic hand-washing facilities (Unicef, 2020) – and most households have extremely limited savings and liquidity so it is conceivable that a rapid rise in unemployment and a considerable loss of income can lead to food insecurity, malnutrition, and starvation.

To highlight developing countries' readiness for a lockdown and provide an idea of practicality of the underly policies, we follow the methodology introduced by Jones et al. (2020) and use three case studies – one from each of low income, lower-middle income and upper-middle income groups – to illustrate the relative extent to which countries in different income groups face such problems. We would like to emphasise at the outset that our analysis

below is merely illustrative and to this end we have chosen Afghanistan, Nigeria and Colombia on the basis of their income group respectively, their location (one from each continent), some similarity in their main demographic properties, and availability of more recent data, and the fact that in response to the pandemic these countries have enforced a lockdown policy, including work place closure, for a period of time.

The survey data from the DHS programme provides information on the indicators described by Jones et al. (2020), namely households' access to: *Electricity*; *Clean Drinking Water*; *Improved Sanitation*; *Telephone* (*landline or mobile*); and *Regular or Formal Employment*.[6] A summary of our findings for the three countries chosen is presented in Table 6. Combining this information with IMF policy tracker enables us to compare governments' response to the pandemic given the readiness of households.

Our case studies analysis suggests that all three governments tried to mitigate the pressure on vulnerable households by introducing a variety of protective policies. However, the level of support and number of people who benefit from such measures depend on state's capacity.

In Afghanistan, there is a support programme that provides free bread to needy families, but its coverage is limited to a very small portion of households in the whole country (Saif, 2020). 90% of the population in the country (around 30 million people) do not have access to electricity, clean water, or improved sanitation (based on 2015 estimates) and most people need to go out of their house for their basic needs. This is especially prevalent in rural areas where only about 1% of the population have access to all the above-mentioned necessities. In addition, given the state's limited capacity, it is very unlikely that those who need support can receive it in good time. As Dercon (2020) explains, even though rural population is relatively less prepared, those working in informal sector in urban areas and non-farm sector in rural regions are likely to be in a worse situation in this respect. It is worth mentioning that 94% of the country's population is not involved in regular or formal employment. Thus, enforcing a lockdown policy might have severe consequences, as could be seen by the increased number of Afghan families falling into poverty since the initiation of lockdown. Oxfam (2020) estimates that the number of people on the brink of famine in Afghanistan has risen substantially just after a month into the lockdown.

In Nigeria, where the formal employment rate is substantially higher than Afghanistan – 51% compared to 6% – people on average enjoy a slightly better economic condition. But access to clean drinking water and electricity, which is even lower than in Afghanistan, remains a serious challenge; e.g. approximately only one in five of urban residents and one in ten of rural residents have access to clean drinking water in their premises. This portrays a similar survival situation; most people (89%), especially in rural areas (99%), need to go out of their house for their basic needs and it is very unlikely that those who need support can receive it in good time. At the time of writing this text, three major states in the country are under lockdown and there is a nationwide night-time curfew. There are some concerns with imposing lockdown

in densely populated cities such as Lagos since, instead of social distancing, this might force a large number of people to be crammed in a single room in poor sanitary conditions and without easy access to most basic hygiene facilities. Despite the sharp decline in oil prices, which occurred at the same time as the pandemic and shrank the state's financial capacity, a number of expansionary monetary and fiscal policies were introduced to keep the impaired economy alive. However, a nation-wide lockdown, especially if it includes work place closure, seems inappropriate given the low readiness of the population and their reliance on their jobs.

In Colombia, which is classified as an upper-middle income country, data suggest that most people are likely to survive stay-in conditions with respect to their basic needs; 80% of the population has access to the three above-mentioned necessities. Thus, unlike Afghanistan and Nigeria, it would be justified if the authorities paid some attention to secondary considerations such as income support for low-skill workers and provision of infrastructure to facilitate remote-working for high-skill workers. The government has in fact implemented measures to support the vulnerable via fiscal policies such as a payroll subsidy equivalent to 40% of the minimum wage per worker for specific businesses that have substantially suffered from the lockdown.

In comparison to the above groups of countries, in a typical high-income country there are two core considerations which feature at the forefront of any feasibility study. The first involves the extent to which households' main survival needs – essential food, health and safety requirements – are met. Unless the provision is adequate, even a short-term lockdown will be ineffective as household members will need to make multiple daily trips outside their home. In the UK, for example, ONS (2020) records that almost all residents have access to electricity and running water, around 99% enjoy standard sanitation, telephone coverage is comprehensive and about 95% of adults have access to internet. Therefore, the problem is mainly a matter of providing adequate protection for the most vulnerable for their safety, security, and loss of income and jobs to minimise threats of falling into perpetual poverty trap. This brings us to the second consideration, which concerns the fiscal sustainability of financial compensation policies which is a considerable challenge in a situation where production and trade have substantially reduced and most of low-skill workers as well as a considerable proportion of high-skill workers are not able to work. In a study of the EU countries, Midoes (2020) finds that 99 million individuals live in households whose savings would not cover their most basic expenses (e.g. food, utilities and rent/mortgage) beyond two months. Clearly, any commitment to protect incomes and jobs of these individuals will require a considerable shift in fiscal policy in high-income countries where, as Ferguson et al. (2020) observe, "*no public health intervention with such disruptive effects on society has been previously attempted for such a long duration of time. How populations and societies will respond remains unclear*" (pp. 16).

5. Summary and conclusion

Using the OxCGRT and the World Bank datasets, our regression analysis reveals that containment policies have a significant direct effect in reducing the fatality rate of COVID-19 pandemic. However, there is at least a three weeks lag in realising the impact. We also find that the effectiveness of these policies reduces across countries with per capita income, and that workplace closure is likely to be completely ineffective in low-income countries. This is due to two inefficiencies, (a) weak state capacity, and (b) unreadiness of people to abide by the restrictive rules. The former refers to low health and financial capacity, and poor infrastructure. For instance, even if we manage to deliver more ventilators to the least-developed countries across Africa, there are neither enough trained medical personnel who could utilise the machines, nor reliable electricity supply and piped oxygen facilities. The presence of these basic considerations is taken for granted in developed countries' hospitals, but they are frequently absent in health facilities across low-income countries. Also, most developing-country governments have large levels of external debt, low tax revenues, and high credit risk which makes it difficult for them to borrow (Loayza and Pennings, 2020), hence undermining the feasibility of enforcing lock-down policies that cannot be accompanied by adequate financial easing to facilitate stay-in conditions. Our case studies, based on data from DHS surveys and descriptive information from IMF Policy Tracker for Afghanistan, Nigeria and Colombia – which are chosen to demonstrate the situation of countries from different income groups – imply that readiness to implement lockdown measures varies drastically across developing countries.

It is worthwhile stressing that even those households that have adequate access to the infrastructure to satisfy their basic needs in-house face financing problems. Whereas most of the high-skill workers would be able to maintain their income if they could carry on with their work remotely, low-skilled workers whose jobs require physical presence at workplace are likely to struggle, especially in developing countries where a large portion such of jobs are informal. Various measures are being taken across the world to make sure that formal sector workers are not laid off and retain some of their earnings. Nevertheless, even rich economies struggle to provide financial support to casual workers and the self-employed. This dire situation calls for pragmatic and effective solutions, tailored to the reality of poor and developing countries.

On the whole, our evidence highlights the importance of using 'smart' or 'targeted' approach to imposing lockdown measures for developing countries as long as they are tailored for the local conditions and do not blindly emulate those recommended mainly for high-income countries. Whilst there is evidently no 'one-size fits all' response to this worldwide crisis, the unprecedented nature of the situation calls for a rapid learning of effective measures (Shiva, 2020) so as to minimise stress and casualties across different countries; Dercon (2020) identifies these as 'no-regret policies' which are effective but carry minimal risk.

Endnotes

[1] For example, Ferguson et al. (2020) find that school closure is suggested to be insufficient to mitigate or supress an epidemic in isolation and the WHO-China (2020) Joint Mission report suggests that 80% of transmissions were likely to have occurred within the households that did not stay in.

[2] ILO (2003) defines informal employment as comprising the total number of informal jobs, whether carried out in formal sector enterprises, informal sector enterprises, or households, during a given reference period.

[3] See Thompson (2020) for a discussion of using the *SIR* model to predict the evolution of COVID-19 infections in the UK and to develop a better understanding of decisions about the timing of policies. Rodrigues (2016) discusses the new developments in the application of *SIR*-type models and Giordano et al. (2020) develop and apply a generalised version of *SIR*, called *SIDARTHE*, which consists of 8 differential equations and use it to model the spread of COVID-19 in Italy.

[4] Idiosyncratic residual serial correlation is likely to result in these regressions because the dependent variable is bound to exhibit a systematic pattern of fluctuation which is unlikely to be captured by the main explanatory variables which cannot, by definition, embody such fluctuations. The only variable which could have similar fluctuations to the dependent variable on the same frequency is the rate of growth of infections. Hence adding the latter as explanatory variables increases the robustness of the estimates of coefficients of the stringency index.

[5] These results are not reported but are available from the authors on request. As a referee points out, these results and conclusions disregard the fact that some workers were already working from home before the policy was implemented, and that the fraction of the labour force working remotely is likely to be higher in high income countries. In the absence of data, we hope that country fixed effects and country group dummies at least partially correct for the impact such discrepancies.

[6] Two examples from the existing studies that have used this method are: Jones et al. (2020) for Mozambique who conclude that it would only be feasible to immediately lockdown around 6% of all households, that only 13% of all households are partially ready for lockdown since they have access to basic services but lack the required financial capacity, and that the rest are totally unprepared; Nemzoff et al. (2020) for Bolivia who find that only 2.3% of households are fully ready for a lockdown while 44.8% are totally unprepared.

Conflict of Interest Statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Table 1. Summary Statistics for Country Groups Classified by Per Capita Gross National Income[1]

	All Countries	Low Income	Lower-Middle Income	Upper-Middle Income	High Income
Number of countries and their percentage in the sample	169 100%	28 16.57%	41 24.26%	43 25.44%	57 33.73%
Per capita GNI range in current US$[2]	--	below 1026	between 1026 & 3995	between 3996 & 12375	above 12375
Per capita GDP, in constant 2011 PPP international $	20621 (21588) {671,113262}	1721 (627) {671, 2924}	5893 (2463) {2568, 11627}	14970 (5086) {7401, 27291}	44667 (20887) {16561, 113262}
% of the population living below the poverty line[3]	10.28 (16.64) {0, 70.3}	40.11 (18.73) {4.8, 70.3}	13.71 (15.29) {0.04, 57.5}	3.61 (4.89) {0, 18.9}	0.45 (0.54) {0, 2.4}
Population (millions of persons)	44.2 (153) {0.034, 1390}	24.0 (23.6) {2.214, 106}	72.7 (212) {0.537, 1340}	61.0 (211) {0.0715, 1390}	20.6 (47.8) {0.034, 325}
Population density (persons/ km^2)	366.5 (1779.3) {0.136, 20479.8}	119.4 (131.7) {7.37, 485.64}	146.6 (226.2) {2.01, 1226.63}	101.0 (141.2) {2.9, 665.87}	833.8 (2988. 5) {0.13, 20479.7}
% of above 65 years old in total population	8.97 (6.42) {1.085, 27.57}	3.06 (0.82) {1.94, 5.72}	4.97 (2.66) {2.09, 16.43}	9.09 (4.52) {3.32, 21.02}	14.97 (6.25) {1.08, 27.57}
% of vulnerable employment in total employment	37.15 (28.01) {0.14, 94.5}	77.87 (15.68) {32.43, 94.58}	51.63 (18.81) {14.85, 80.05}	28.72 (13.98) {3.29, 55.23}	10.11 (6.71) {0.14, 34.22}
Per capita expenditure on health, in current US$	1114.8 (1840.1) {16.3, 9869.7}	36.3 (17.0) {16.4, 86.3}	112.1 (63.1) {34.2, 293.9}	420.3 (213.8) {152.6, 1015.9}	3004.3 (2272.5) {596.9, 9869.7}
Number of hospital beds per 1000 people[4]	3.23 (2.41) {0.3, 11.5}	1.17 (1.41) {0.3, 4.8}	2.18 (2.23) {0.6, 8.8}	3.14 (2.47) {0.6, 11}	4.17 (2.18) {1.2, 11.5}

Source: World Bank databank (WB, 2020).

[1] The full period is from 1 January to 8 June 2020. The first number in each cell is the sample (or subsample) mean, followed by its standard deviations in parentheses; below these, the corresponding minimum and maximum values are given within the curly brackets.

[2] This classification of countries based on their per capita GNI level is suggested by the World Bank.

[3] Poverty headcount ratio is at $1.90 per day in 2011 PPP and values reported are based on the average of 2014-2018, or any value available during this period as data are not collected annually for all countries. Data are missing for 50% of low income countries, 22% of lower-middle income countries, 32% of upper-middle income countries, and 40% of high income countries.

[4] Data for hospital beds are missing for 67% of low-income countries, 56% of lower-middle income countries, 28% of upper-middle income countries, and 24% of high-income countries.

Table 2. Basic Summary Statistics for Variables Used in Regression Analysis[1]

	All Countries	Low Income	Lower-Middle Income	Upper-Middle Income	High Income
Sample size	*14730*	*2040*	*3349*	*3710*	*5631*
Daily growth rate of mortalities, $\Delta ln(y_{i,t})$	0.0478 (0.123) {-0.286, 1.60}	0.0363 (0.120) {0, 1.098}	0.0420 (0.114) {0, 1.386}	0.0524 (0.127) {0, 1.609}	0.0524 (0.126) {-0.286, 1.57}
Daily growth rate of infected, $\Delta ln(x_{i,t})$	0.0780 (0.151) {-0.953, 2.37}	0.0759 (0.157) {-0.953, 1.65}	0.0753 (0.147) {0, 2.37}	0.0796 (0.144) {-0.080, 2.07}	0.0793 (0.155) {-0.075, 2.35}
Stringency Index, $z_{i,t}$	67.744 (25.055) {0, 100}	67.639 (20.592) {0, 96.3}	72.965 (23.988) {0, 100}	72.856 (24.874) {0, 100}	61.309 (25.771) {0, 100}
Modified Stringency Index[2], $\tilde{z}_{i,t}$	68.382 (24.79) {0, 100}	68.639 (19.90) {0, 95.98 }	73.881 (23.80) {0, 100}	73.318 (24.68) {0, 100}	61.767 (25.45) {0, 100}
Testing Practice:[3]					
Type 1	0.074 (0.262)	0.109 (0.312)	0.069 (0.253)	0.095 (0.294)	0.050 (0.218)
Type 2	0.501 (0.500)	0.733 (0.442)	0.467 (0.499)	0.463 (0.498)	0.462 (0.498)
Type 3	0.299 (0.458)	0.121 (0.326)	0.347 (0.476)	0.323 (0.467)	0.319 (0.466)
Type 4	0.122 (0.327)	0.035 (0.185)	0.107 (0.309)	0.117 (0.322)	0.166 (0.372)
Contact Tracing:[4]					
Type 1	0.150 (0.357)	0.162 (0.369)	0.130 (0.336)	0.224 (0.417)	0.109 (0.312)
Type 2	0.385 (0.486)	0.442 (0.496)	0.421 (0.493)	0.359 (0.479)	0.361 (0.480)
Type 3	0.462 (0.498)	0.395 (0.488)	0.444 (0.497)	0.415 (0.492)	0.527 (0.499)
Workplace Closure:[5]					
Type 1	0.214 (0.410), **9**	0.246 (0.430), **4**	0.194 (0.396), **2**	0.179 (0.383), **2**	0.236 (0.425), **1**
Type 2	0.086 (0.218), **7**	0.093 (0.290), **2**	0.078 (0.269), **1**	0.057 (0.233), **1**	0.108 (0.311), **3**
Type 3	0.378 (0.485), **45**	0.400 (0.490), **9**	0.392 (0.488), **12**	0.325 (0.468), **5**	0.398 (0.489), **19**
Type 4	0.320 (0.466), **108**	0.260 (0.438), **13**	0.333 (0.471), **26**	0.437 (0.496), **35**	0.256 (0.436), **34**

Source: Oxford COVID-19 Government Response Tracker (Hale et al., 2020).

[1] The full period is from 1 January to 8 June 2020. The first number in each cell is the sample (or subsample) mean, followed by its standard deviation in parentheses; below these, the corresponding minimum and maximum values are given within the curly brackets.

[2] $\tilde{z}_i$ excludes *workplace closure* and is constructed in the same way as z_i on the basis of the 8 remaining indicators.

[3] Type 1: no testing policy; Type 2: testing specific individuals with symptoms; Type 3: testing anyone with symptoms; Type 4: open public testing.

[4] Type 1: no contact tracing; Type 2: tracing contacts with specific individuals with symptoms; Type 3: tracing contacts with anyone with symptoms.

[5] Type 1: no action; Type 2: recommending closure; Type 3: require part closure (excludes specific priority sectors/workers); Type 4: require full closure (excludes all essential sectors/workers). The figure in bold after the standard deviation in each cell is the actual number of the countries that followed the specific policy type.

Table 3. Fixed Effect Estimates of Coefficient Estimate of $z_{i,t-m}$

Lag m	Estimate of η_m	t-ratio	Within R^2	Between R^2	Overall R^2
1 week	0.000615	3.57	0.0996	0.0043	0.0822
2 weeks	-0.00017	-0.98	0.0963	0.0121	0.0882
3 weeks	-0.00101	-8.65	0.109	0.0556	0.1023
4 weeks	-0.00107	-10.32	0.1117	0.1149	0.1087
5 weeks	-0.00084	-8.13	0.1062	0.1199	0.1067
6 weeks	-0.00056	-5.3	0.1013	0.0628	0.0982
7 weeks	-0.00015	-1.39	0.0994	0.0041	0.0882
8 weeks	0.000075	0.75	0.0977	0.0005	0.0841

The estimates are based on Equation (3). The regression equation for each row included only one $z_{i,t-m}$. The full period is from 1 January to 8 June 2020. The sample size with 8 weeks lag is 13756. The t-ratios are based on standard errors clustered at the country level. In the interest of saving space we only report the relevant coefficient estimates in Tables 3 and have provided the full set of estimates in the online Appendix.

Table 4. Fixed Effect Estimates of the Average Marginal Effects of Stringency Index at Different Per Capita Income Levels

Income Groups	Estimate	St. Error	z score	95% Confidence Interval	
Low Income	-.0008077	.0001512	-5.34	[-.0011041	-.0005113]
Lower-Middle Income	-.0008242	.0001033	-7.98	[-.0010267	-.0006218]
Upper-Middle Income	-.0012016	.000112	-10.73	[-.0014211	-.0009821]
High Income	-.001331	.0001309	-10.17	[-.0015876	-.0010744]

Estimates are based on Equation (4) with 4 weeks lag and the standard errors are clustered at the country level. The sample size is 14591.

Table 5. Estimates of the Average Marginal Effects of the Stringency Index at Different Per Capita Income Levels

	Estimate	St. Error	z score	95% Confidence Interval	
Low Income					
Type 2 : Recommend closure	-0.007437	0.02514	-0.30	[-0.0567105	0.0418364]
Type 3: Require part closure	-0.0290175	0.0158845	-1.83	[-0.0601506	0.0021156]
Type 4: Require full closure	-0.0251344	0.0152981	-1.64	[-0.0551181	0.0048493]
Lower-Middle Income					
Type 2 : Recommend closure	-0.0115163	0.0193542	-0.60	[-0.0494499	0.0264172]
Type 3: Require part closure	-0.0303993	0.0132559	-2.29	[-0.0563803	-0.0044183]
Type 4: Require full closure	-0.0385359	0.0135953	-2.83	[-0.0651822	-0.0118896]
Upper-Middle Income					
Type 2 : Recommend closure	-0.0108084	0.0103968	-1.04	[-0.0311857	0.009569]
Type 3: Require part closure	-0.0381196	0.0118442	-3.22	[-0.0613337	-0.0149055]
Type 4: Require full closure	-0.0344651	0.0094437	-3.65	-0.0529744	-0.0159559]
High Income					
Type 2 : Recommend closure	-0.0190401	0.0112498	-1.69	[-0.0410894	0.0030092]
Type 3: Require part closure	-0.0287052	0.0091373	-3.14	[-0.0466139	-0.0107965]
Type 4: Require full closure	-0.0438838	0.0116527	-3.77	[-0.0667227	-0.021045]

Estimates are based on Equation (5) with 4 weeks lag and the standard errors are clustered at the country level. The sample size is 14591.

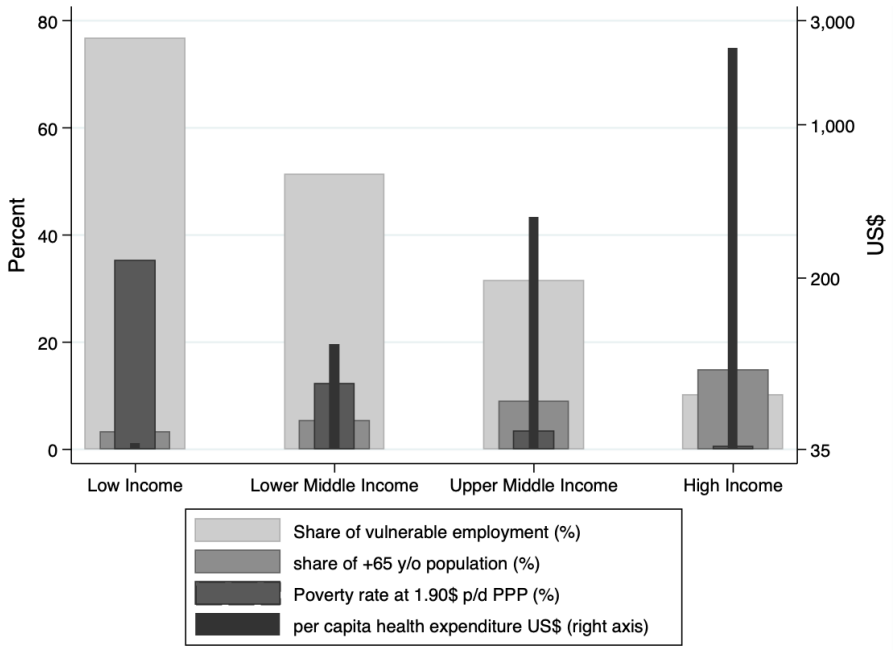
Table 6. Lockdown Readiness (the DHS programme)

		National (%)	Rural (%)	Urban (%)
Afghanistan	Electricity	72	66	89
	Clean Drinking Water	25	17	48
	Improved Sanitation	24	14	54
	All three above	***10***	***1***	***30***
	Telephone (*landline or mobile*)	86	84	99
	Regular or Formal Employment	6	6	7
Nigeria	Electricity	55	38	80
	Clean Drinking Water	16	12	22
	Improved Sanitation	51	37	71
	All three above	***11***	***1***	***18***
	Telephone (*landline or mobile*)	87	82	99
	Regular or Formal Employment	51	46	60
Colombia	Electricity	96	86	99
	Clean Drinking Water	83	55	93
	Improved Sanitation	93	77	99
	All three above	***80***	***48***	***92***
	Telephone (*landline or mobile*)	95	89	99
	Regular or Formal Employment	54	40	58

Source: the DHS programme (ICF, 2020).

We used household and individual recodes. Afghanistan and Colombia data are based on 2015 survey, Nigeria based on 2018. Safe drinking water is defined as drinking water on premises from the public network, tube or protected well, or bottled mineral water. Improved sanitation is defined as flush toilet inside the household or compound or improved latrine. Regular or formal employment includes individuals who work all year and excludes seasonal and occasional workers. The legal working age is set to 16.

Figure 1. Selected Characteristics of Countries that Enforced Workplace Closure



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