EXPLORING THE BACKYARD OF nCOVID: DETERMINANTS OF DEATH TOLL IN PANDEMICS

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ABSTRACT

Heterogeneity in number of deaths in different countries during the ongoing nCOVID crisis challenged us to look for determinants of pandemic death toll across the world. Using the past two decades data of pandemic deaths in the world, this study considered if engagement in international trade, health care expenditure and population density have any impact on the pandemic death toll. Using linear regression model controlled for types of disease, we not only found trade significantly impacting death toll, but also surprisingly found positive correlation between share of healthcare expenditure in GDP and fatalities in pandemics. Our findings suggest that policy intervention is required for mitigating health impacts of trade and ‘tweaking’ the health expenditure towards pandemic prevention.

KEYWORDS

pandemic, global trade, healthcare

JEL Classification: F10, F13, I18, Q18

INTRODUCTION

The recent eruption of nCOVID pandemic has seen 2,379,975 nCOVID-19 cases and 163,921 deaths as on the 19th April 2020 [1] is not the first pandemic in human history. Death toll in pandemics have been more horrific than nCOVID so far. To count a few of them, Black Death of 1347 killed 75 million, Spanish Flu of 1918 killed 100 million and Asian Flu of 1957 killed 2 million people world over.[2] Unfortunately, nCOVID may not be the last pandemic, as virus strains continue to evolve. [3] Since history throws light on the factors affecting pandemic spread [4], there was no greater need for studies on the subject than now. Pandemics are occurring more frequently with the passage of time, and this increase is observed to be concomitant with the increase in economic activity such as trade and travelling.[5] While mode of transmission of such disease outbreaks remains ambiguous, [6] studies are attempting to bring some clarity on the channel which increased economic activities might be correlated with disease outbreaks.

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International trade, which means integration of domestic economy with the world economy is unavoidable as it is quintessential to growth. [7] Apart from impact on economic conditions such as growth, poverty and financial development, trade has been studied for impact on biodiversity, [8] environment [9] and health. [10] Overall impact of population density was dealt comprehensively by Ehrlich and Holdren [11] and environment impact of the same was also taken up. [12] Health expenditure has been found to be impacting inequality, [13] economic growth [14] and of course health outcomes. [15] Trend of trade, population density and healthcare expenditure globally is explained in following panels:

**Panel 1. Trade as % of Global GDP**

**Panel 2. Global Population Density (People/Sq Km)**

**Panel 3. Global Health Expenditure (% of GDP)**

**Panel 4. Global Health Expenditure (US$ /Capita)**

It is apparent that trade, population density and healthcare expenditure, all have increasing trends. The question is how these factors impact fatalities in pandemics. Surprisingly, studies on pandemic impact on either trade, population density or health-expenditure are conspicuous by absence. This question is important since response to pandemics has to be decided with global cooperation in the wake of capacity imbalance. [16] We study impact of global trade, health care expenditure and population density upon virus-borne and bacteria-borne pandemic deaths of the last two decades. We contribute by doing this first such study, to the best of our knowledge. Our findings suggest that two key policy interventions are required: one for mitigating health impacts of trade and second for ‘tweaking’ the health expenditure towards pandemic prevention. Results of our model indicate a positive correlation of trade and (surprisingly) negative correlation between share of healthcare expenditure with death toll in pandemics.

The structure of the paper is the following: Section 2 reviews the existing literature on nexus between disease outbreaks and global trade integration. Section 3 entails the need of such analysis. Section 4 describes the methodology including data sources, model specification and
econometric methods. Section 5 discusses the findings; followed by the concluding remarks in Section 6.

LITERATURE REVIEW:

Literature on pandemics is profound in the natural sciences. Emergence and re-emergence of zoonotic infections by different influenza virus has been discussed for genetic evolution by Taubenberger and Kash. [17] Influenza pandemics like Spanish (H1N1), Asian (H2N2) and Hongkong (H3N2) have been discussed for genetic patterns by Kilbourne. [18] Natural science studies like these have immense value since vaccination is the final saviour in such pandemics. [19]

Since disease outbreaks have become globalised [20] and frequent, [21] literature in social science has also become populated in the recent past. The literature on pandemics spread and economic activity nexus can be divided into two broad streams as depicted in the Figure 1 below:

FIGURE 1. TWO STREAMS OF LITERATURE ON ECONOMIC ACTIVITY AND PANDEMICS

Literature on first stream (impact of economic activity on pandemics spread) is scarce compared to the second stream (impact of pandemics spread on economic activity). Our study belongs to the first stream. The 1918 influenza epidemic motivated much research on determinants of pandemics spread and Taubenberger & Morens [17] can be termed as the seminal paper in this field. Around the same time, the question of impact of trade on child health has been discussed for many countries. [23] The role of administration in bioterrorism has been discussed for many countries. [24] The risk analysis for China has been done in relation to Nipah virus outbreak.[25] Most of the studies have been lacking in either control variables or the number pandemics included like diarrhoea, chicken pox and flu were included in a study examining impact of economic activity upon disease spread.[26] We found that determinants of HIV spread have been abundantly discussed in Hunt, [27] Altman [28] and Kieh & Jr. [29] but other diseases have had less attention in the literature. The literature is not profound on the determinant side also, like Hosseini et al [30] found air travel and livestock export positively correlated with pandemic spread, but did not examine factors like healthcare expenditure in the study.

While there are many studies on the impact of disease outbreaks on the economy, especially after NCOVID, [31] literature on determinants of pandemics is scarce, to best of knowledge of the authors’, and this paper attempts to fill this gap.

We should not leave this literature review without mentioning the important stream of response towards pandemics. The prescription paper [32] highlighted weaknesses and strengths of approaches for drug-makers, Osterholm [33] highlighted that the world is under-prepared for dealing with pandemics. Enemark [34] argued that every country needs to consider virus borne outbreaks in other countries as “their own”. Thus, literature on determinants of pandemic spread, a stream to which our study belongs, is very relevant in the present context of nCOVID crisis.

METHODOLOGY

DATA AND METHOD:

To investigate the question what determines the mortality rate due to pandemics, the candidates for capturing the damage are: number of lives lost due to disease (death toll)
and number of people infected (caseload). In our study, the death toll was chosen as the dependent variable instead of caseload because of two reasons: one, there could be misreporting in caseload data and second, death toll captures the effect of healthcare expenditure. We use panel data for 50 pandemics that raged the world during 1990 to 2019. There were pandemics before this period also, but this period was found suitable for study as frequency of pandemics was higher during this period indicating increased vulnerability.[35] Also, since the world became more and more open for trade during this period, [36] we were motivated to probe if there is any impact of trade on pandemic death toll during the period. Data and source are as in Table 1.

As multiple linear regression models are widely used in healthcare literature, [43-45] we also use the multivariate linear regression model in our study.

Our model specification is as follows:

\[ DPCPY = \alpha + \beta_1 TGDP + \beta_2 HCPC + \beta_3 PDEN + \beta_4 HCGDP + \beta_c X_c + \mu_1 \ldots \ldots \] (1)

Where TGDP, HCPC, PDEN and HCGPD are main variables and Xc are control variable for diseases. Trade is one of the main explanatory variables, which we want to study. Population density is the obvious choice for explanatory variable as disease spread and fatality rate will be impacted by how closely people are settled.[46] Per-capita healthcare expenditure and percentage share of GDP in healthcare capture the granularity of healthcare expenditure. Since fatality rates vary for types of diseases, [47] we control for the type of disease using dummy variables for different diseases in our model. Variables studied are summarized as Table 2.

### TABLE 1. VARIABLES AND DATA SOURCES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>SOURCE</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT</td>
<td>Death toll in disease outbreaks per capita per year</td>
<td>World Health Organization (WHO) database</td>
<td>Floret et al. (2006)</td>
</tr>
<tr>
<td>TGDP</td>
<td>Trade as percentage of GDP</td>
<td>World Integrated Trade Solutions (WB) database</td>
<td>Constantinescu et al. (2020)</td>
</tr>
<tr>
<td>HCPC</td>
<td>Healthcare expenditure in $ per capita</td>
<td>World bank database</td>
<td>Reeves et al. (2014)</td>
</tr>
<tr>
<td>PDEN</td>
<td>Population density in people per sq. km of land area</td>
<td>World bank database</td>
<td>Hathi et al. (2014)</td>
</tr>
<tr>
<td>HCGDP</td>
<td>Healthcare expenditure as percentage of GDP</td>
<td>World bank database</td>
<td>Davoodi et al. (2010)</td>
</tr>
</tbody>
</table>

### TABLE 2. DESCRIPTIVE STATISTICS

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>MIN</th>
<th>MAX</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT</td>
<td>10.85</td>
<td>0.001</td>
<td>262.4</td>
<td>42.39</td>
</tr>
<tr>
<td>TGDP</td>
<td>61.29</td>
<td>20.08</td>
<td>209.49</td>
<td>39.68</td>
</tr>
<tr>
<td>HCPC</td>
<td>1233.36</td>
<td>24.62</td>
<td>8335.87</td>
<td>2043.64</td>
</tr>
<tr>
<td>PDEN</td>
<td>126.82</td>
<td>2.82</td>
<td>454.93</td>
<td>140.64</td>
</tr>
<tr>
<td>HCGDP</td>
<td>6.92</td>
<td>2.56</td>
<td>20.4</td>
<td>3.71</td>
</tr>
</tbody>
</table>
We observe from the above table the heterogeneity in country variables and the disease death toll as well. We have run the linear regression duly including the disease control variables.

### RESULTS

Regression results are presented in the Table 3 and our explanatory variables could explain 43% of the variation in the dependent variable. Though coefficients of healthcare expenditure per capita and population density are having signs as expected (negative and positive respectively), they are not found significant in our study. We find significant impact of share of GDP spent upon healthcare. Interestingly, each additional % of GDP spend upon healthcare results into about 7 more death per capita in a year due to pandemics in a country.

**TABLE 3: RESULTS OF REGRESSION**

<table>
<thead>
<tr>
<th></th>
<th>Coeff</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>intercept</td>
<td>-67.73</td>
<td>0.003</td>
</tr>
<tr>
<td>TGDP</td>
<td>0.428</td>
<td>0.017</td>
</tr>
<tr>
<td>HCPC</td>
<td>-0.006</td>
<td>0.143</td>
</tr>
<tr>
<td>PDEN</td>
<td>0.053</td>
<td>0.261</td>
</tr>
<tr>
<td>HCGDP</td>
<td>6.97</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**R Square** 0.639  
**Adj R Square** 0.435  
**F Statistic** 3.13 (**)  

**IMPACT OF TRADE:**

We found the coefficient of trade as a percentage of GDP significant and positive. This means countries with higher dependence of their economy on trade are likely to be more vulnerable to pandemics. This empirical finding is first ever in the literature (to the best of our knowledge) and thus our contribution to the literature. This also means that with increasing trade openness in the world, perhaps the necessary guard against the danger of pandemics has been missed by countries.

**IMPACT OF HEALTHCARE EXPENDITURE:**

It is worthwhile to underscore here that coefficient for healthcare expenditure per capita is negative (which means more per capita expenditure results into less deaths in pandemics) but the coefficient of healthcare expenditure as a percentage of GDP is positive (which means countries spending more of their GDP on health goes against pandemic death prevention). The former is in agreement with the findings that argue for universal coverage for primary healthcare. [48] But the latter should lead to much needed further research on prioritisation of healthcare expenditure. These findings are important for developing countries as they have low income elasticities of health expenditure.[49] As the 2020 nCOVID crisis has highlighted healthcare expenditure needs re-design so as to deal with pandemics.

**IMPACT OF POPULATION DENSITY:**

We find that densely populated countries are significantly more impacted by pandemics. As seen from Panel 4 of the Section-I, global population density has more than doubled in last few decades, this finding is on the expected lines, but empirical statement of relationship with pandemics is brought out in our study. This calls for re-design of urban clusters for saving lives from pandemics. This is a huge challenge as increase in population density is concomitant with economic growth.[50] Since healthcare reform with community engagement [51] has the potential to address such challenges, more study in this direction will be of great value. It is time that research for pandemic-resistant urban spaces stems from the literature.

Infectious disease outbreak happens due to human-to-human contacts across geographies [52] and if we go by the argument that such contacts are random, [53] we can assume pandemics as random experiments of disease-causing virus. Though our regression results only mean correlation and more research is required to establish causality, with the randomness assumption, our results qualify as causal enough to at least draw the attention of policymakers in the economic growth-chasing world.

**CONCLUDING REMARKS**

Our findings indicate positive correlation between international trade and pandemic death toll. For every additional 1% contribution of trade in GDP of the country, per capita death toll goes up by 0.428. This finding has serious repercussions in the era of globalization. Our findings are in agreement with findings of recent nCOVID death toll across the world. Top 5 countries (as on 15th April 2020) by death toll are USA, Italy, Spain, France and UK and their healthcare expenditure as percentage of
We draw two policy implications:
1. Countries, which have their economies heavily reliant upon trade, need to take special safeguards against pandemic outbreaks.
2. Countries need to redesign their health care expenditure so as to cope with the pandemics. Apart from primary secondary and tertiary healthcare, fourth dimension of pandemic healthcare need to be institutionalized.

It has been recognised that response to pandemics has to be globalised [54] as characterised by the concept of ‘One Health’. [55] Thus our findings need appreciation by both academics and policy makers while long term strategies are being formulated in the wake of the nCOVID crisis. There is a procedurally established system of ‘health inquiries’ the importance of which was highlighted by [56] and empirical evidence like the one brought out in this study will help in taking the inquiry further.

References


56. Day GE, Casali GL. Do health inquiries lead to health system change? What have we learnt from recent inquiries and will the same mistakes happen again? Asia Pac J Health Manag. 2015;10(3):Si32.