

# Quantifying Economic Vulnerability to COVID-19 Pandemic: A Cross-county Study

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## Abstract

*This study is an attempt to quantify the vulnerability of countries to the COVID-19 crisis based on some select criteria which had played crucial role during past crises as well as the factors specific to the COVID-19 pandemic. Apart from assessing the initial conditions, various economic indicators have also been selected which get affected by the COVID-19 crisis through various channels of transmission. The challenge in selection of indicators is to make the exercise comprehensive enough as to capture both the direct and indirect channels through which the pandemic could hit economic activities. In the next step, these select indicators are combined to arrive at a single vulnerability index based on which countries could be ranked in the declining order of their vulnerability to the crisis. The index is constructed based on three distinguishable building blocks: (i) the severity of the shock, (ii) the exposure of a country to these shocks measured in indicators representing several transmission channels, and finally (iii) a country's ability to resist to these shocks or the degree of resilience of a country to these shocks. Overall, advanced economies exhibit lower exposure and higher resilience as compared to the emerging and developing economies within our set.*

## 1. Introduction

The COVID-19 pandemic is proving to be a defining global health crisis - the first of its kind, the world has witnessed in the 21st century. The virus erupted first in Wuhan province of China in December 2019, and gradually engulfed the entire world to be raised to the status of a pandemic by the World Health Organisation. As on September 7, 2020, the total confirmed cases in the world stood at 2,70,65,789 with 8,83,742 casualties. India has surpassed Brazil and emerged as the second most severely impacted country after the US, and crossed the mark of 4 million confirmed cases (more than 15 per cent of global cases). Though active cases are still rising death rate at 1.72 per cent however is significantly lower than the world death rate (3.27 per cent). All the affected countries had to bear its direct effect in the form of lockdown, containment measures, and social distancing wreaking havoc on the health care system as well as on the economy. Moreover, the developing countries have to bear an additional blow in the

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<sup>1</sup> The views expressed in the paper are those of the authors and not of the RBI. The usual disclaimer applies.

form of spill-over effect from the rest of the world through various channels of integration simultaneously at work further deepening their disaster.

Just as the spread of the disease was not uniform across countries, its economic impact has also been diverse. The early signs of economic activity indicated that the severity of economic calamity triggered by COVID-19 pandemic would not be uniform across the world. The United States registered an all-time high contraction in GDP by 31.7 per cent (q-o-q annualised and seasonally adjusted) during the April-June quarter of 2020. Euro Area and the European Union contracted by 15 per cent and 14.4 per cent (q-o-q annualised and seasonally adjusted), respectively, during the same period. As per the IMF World Economic Outlook of June 2020, the growth prospects for emerging market and developing economies (EMDEs) for 2020 further deteriorated from a contraction of 1 per cent to that of 3 per cent. This however exceeds the downward revision of the advanced economies from 6.1 per cent to 8 per cent of contraction. Particularly for India, growth forecast is revised downward to a contraction of 4.5 per cent in 2020. The middle and low income countries face larger hurdles as capital outflow coupled with the fear of downgrade of credit ratings in case it deviates from macroeconomic conservatism, limit the extent of additional spending by the Government required to combat the crisis. Sovereign credit ratings for South Africa, Mexico and India<sup>2</sup> have already been downgraded post COVID outbreak while a number of others with negative outlook are at high risk of facing downgrade in due course. Moreover, the risk of inflation, current account deficit are all critically intertwined with fiscal deficit which warrants a much cautious action on the part of developing economies.

Gauging the ramification of COVID-19 pandemic has since been the main focus not only for the policy makers in every individual country that was taken in its fold, but also for several multilateral agencies and academic scholars. It is now widely understood that how economies emerge from this crisis could shape the world economic order in the post-COVID era. Historically, there are evidence of strong recovery made by countries post crises. The speed with which Germany, Japan, Britain and France recovered after the World War II is testimony to the tendency of market economies to return to their previous performance when normality is restored (The Economist, May 2020). In general, there are a few common factors which are

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2. Post COVID-19 outbreak, Moody's downgraded India to the lowest investment grade Baa3 with a negative watch while S&P retains India's credit rating at BBB- with stable outlook. Fitch has retained BBB-status but revised outlook to be negative.

crucial determinants of the pace of recovery in the aftermath of every crisis which includes economic structure, strength of macro-fundamentals, integration with rest of the world, quality of institutions and not the least the nature and extent of support from the Government. This paper is an attempt to quantify the vulnerability of countries to COVID-19 crisis based on some select criteria which had played crucial role during past crises as well as the factors exclusive to the COVID-19 pandemic.

The present study adopts vulnerability approach to quantify susceptibility of a set of 34 advanced and emerging market economies. Apart from the channels of transmission recognised in the existing literature as common to any crisis are, we have also incorporated the channels specific to the COVID-19 crisis. The endeavour is to cover both direct and indirect channels of transmission. This pandemic being a health crisis which necessitates social distancing and avoidance of certain activities as precautionary measures, sectors providing non-essential luxury and recreational services such as hotel and restaurants, tourism and transports, arts and entertainment have taken the hardest hit. The lockdown imposed also called for shift in the mode of work and resorts to work remotely wherever possible. However, all countries were not in same degree of readiness to adopt work from home and those with higher share of activities which could be done remotely and having the necessary infrastructure to do so are likely to be more resilient. Thus, a total of 20 indicators representing various channels of transmission are classified under three distinguishable building blocks (Essers, 2013): the severity of the shock, the exposure of a country to these shocks measured in indicators representing several transmission channels, and finally a country's ability to resist to these shocks or the degree of resilience of a country to these shocks. These blocks are then combined together using suitable formula to arrive at a single vulnerability score, based on which countries are ranked; the highest rank conferred to the country with highest degree of vulnerability. It is important to mention here that this study is a work in progress and will be further revised when IMF would release updates on country GDP forecast in October 2020.

A composite vulnerability score for individual countries is important for several reasons. First, countries possess varying degree of vulnerability to different categories. Some countries may have strong domestic macro-fundamentals but vulnerable external sector, while some country may be fiscally sound but the sectoral composition is at a higher risk. A suitable aggregation of each country's level of vulnerability under individual categories into one composite indicator would present a fair relative position while outlaying a combined effort by countries

to combat the crisis. Second, this would contribute to optimal allocation of aids and support packages across countries by multi-lateral agencies based on needs. Third, the knowledge of relative position among the peer countries would help individual countries to discover the right combination of policies going forward. It can be presumed that COVID-19 pandemic would significantly alter the trajectory of foreign trade and investment flows in near future and the countries presenting higher resilience to the crisis would fare better in attracting foreign funds. A country-level composite vulnerability score may anchor decision making in these regards. Our choice of indicators is guided by both evidence from past history of crisis as well as the specific features of the present crisis which is elaborated in the following sections.

The rest of the paper is structured as follows: Section 2 presents review of existing literature relating to crisis and vulnerability. Section 3 presents a picture of initial macroeconomic conditions of countries at the advent of global financial crisis in 2008 *vis-à-vis* that of COVID-19. Section 4 provides a detailed description of the indicators used in the construction of the vulnerability index and the broader channels of transmission of crisis. Data sources, methodology and the building blocks of the composite vulnerability indicators are discussed in section 5. Section 6 presents the outcome *i.e.*, vulnerability position of countries in each broader category as well as at aggregate level. Section 7 concludes the paper.

## **2. Literature Review**

Capturing vulnerability of the countries to external shocks has been a pertinent topic of study which gained all the more relevance in the post GFC era. Concept of economic vulnerability has been discussed in many studies which have come up with indices reflecting the potential instability that can be triggered by an exogenous shock and whether the economy can withstand the shocks and recover with minimum damage. Vulnerability as a part of macroeconomic study has also gained relevance as it is detrimental to development and sustained growth. Higher vulnerability in one or the other dimension may lead to higher instability due to potential shocks which keep the economies in trap of low economic development.

So far various studies have examined multiple dimensions of the economies ranging from inherent structural factors to policy actions which can help them stand insulated in the times of shock. Briguglio (1992) as one of the initial studies in this domain constructs index for ranking countries according to their economic vulnerability. Briguglio (1995) also attempts to provide vulnerability ranking to 114 countries with varying weights to the sub -indices and reveals the

weaknesses of the small island developing states (SIDS) rendering them vulnerable to forces outside their control. Guillaumont, (2006, 2009) have discussed in detail the importance of studying vulnerability and its relevance in achieving sustained growth. It breaks down the concept of vulnerability into three components: size and frequency of exogenous shock, exposure to shocks and the capacity to react to the shock or the resilience comprising of both structural as well as non-structural parts. IMF have also come up with a detailed analytical framework for a Vulnerability Exercise for low income countries (VE-LIC, 2011) to bring out the macroeconomic vulnerabilities which are important obstacle to economic growth and development particularly for the low-income countries.

COVID-19 is a situation where instead of an economic shock, there is a natural health disaster having a negative impact on the economies world-wide without any question. Firstly there is huge damage in terms of loss of lives and health and secondly the economic downturn due to the containment measures as well the potential subsequent behavioural changes which are expected to have a long lasting impact on the economy. This study looks at fairly large set of variables covering multiple dimensions of exposure and resilience. The creation of vulnerability index in this scenario provides direction for policy makers to focus on the essential resilience building issues so that the economies can withstand any potential second wave of the epidemic.

A longer perspective confirms that even globally crisis of such magnitude has been rare. Since 1870, across 18 industrialised economies, there have been only 47 instances in which a country ever experienced an annual decline in output of more than 10 per cent and majority of such events occurred during the world wars and the Great Depression during 1930s (Maddison project database, 2018)<sup>3</sup>. In the post-world war period, across rich countries, there have been no occasion when an economy experienced an annual decline in GDP by more than 10 per cent. Although there is no such study available for the developing countries for such a long stretch of time. We have observed from sample of 58 developing, low income and middle and low income countries in the post war period since 1960, that economic contraction is very less prevalent even among developing countries *albeit* higher than the rich countries (World Development Indicator, The World Bank, 2020). Except during 2009-the aftermath of the GFC

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<sup>3</sup> The Maddison Project Database developed by the Groningen Growth and Development Centre of the University of Groningen, Netherland provides information on comparative economic growth and income levels over the very long run. The 2018 version of this database covers 169 countries and the period up to 2016.

when more than 50 per cent developing countries experienced contraction in GDP, in all other occasions GDP contraction was never such a wide-spread phenomenon. We also gather a few lessons from the history of strong resurgence made by countries post crisis. First, the countries which made stronger recovery from crisis were those with strong governments that enjoyed a fair amount of legitimacy (albeit with very different political systems). Second, most of these countries had very little inequality, which surely contributed to the sense of a joint enterprise. Finally and relevantly, it has been observed that countries where strong institutions were absent there was no rebound when the conflicts ended. Instead, the countries plunged into further chaos. Therefore, quality of institutions also play a crucial role in the road to recovery.

### **3. The Initial Conditions**

The initial conditions *i.e.* the macro-economic fundamentals of an economy before the crisis also determine to a large extent how effectively the crisis could be managed. One major difference between the Global Financial Crisis (GFC) of 2008 and the COVID-19 pandemic has been with respect to these varying initial economic positions. The global economy entered into the GFC from a prolonged period of boom, strong fundamentals and lower indebtedness. On the contrary, the global economy was already heading on a downward trajectory registering lowest GDP growth since the GFC in 2019, just before the COVID-19 kicked in. Therefore, the initial condition is found to be much adverse in case of COVID-19 crisis compared to that of the GFC in terms of GDP growth (Table 1). While the inflation in most countries is found to be lower than pre GFC period for most of the countries, fiscal balance<sup>4</sup> is adverse for more countries, and external balance presents a more mixed picture. More than half of the sample in the table, the fiscal and current account positions in pre-COVID year is worse than the pre-GFC year.

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<sup>4</sup> In case of fiscal deficit, (in IMF' terminology General government net borrowing/lending) IMF and Indian presentations differ, particularly regarding disinvestment and license-auction proceeds, net versus gross recording of revenues in certain minor categories, and some public-sector lending. Accordingly the estimates of fiscal deficit as per India's official data differ with that of IMF.

Table 1: Initial conditions prior to GFC <i>vis-à-vis</i> . COVID-19								
	Real GDP Growth		CPI		Fiscal Deficit		Current Account Deficit	
COUNTR	2007	2019	2007	2019	2007	2019	2007	2019
Argentina	9.0	-2.2	8.8	53.5	0.8	-3.9	2.1	-0.8
Bangladesh	6.5	7.9	9.1	5.7	-2.2	-5.2	0.7	-2.7
Brazil	6.1	1.1	3.6	3.7	-2.7	-6.0	0.0	-2.7
Chile	4.9	1.1	4.4	2.3	7.9	-2.6	4.3	-3.9
China	14.3	6.1	4.8	2.9	0.1	-6.4	9.9	1.0
Colombia	6.7	3.3	5.5	3.5	-0.8	-2.2	-2.9	-4.3
Croatia	5.3	2.9	2.9	0.8	-2.2	0.0	-6.7	2.9
Czech Republic	5.6	2.6	2.9	2.9	-0.7	0.3	-4.6	0.0
Hungary	0.2	4.9	8.0	3.4	-5.0	-2.0	-6.7	-0.8
India	9.8	4.2	6.2	4.5	-4.5	-7.4	-1.3	-1.1
Indonesia	6.3	5.0	6.3	2.8	-0.9	-2.2	1.4	-2.7
Malaysia	6.3	4.3	2.0	0.7	-2.6	-3.2	14.7	3.3
Mexico	2.3	-0.1	4.0	3.6	-1.5	-2.3	-0.9	-0.2
Morocco	3.5	2.2	2.0	0.0	-0.1	-4.1	-2.5	-4.2
Nigeria	7.3	2.2	5.4	11.4	-1.1	-5.0	10.5	-3.8
Poland	7.0	4.1	2.5	2.3	-1.9	-0.7	-6.4	0.5
Romania	7.2	4.1	4.8	3.8	-3.0	-4.6	-13.6	-4.7
Russia	8.5	1.3	9.0	4.5	5.6	1.9	5.2	3.8
Saudi Arabia	1.8	0.3	5.1	-1.2	11.8	-4.5	22.5	6.3
South Africa	5.4	0.2	7.2	4.1	1.4	-6.3	-5.4	-3.0
Sri Lanka	6.8	2.3	15.8	4.3	-6.0	-6.8	-3.8	-2.2
Thailand	5.4	2.4	2.2	0.7	0.2	-0.8	5.9	6.9
Tunisia	6.7	1.0	3.4	6.7	-2.6	-3.9	-3.2	-8.8
Turkey	5.0	0.9	8.8	15.2	-1.9	-5.3	-5.5	1.1
Vietnam	7.1	7.0	8.3	2.8	-1.7	-3.3	-7.1	4.0
Australia	4.4	1.8	2.4	1.6	1.5	-3.7	-6.7	0.5
Canada	2.1	1.6	2.1	1.9	1.8	-0.4	0.8	-2.0
France	2.4	1.3	1.6	1.3	-2.6	-3.0	-0.1	-0.8
Germany	3.0	0.6	2.3	1.3	0.3	1.4	6.9	7.1
Japan	1.7	0.7	0.1	0.5	-3.2	-2.8	4.7	3.6
Korea	5.8	2.0	2.5	0.4	2.1	0.9	0.9	3.7
United Kingdom	2.4	1.4	2.3	1.8	-2.7	-2.1	-3.3	-3.8
United States	1.9	2.3	2.9	1.8	-2.9	-5.8	-4.9	-2.3

Source: IMF World Economic Outlook, April 2020

The international agencies such as the UN and the IMF have identified that those developing countries which could find it difficult to combat such a large scale multi-dimensional crisis on their own, and have recognised the need for coordinated and comprehensive multilateral response (United Nations, 2020).

#### **4. Description of the Indicators<sup>5</sup>**

We have classified the indicators of vulnerability under eight broad categories which get impacted *via* both direct domestic impact channel as well as through channels of inter-linkages with the global economy. The domestic impact channel signifies the sectoral composition and industrial structure which substantially impact the severity of output loss resulting from the preventive measures to contain the spread of COVID-19. The indirect channels are conceptualised following Pelin Berkmen *et al.* (2012) which is in the tradition of sudden stop literature where an economy in the “periphery” is hit by the crisis through a variety of real and financial channels. In such a framework, the short-run dynamics depend on countries’ structural characteristics, their initial position and vulnerabilities, and macroeconomic policies, while the existing financial and trade linkages shape the transmission of the shock from the rest of the world. The channels of transmission are however not independent of each other, the extent to which the shock transmitted through the trade and finance channels gets amplified depends in turn on existing domestic financial vulnerabilities and the response of monetary and fiscal policies. A brief description of the indicators under the eight broad categories are outlined as below:

##### *4.1. Industrial Structure*

A total of three indicators of the industrial structure have been considered. (a) share of retail, transport and hospitality in the total output; (b) proportion of work that could not be accomplished from home under the work from home arrangements; and (c) share of SME employment in total employment. The first component of the industrial structure covers those sectors that were directly and most adversely impacted by the shutdown. Network infrastructure in terms of the coverage and speed of the broadband connectivity plays a vital role when we talk about the work that can be done from home. It shows the readiness of a country to perform the work from home seamlessly. To capture the second component, two

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<sup>5</sup> Data for all indicators except short-term debt, the foreign exchange cover for imports, fiscal stimulus belong to 2018. Short term debt corresponds to 2019 while foreign exchange cover for imports and fiscal stimulus requires most recent figures and accordingly 2020 data has been taken.



indicators have been considered: (i) percentage of individuals using the internet, and (ii) fixed broadband subscriptions per 100 inhabitants. Unlike large corporates, the small enterprises are expected to be hurt more by COVID induced lockdown as they have very little or no cash buffer to survive through an extended period of shutdown. This would result in job losses and a threat to livelihood of such workers. A higher share of SME employment, thus, would mean greater vulnerability to COVID shock.

#### *4.2. Health Infrastructure*

The extent of damage that this crisis can inflict on an economy is crucially dependent on the pace with which the health sector authorities are able to identify the infected people and treat them under appropriate quarantined conditions. In this regard it is pertinent that the health infrastructure of the country is sound and sufficient to contain the outbreak. Two indicators are used to reflect the domestic health infrastructure: (i) number of physicians per 1000 people and (ii) general government health expenditure per capita, PPP (current international \$). Capacity of hospital to treat patients is also a crucial indicators of health infrastructure. However, hospital capacity are enhanced within short span as emergency response to the COVID outbreak for which latest data is not available. The ability to enhance such capacities in a short time are likely to be positively correlated with public health expenditure which is already included. Apart from the domestic health infrastructure, a measure of the general health of the population reflecting their tolerance also needs to be included to find the relative vulnerability of the country. The third indicator used as a proxy for a country's general health is life expectancy of the country.

#### *4.3. External Sector Indicators*

The immediate impact of the COVID crisis on every country was felt *via* the trade channel as the risk of the spread of virus resulted in every country raising all the barriers to trade. Although the regular trade has been stopped by almost every country, the requirement of the essential drugs and protective equipment increased manifold as not all the countries are able to produce them to meet the raging demand. This however requires sufficient amount of foreign exchange to ensure regular supply. In view of the above, To capture the external sector risks, following two indicators have been considered for each country: (a) foreign exchange reserves in terms of the number of months of imports available with each country at the beginning of the year; and (b) personal remittances (as a per cent of GDP). The flow of remittances has also been

affected not just due to the pandemic but also due to the plummeting oil prices as large number of workers from Asian developing economies work in the middle-east oil exporting countries.

As per the UNCTAD, a country is termed as commodity dependent if commodities account for more than 60 per cent of its total merchandise export in value terms. However, commodity dependence is almost exclusively a developing economy phenomenon as around 64 per cent of the developing economies are commodity dependant as compared to 13 per cent of developed countries. Being commodity dependent add to the vulnerability of a developing economy in times of crisis as the sharp reduction in the commodity price reduces the external balance of the economy triggering massive capital flows, exchange rate depreciations thereby reducing their ability to reduce the external debt as well. In this regard, the extent of the commodity dependence is taken as a factor to gauge the vulnerability of the developing economies.

Apart from the commodity dependence, in general the bigger is the dependence and interconnectedness with the external sector bigger would be the impact on the economy. To measure this impact the indicator used is trade openness of an economy measured as the sum of exports and imports as a proportion of GDP.

#### *4.4. Debt Burden*

Immediate attention is also required to pay off the short term debt of an economy. Hence, higher is the proportion of the short term debt to the total external debt, higher would be the immediate burden on the economy, thereby making it even harder for the countries to manage debt and related issues. Share of external debt in total debt is another concern, especially for developing economies which experience currency depreciation during crisis. Devaluation of domestic currency increase the real burden of external debt as well as debt servicing cost. A decline in foreign trade and lower exports earnings imposes additional constraint on ability to service external debt. Thus higher share of external debt adds to country's vulnerability during a crisis period.

#### *4.5. Economic Distribution*

Developing economies also differ in great extent to the level of economic development which denotes the amount of resources available with them and impacts their ability to effectively and immediately contain the outbreak. As a proxy for the level of economic development, GDP per capita in PPP terms is taken into the analysis. Apart from the level of economic development, the distribution of the wealth across the economy also plays an important role as

the large proportion of the population living under poverty and vulnerable conditions also places an extra burden on the government. So, the GINI Index of the country is taken as the indicator of the inequality and thereby, to represent the proportion of vulnerable section of the total population.

#### *4.6. Fiscal Health*

As the outbreak began hitting each country, they started coming out with a slew of measures including doling out huge fiscal packages. These fiscal stimulus ranges from universal cash transfers, unemployment allowances, wage sharing schemes, distribution of food and essential items to the vulnerable section and much more. Such fiscal responses also varies among the developing countries depending upon their capacity to raise the required resources either through appropriating the domestic resources kept for other purposes or by borrowing from the domestic or foreign market based on their ability to service the increase in the debt. To take this into account (a) Fiscal stimulus doled out as a per cent of GDP and (b) central government debt as a per cent of GDP are the two indicators included in this factor.

#### *4.7. Infrastructure Support*

The new-normal working conditions where most of the business operations have shifted to online mode requires certain infrastructure support. Two indicators, viz., (i) proportion of individuals using internet (ii) fixed broadband subscriptions per hundred inhabitants, are used to measure existing level of in necessary infrastructure support in a country to adapt to the changing working condition. Transition to changing working condition and thereby continuation of activates would be easier for countries well equipped with such infrastructure.

#### *4.8. Governance Quality*

Efficacy of the various measures taken by the countries hinges on the vital factor of the quality of governance. Many steps taken by the government require a coordinated effort from different authorities, strict orders are required to be followed by the people as well as the small or big corporations functioning in the territory. Worldwide governance indicators are compiled by the World Bank group compile and use three indicators in the analysis to measure the quality of the governance in a country: (a) Government effectiveness, (b) regulatory quality and (c) control of corruption. A higher index value for the above three indicators is likely to correlate positively with efficient administration of the economy required to achieve early containment of the outbreak and minimise economic loss.

## 5. Data and Methodology

Given the varying nature of the indicators, data are also collected from multiple sources all of which are publicly available. Within industrial structure, data on two indicators- share of retail, transport and hospitality in the total output and ability to work from home are obtained from national accounts data of each country from the CEIC. Cross country data on SME employment was not available from a common database. For a set of countries, SME employment data could be obtained from the OECD SME and Entrepreneurship Outlook Report. For others, country-specific reports are used to obtain data. World Development Indicator (WDI) data of the World Bank for selected countries have been used for a set of indicators such as short-term debt, external debt ratio, GDP per capita, number of physician per thousand population and all the governance indicators. Country-wise data income Gini index has been obtained from the Global Competitiveness Report (2019). Finally, country-wise data on proportion of population using internet and broadband subscription per hundred population has been fetched from the International Telecommunication Union's report.

### *Forecast Revision*

The choice of countries for the study is to an extent constrained by availability of data on one or more indicators. As the pandemic is still unfolding and there is no official data to measure the growth impact, we recourse to cross-country growth projection for 2020 by the IMF published in its bi-annual World Economic Outlook (WEO) report. IMF's WEO publishes growth projections for a large set of countries in the month of April and October every year followed by updates in June and January respectively. The extent of revision in country GDP growth forecast pre and post pandemic are assumed to be directly related to vulnerability of countries associated with pandemic induced crisis. Accordingly, difference in projection between the latest WEO June 2020 update and that in October, 2019 edition is used as a proxy for the output impact of the pandemic in relation to our eight broader partitions discussed in detail in the previous section. The correlation between the extent of revision in growth projection and the degree of vulnerability in each category, are in turn, used as weights corresponding to each partition for calculating the aggregate vulnerability index.

One caveat needs to be noted here is that the sample size of countries taken is 34 which is decided on the basis of availability of the extensive data for all the indicators. However the data for the GDP growth forecast revision was available only for 22 countries. For the calculation of the weighted vulnerability index, correlation of each of the eight indicator with

the GDP revision has been used. However, the GDP growth revision data is available only for 22 countries and the same correlation is leveraged as the weights in the calculation of the index for the entire set of 34 countries. In terms of share, the additional 12 countries are much smaller and comprise of only 3.7 per cent of the total GDP of 34 countries and further are assumed to not have much difference in terms of the correlation weights as that of the 22 countries. We further intend to revise the calculation of weights and index on the basis of the data for all the countries which will be made available in October WEO release of IMF.

### *5.1. Vulnerability Index*

For each of the eight broad category of indicators, we first create an index by taking average of the individual component variable index. To create component variable index, absolute value of each variable for each country is first scaled from 0 to 1 using the following the United Nations Development Programme (UNDP) methodology for standardisation.

$$Index = \frac{Actual\ Value - Minimum\ Value}{Maximum\ Value - Minimum\ Value} \dots\dots\dots (1)$$

Simple average of the individual component index gives the composite index value for each eight categories described in section 3.

### *5.2. Aggregate Index and Country Ranking*

In very general terms, vulnerability can be defined as the likelihood of a system being negatively affected by some sort of perturbation or sudden ‘shock’ going beyond the normal range of variability (Gallopín, 2006). The risk that economic growth is markedly and extensively reduced by the shock (Guillaumont’s, 2009). In our study, the system refers to an individual country and the perturbation refers to the direct and indirect economic impact of COVID-19 through various transmission channel. Vulnerability defined in this manner, we have tried to construct the composite vulnerability index for countries based on three distinguishable building blocks following (Essers, 2013): the severity of the shock, the exposure of a country to these shocks measured in indicators representing several transmission channels, and finally a country’s ability to resist to these shocks or the degree of resilience of a country to these shocks. One implicit criteria of the shock defined here is that it needs to be unexpected and exogenous. It should not result from any policy formulation and beyond the control of the Government and the monetary authority. The COVID-19 shock by its very nature perfectly meets these criteria of unexpectedness and erogeneity. The constituents of the

composite vulnerability index- the eight broad categories described earlier, have been classified under the exposure and resilience blocks, the third block being the severity of crisis.

$$Vulnerability = Shock * (Exposure - Resilience)..... (2)$$

<b>Table 2: Building Blocks of Composite Index</b>		
<b>Shock</b>	<b>Exposure</b>	<b>Resilience</b>
Direct effect: Number of infections per thousand population	Industrial structure	Infrastructure support
	External sector risk not be done from home	Health resilience
	Debt burden	Economic resilience
	Income inequality	Governance

Industrial structure, comprising indicators such as share of non-essential services and the proportion of work could not be degree of performed at home, share of SME employment represent country's exposure to crisis. Similarly, external sector risks, debt burden and income inequality are listed in the exposure category.

On the other hand, indicators pertaining to Infrastructure support, health resilience, economic resilience and Governance all essentially postulate a country's strength to resist the crisis and hence classified under the resilience block.

## 6. Results

There is marked difference in the position of advanced economies and emerging and developing economies in terms of exposure and resilience components. Advanced economies<sup>6</sup> in darker shades are visibly better placed uniformly across categories (Chart 1 to 8).

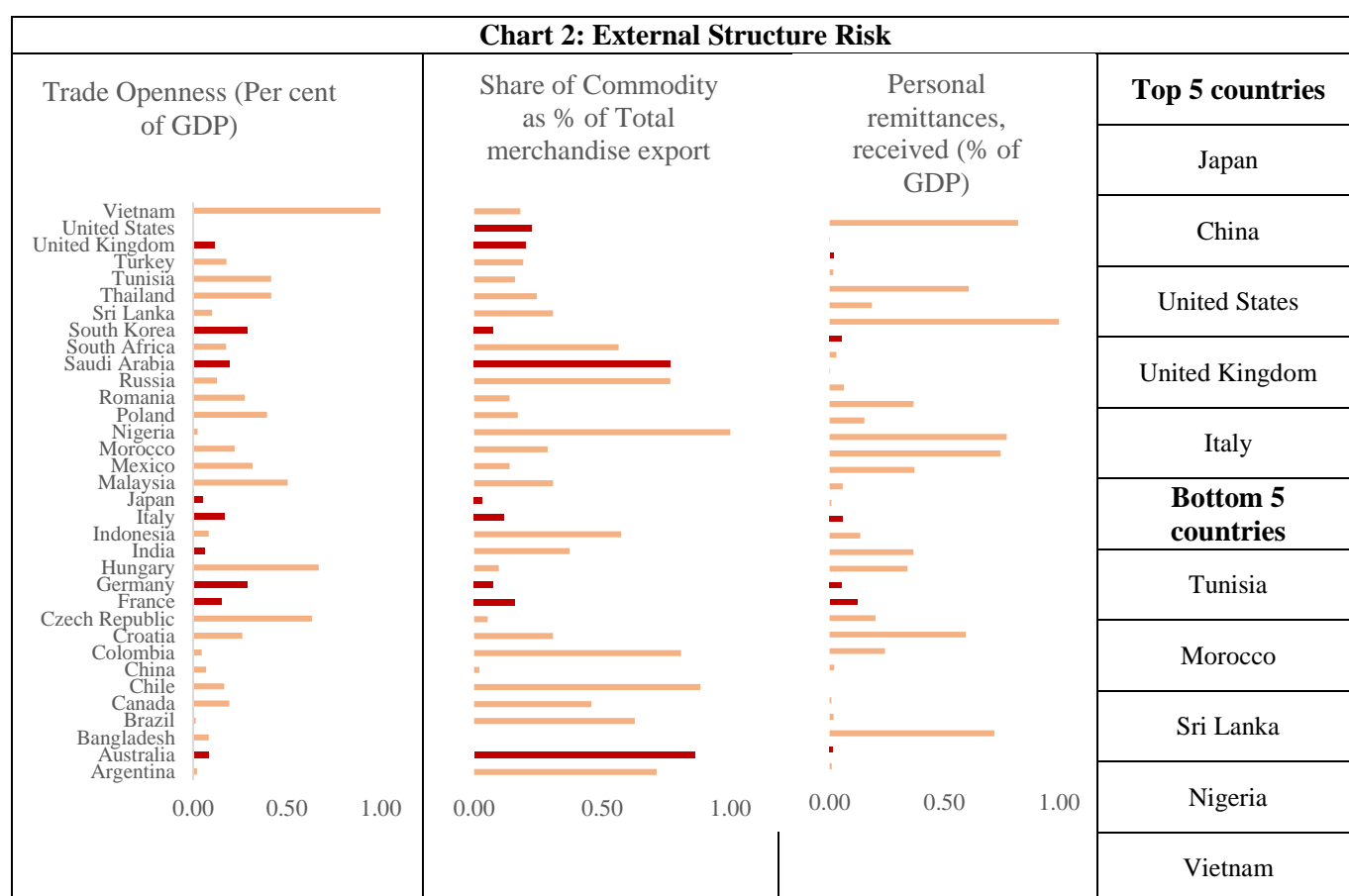
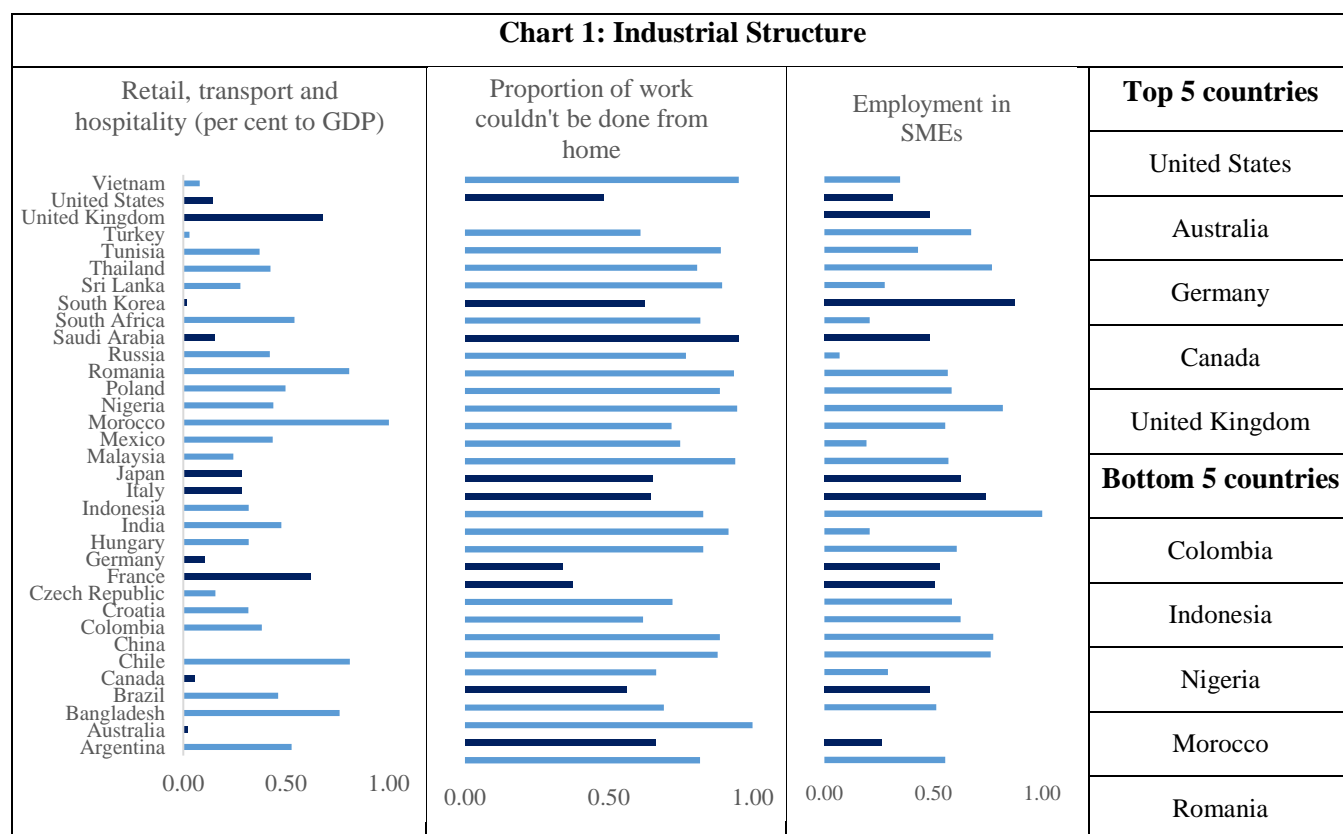
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<sup>6</sup> According to the definition of the International Monetary Fund (IMF), Saudi Arabia is one of the developing countries because of its lower economic performance. However, Saudi Arabia counts as one of the high developed economies by UN-definition. With a Human Development Index (HDI) of 0.857 (rank 36 out of 189 countries) in 2019. Since in our study, health, governance, institutional quality also given importance, we have placed Saudi Arabia in the group of advanced economies.

### *6.1. Exposure Partition*

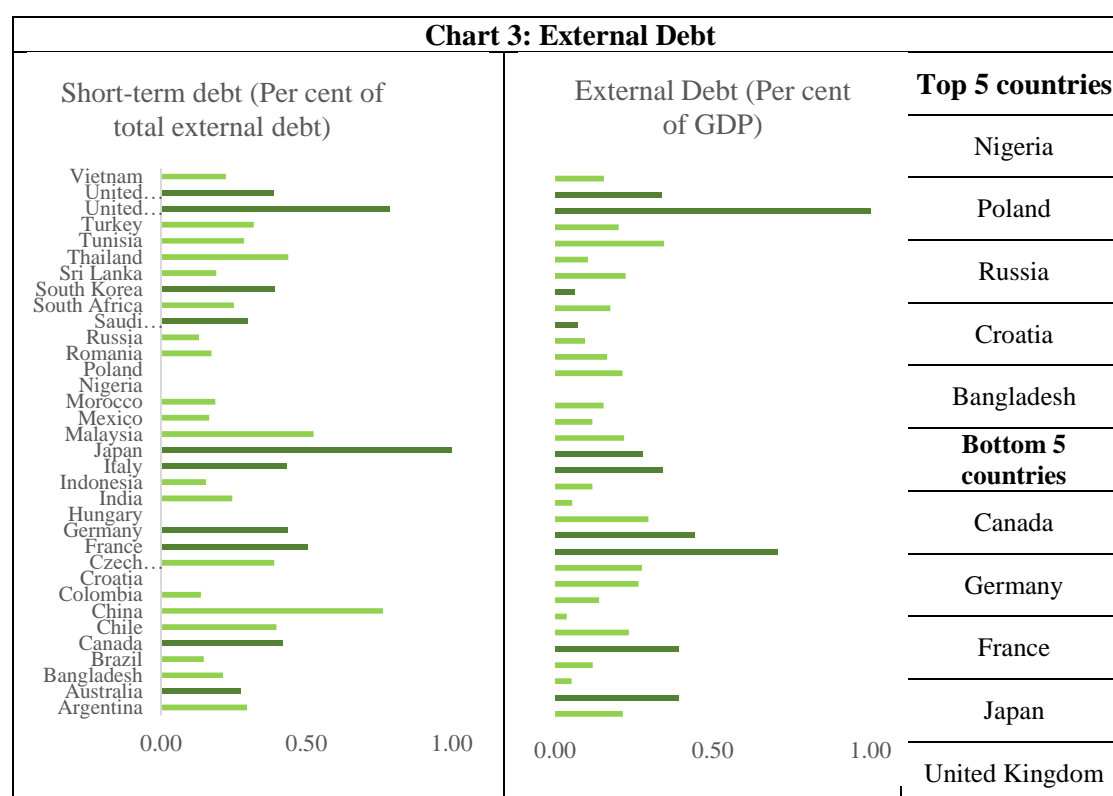
With lower share of activities directly affected by COVID-19, relatively higher share of services activities which could be performed remotely from home, domestic structure in advanced economies are relatively immune to COVID-19 (Chart 1). Only in case of SME employment the exposure is mixed as South Korea, UK, Japan, Italy has high SME employment while many emerging India, South Africa, Bangladesh, Chile have relatively lower share of SME employment.

The external sector exposure is clearly higher for the developing countries. Trade dependence, Except Saudi Arabia and Australia, commodity trade is negligible for all other advanced economies (Chart 2). Personal remittances are particularly high for countries in lower income categories such as Morocco, Tunisia, Sri Lanka, Bangladesh and Thailand.

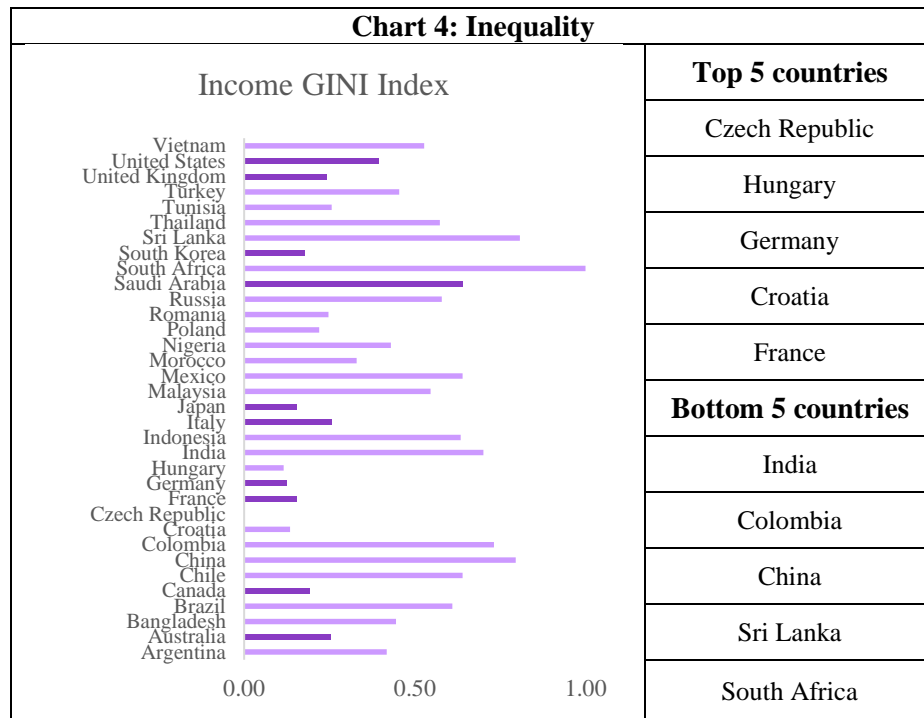




In the third partition relating to external debt metric, advanced economies clearly have higher debt exposure (Chart 3). In terms of the two constituents in the debt partition- Proportion of short-term debt and external debt to GDP, debt exposure risk is highest for Canada, Germany, France, Japan and United Kingdom while it is lowest for Nigeria, Poland, Russia, Croatia and Bangladesh. However, it is also true that debt servicing and sustenance capacity of the advanced countries are also better. And two of them, Japan and United Kingdom have reserve currency. Therefore, exposure to the shocks as per debt metric is more relevant within the group of advanced and emerging economies separately rather than across the groups.

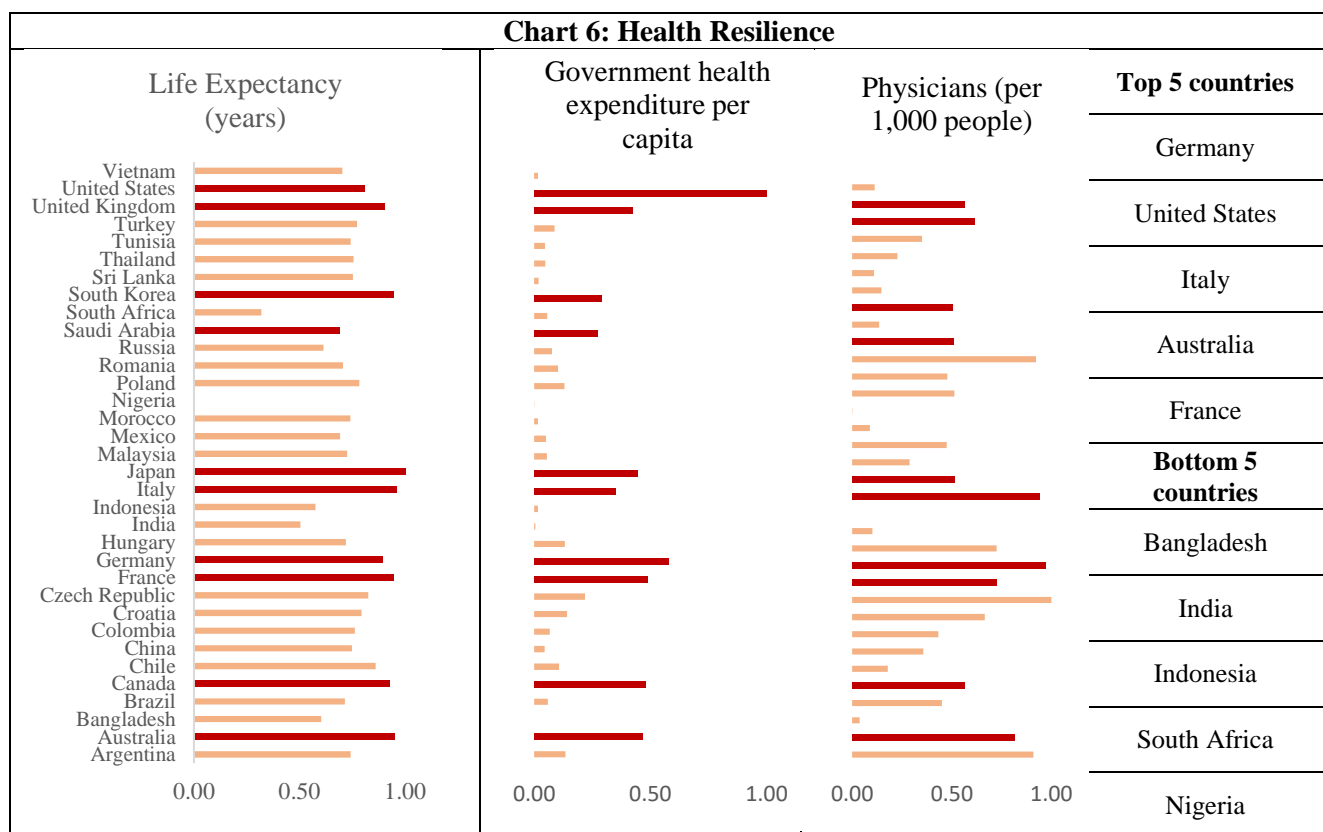
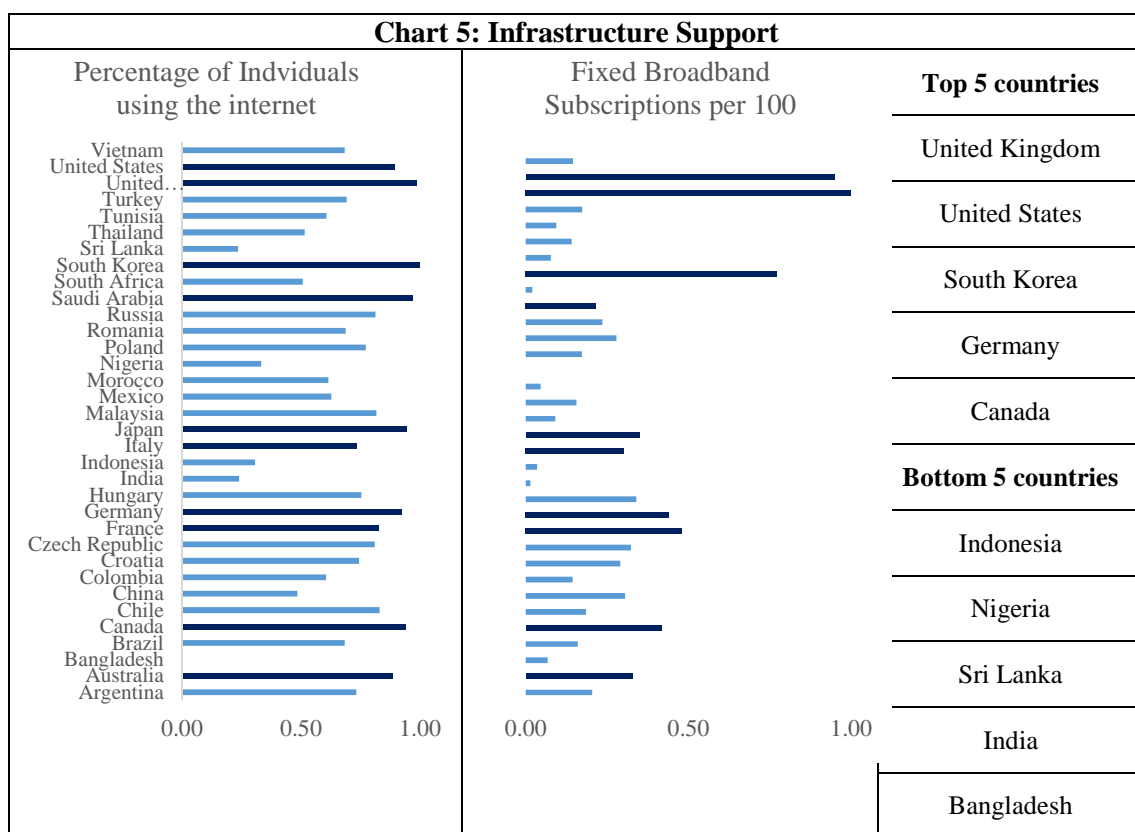


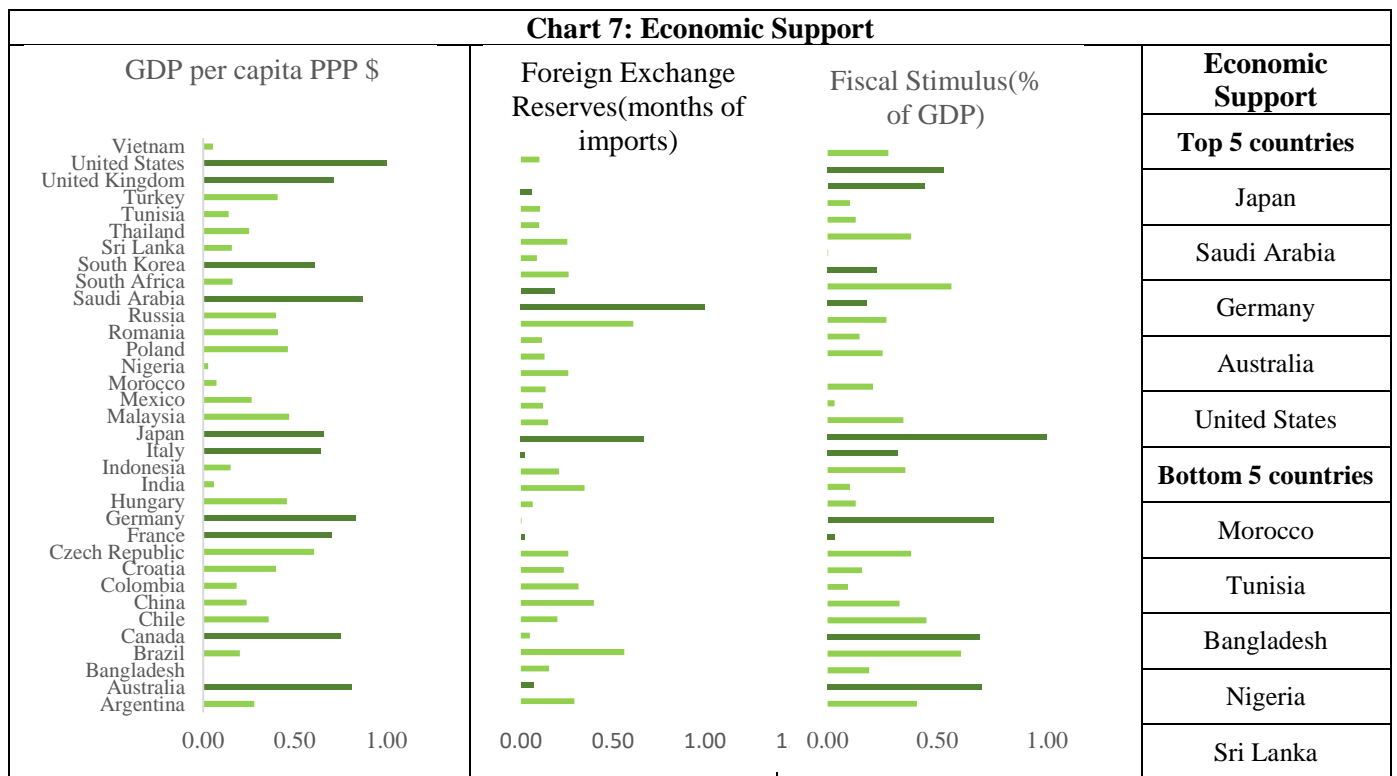
Level of inequality in an economy is another exposure factor to external shock as higher the inequality higher is the proportion of vulnerable population with less resilience. Notably, three among the five most unequal economies (measured in terms of Gini Index) are Asian- India, China and Sri Lanka (Chart 4). On the other hand, two emerging economy from East Europe- Check Republic and Croatia find place in the top bracket in terms lowest income inequality.



## 6.2. Resilience Partition

Broadly, the resilience partitions appear to be the mirror image of the exposure factors with advanced economies securing the highest scores in majority of the partitions under resilience. However, at the country-level, wide variability could be seen in scores in different partitions.



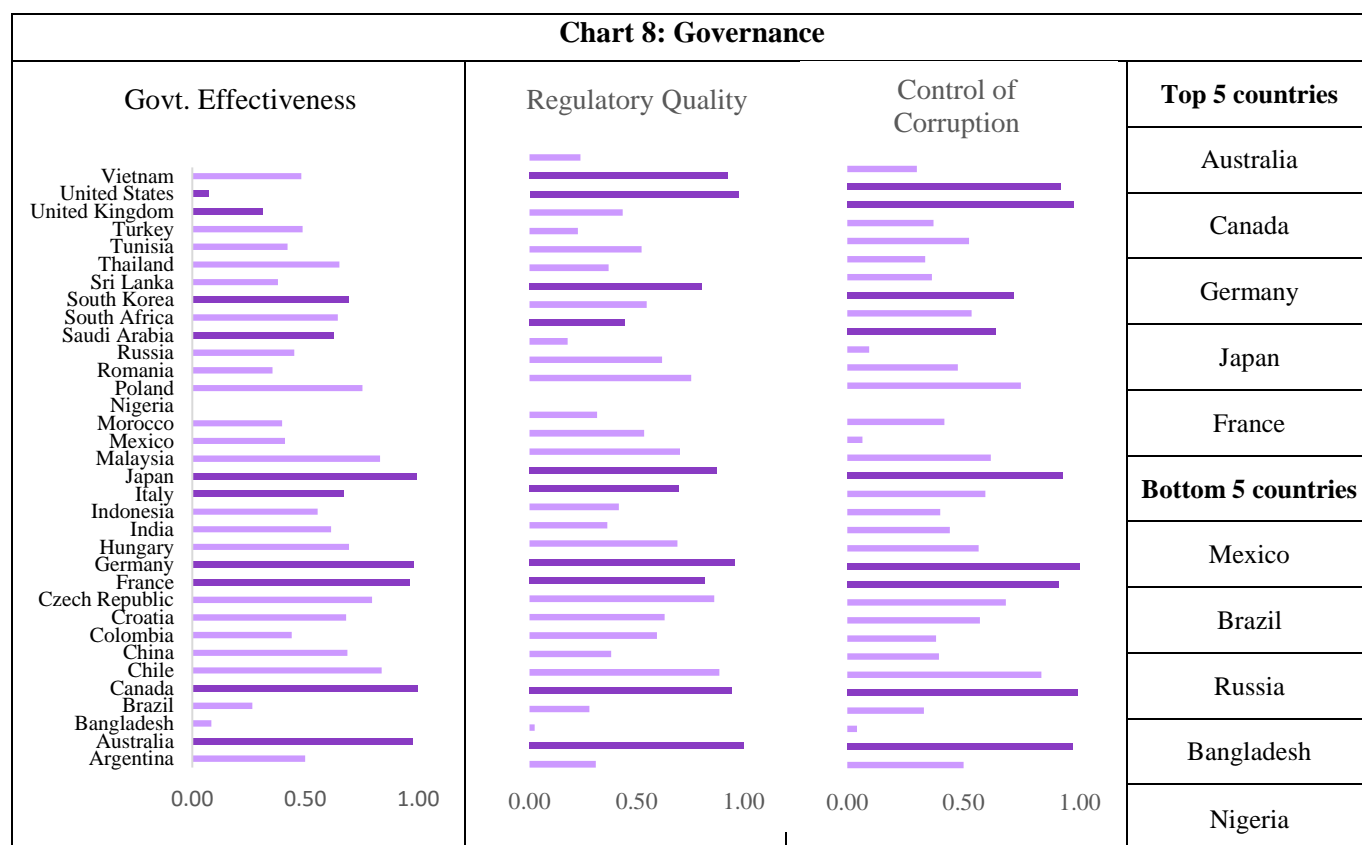


In infrastructure support to adapt to the changing working conditions which is more reliant on internet, advanced economies are clear winners. Three South-Asian countries- Sri Lanka, India and Bangladesh are at the bottom in terms of readiness with necessary infrastructure to continue economic activity amidst the pandemic (Chart 5).

There is marked difference in Health resilience, advanced and EMs in all three pillars- life expectancy, Government health spending and availability of physicians (Chart 6). Especially, in terms of Government health expenditure, the difference between highest and lowest is close to thousand times.

Economic resilience measured in terms of GDP per capita, foreign exchange reserves for import cover and fiscal stimulus showcases highest resilience by Japan, Saudi Arabia, Germany, Australia and United States. While three African countries (Morocco, Tunisia, Nigeria) and two south Asian countries (Bangladesh and Sri Lanka) rank bottom in terms of economic resilience (Chart 7).

Finally, strength of Governance measured in terms three indicators- effectiveness of the Government, regulatory quality and control of corruption also appear to be stronger in the advanced economies as all top five position held by advance economies while worst performers all belong to the emerging and developing economies (Chart 8).



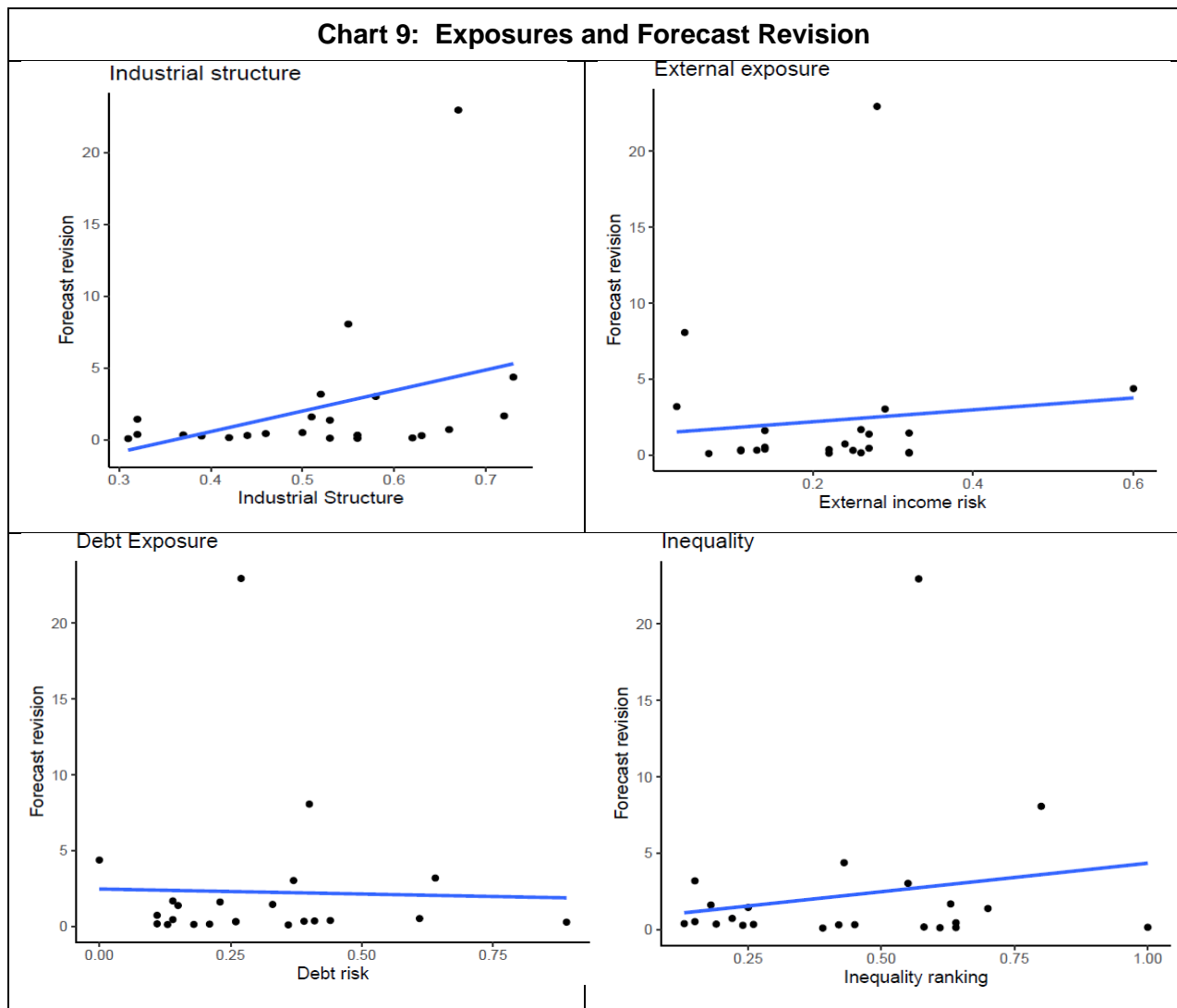
In all, both the exposure and resilience factors seem to be interdependent as the set of top five and bottom five performers are broadly overlapping. United States, UK, Germany, Australia, Canada and Japan appear to be the least exposed and most resilient to the shock as they featured in top five performers in a majority of the exposure and resiliency category.

### 6.3. Initial Measures of Output Impact

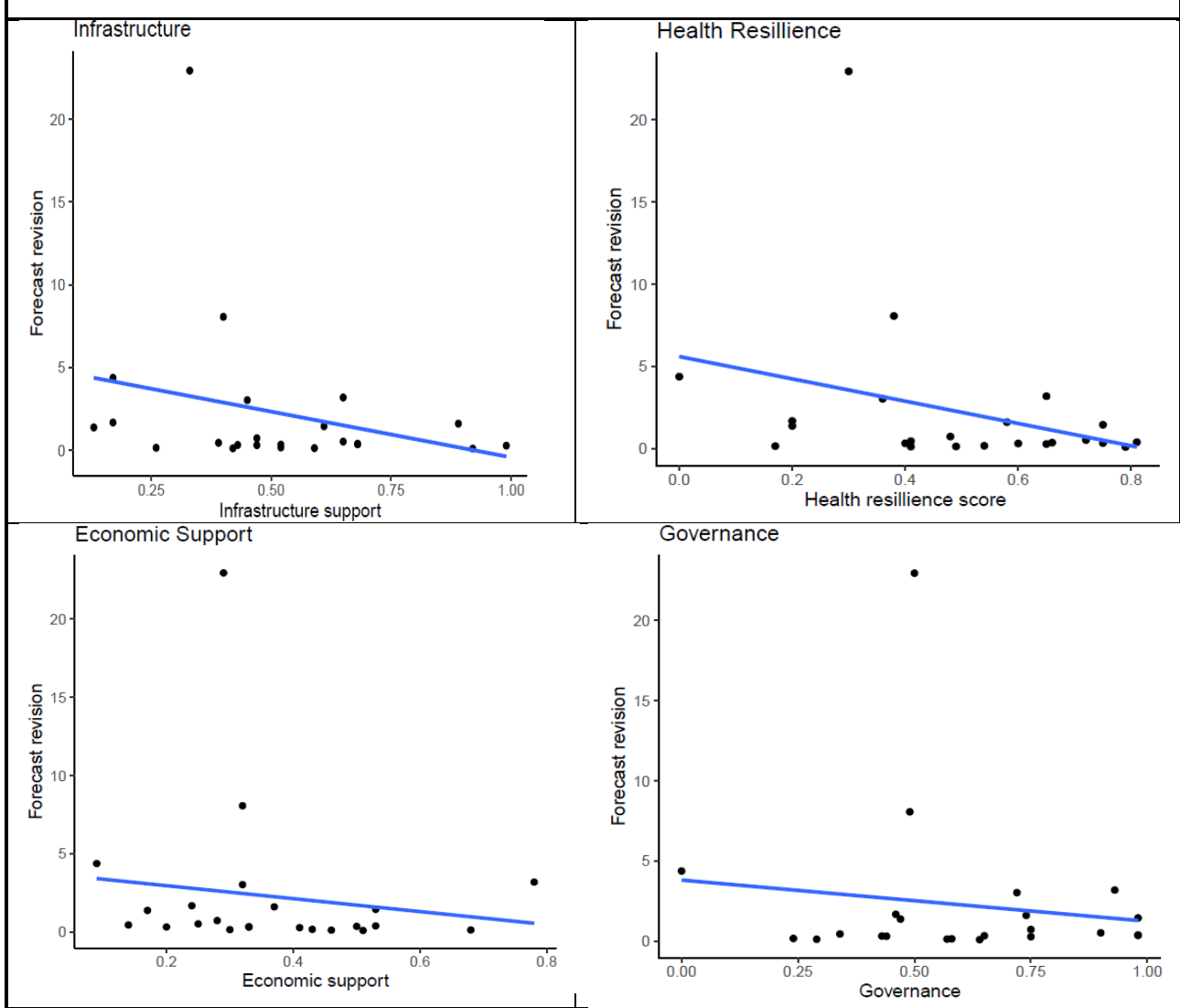
Our choice of vulnerability indicators is based on both economic intuition and vulnerability studies on past crisis events. To ensure these are crucial indicators of vulnerability to the current pandemic crisis, we have tried to provide some preliminary evidence of growth impact associated with these factors. As discussed in section 4, we have used the magnitude of downward revision in growth forecast by the IMF in pre-COVID and post-COVID scenario for 2020 as a proxy for output loss on account of the pandemic and established the relationship between output loss and country's ranking in each exposure and resilience factor. The result is in the expected line as the extent of forecast revision is positively related with all the exposure factors and negatively related with the resilience factors (Chart 9 and 10). This implies higher the exposure of a country higher is the output loss and vice-versa. Conversely, higher the

resilience of a country in terms of digital infrastructure, health infrastructure, economic resources and robust governance, lower would be the output impact of the pandemic shock.

However, the strength of output impact is not homogenous across factors. Some factors tend to impact output more than others reflected in the correlation coefficient between the factors and forecast revision. We have taken this factor in account while preparing the composite vulnerability score. We have constructed both un-weighted and weighted vulnerability index. In the first case, the differential impact of the factors are ignored while in case of the latter, the correlation coefficient between the country ranking in each exposure and resilience factors and forecast revision are used as corresponding weights to each factor to arrive at the composite in vulnerability index.



**Chart 10: Resilience Factors and Forecast Revision**



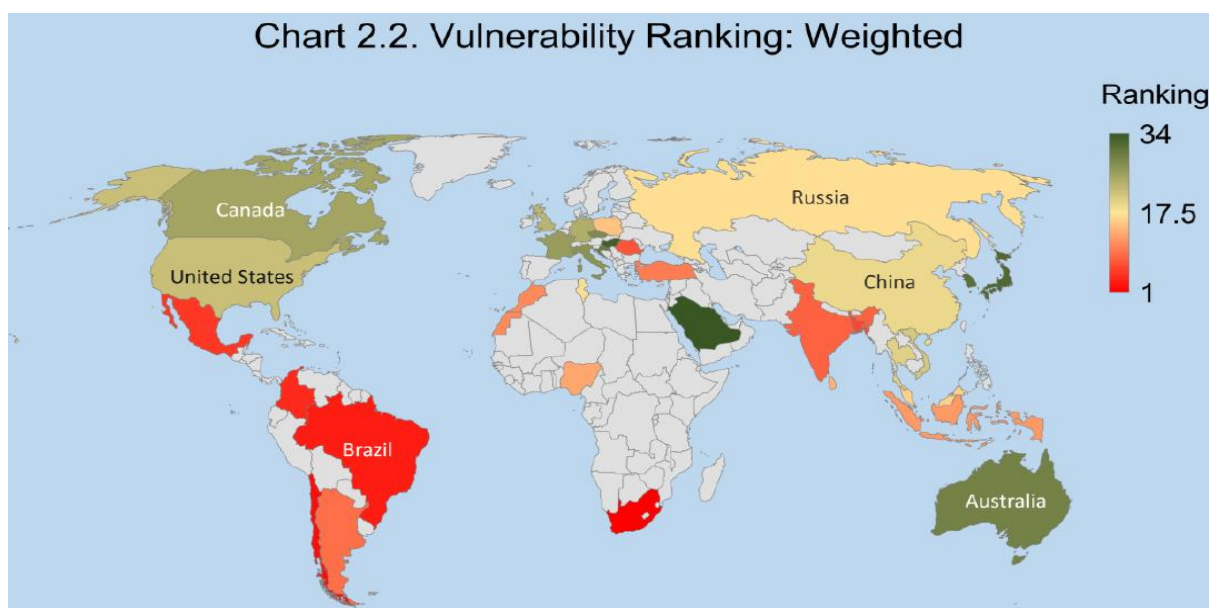
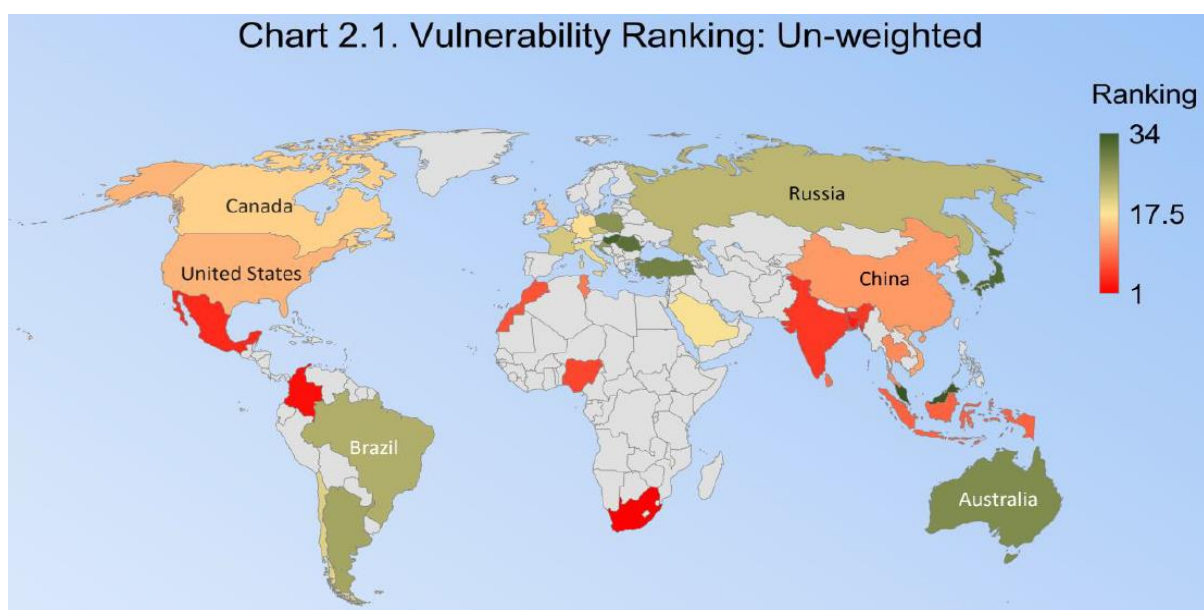
#### 6.4. Vulnerability index: Weighted and Un-weighted

Finally, we arrive at composite country ranking based on equation 2. According to the un-weighted index, in which we assume all the exposure and resilience components to be equally relevant for growth and, therefore, are given equal weights, South Africa, Columbia, Bangladesh, Mexico, Nigeria turn out to be the most vulnerable countries. China, Malaysia, Hungary, Romania Japan, on the other hand, ranked lowest in the vulnerability table. India is placed at 7<sup>th</sup> position in the un-weighted vulnerability ranking.

Weighted vulnerability index however portrays slightly different picture. South Africa continued to be the most vulnerable country followed by Chile, Brazil, Columbia, and Mexico. India fares slightly better as per the weighted index and placed at 9<sup>th</sup> position. Croatia, South

Korea, Japan, Italy and Australia secure the top five positions of being the most resilient economies.

A country's weighted ranking would be better (worse) than un-weighted ranking if it has relatively lower (higher) exposure or higher (lower) resilience or both to categories which hold stronger relationship with growth. Considering the severity of the shock, United States, Canada and Russia have better ranking position in terms of weighted ranking mainly due to stronger health and other infrastructure supports. Latin American countries, on the other hand, stand worse in terms of weighted ranking. The complete list of country ranking- both unweighted and weighted, has been provided in annex I.





Followed from the country ranking is that the extent of shock played a major role in determining a country's position. This is rightly because the first-hand or the direct impact is the severity of shock which determine the stringency of containment measures which in turn lead to loss of activity in the first round. The exposure and resilience factors primarily intend to capture the second round and the indirect effects which includes channels of shock spill over from other countries, and a country's structural, institutional prowess to cope with the COVID-19 pandemic.

## **7. Conclusion**

The economic impact of COVID-19 is not uniform across the world but depends in addition to the intensity of the spread of the virus, on various structural and institutional factors common to all crisis. Factors are classified into two groups-exposure and resilience depending on their relationship with economic activity. The exposure and resilience components are closely inter-linked among themselves which means a country having higher exposure in industrial structure is also likely to have higher external risks and inequality. On average, advanced economies exhibit lower exposure and higher resilience as compared to emerging economies. Only exception is observed in case of debt exposure in which advanced economies scores much higher. However, better debt servicing capacity with stronger currency and low inflation safeguard these advanced economies against higher debt ratio to be a matter of great concern. Health, economic infrastructure and quality of institutions are also sound in advanced economies. The relationship between exposure and resilience factors with initial growth outcome proxies by difference in pre and post COVID-19 growth projection are in expected lines-higher exposure are associated with larger downward revision in growth forecast while higher resilience corresponds to lower downward revision.

Country rankings in our framework reflect a combination of three factors. Despite, being countries hardest hit by the COVID-19 pandemic, United States, United Kingdom, Germany secured middle position in the vulnerability rank table due to their lower exposure and higher resilience scores. Favourable exposure and resilience scores coupled with relatively weaker shock placed countries like Hungary, Japan, Korea, Saudi Arabia and Australia at the bottom of the vulnerability table. On the contrary, Sri Lanka, Indonesia, Morocco, Thailand, Tunisia, Vietnam are less hit by the COVID-19 pandemic are on top due to their higher exposure through indirect channels and lower resilience.

Weighting of the components of exposures and resilience which we believe to represent a better picture economic vulnerability in relation to growth, tends to clearly reflect the cushion available to the developed countries and expose the vulnerability of the developing nations especially the South Asia and Latin American countries. Notably, India features in the list of world's top ten most structurally vulnerable economy among the set of countries considered for the study. Though the external sector and debt exposure is moderate, but India's income inequality is one of the highest. In the resilience category, India is at the bottom in terms of necessary infrastructure support and health facilities, but better placed in terms of economic strength and governance.

The study meets its purpose by providing a broader cross-country framework in portraying a country's position to withstand the COVID-19 crisis. Relative strength and weakness across various parameters would facilitate countries to recognize and focus on areas which require immediate policy attention. Emerging market economies, despite having large exposure in terms of trade openness and commodity dependence, cannot afford to diverge from an open trade policy which would involve trade off with growth. Since building up resilience do not have serious implications on growth, policy objective could be directed towards improving structural resilience, especially health infrastructure, digital infrastructure and quality of institution. This would facilitate both long term sustainable growth as well as building resilience to guard against future crises.

The study has broadly adopted a general vulnerability framework applied to past crisis such as GFC and not specific to pandemic driven crisis. While some of the channels, exclusive to the COVID-19 pandemic has been captured here, a few factors however, remained outside its scope such as sudden stop of domestic remittances from inter-state migration. Similarly, social distancing forcing various activities to run at sub-optimal capacity also could not be accounted within the framework. An attempt can also be made to enhance the scope of this study by taking account of some country specific idiosyncrasies such as internal labour movements, sub optimal utilisation of the infrastructural resources as well as the spatial distribution of the pandemic within countries once necessary data become available. This can provide a deeper dimension to the vulnerability framework. Moreover, robust exercise could also be carried out to establish the relationship between growth outcome and vulnerability indicators once actual GDP growth for a broader set of countries become available.

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<b>Annex 1. Vulnerability Ranking</b>			
<b>Unweighted</b>		<b>Weighted</b>	
<b>Rank</b>	<b>Country</b>	<b>Rank</b>	<b>Country</b>
1	South Africa	1	South Africa
2	Colombia	2	Chile
3	Bangladesh	3	Brazil
4	Mexico	4	Colombia
5	India	5	Mexico
6	Nigeria	6	Bangladesh
7	Morocco	7	Romania
8	Indonesia	8	India
9	Sri Lanka	9	Argentina
10	Tunisia	10	Turkey
11	Thailand	11	Morocco
12	China	12	Indonesia
13	Vietnam	13	Nigeria
14	United States	14	Sri Lanka
15	United Kingdom	15	Poland
16	Canada	16	Malaysia
17	Germany	17	Russia
18	Saudi Arabia	18	Tunisia
19	Italy	19	China
20	Chile	20	Thailand
21	France	21	Vietnam
22	Czech Republic	22	United States
23	Russia	23	United Kingdom
24	Brazil	24	Germany
25	Argentina	25	Canada
26	Croatia	26	France
27	Poland	27	Italy
28	Australia	28	Czech Republic
29	Turkey	29	Australia
30	South Korea	30	Croatia
31	Romania	31	South Korea
32	Japan	32	Japan
33	Hungary	33	Hungary
34	Malaysia	34	Saudi Arabia