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Abstract

The objective of this study is to analyse the correlation between initial conditions and cross-country macroeconomic impact of Covid-19 on OECD economies. The study uses group-wise multivariate linear regression modelling to examine the link between macroeconomic variables of interest and the duration of the pandemic, severity of its impact, and annual investment growth rate. The main result from the study shows that variables related to debt such as domestic credit to private sector, private sector debt and debt-to-GDP ratio had significant relationship with the duration and severity of the crisis as well as the investment growth rate during Covid-19. The original contribution of the study is in bringing out the correlation between initial conditions and first order effects of the pandemic on the economy. The policy implications of the results indicate short, medium and long-term measures required to mitigate the systematic risk posed by the pandemic.

Keywords: OECD; Covid-19; macroeconomic impact; economic growth; investment.

I Introduction

The coronavirus disease 2019 (Covid-19) was a large-scale event that affected economies far and wide at different scales and scope (Beßlich, 2020; Solarz and Waliszewski 2020). Unlike the other pandemics in history, seven of the top ten countries affected by Covid-19 namely the United States, China, Japan, Germany, United Kingdom, France, and Italy were also the largest economies in the world that accounted for 60 percent of global supply and demand, 65 percent of manufacturing, and 41 percent of manufacturing exports (Baldwin and di Mauro, 2020). Such interconnectedness implied disruptions across economic output, supply and demand, value chain, and investment shocks to other countries tied to these large economies. Furthermore, the pandemic was experienced in a wave-like fashion successively across multiple countries and even across the same country during different time-spans which transformed what was perceived initially as an exogenous shock, into a systemic risk (Solarz and Waliszewski, 2020). Finally, Covid-19 also brought out the gap between capacity and challenge for many countries, exposing the need for leadership to tackle this challenge through international collaboration, cooperation, and cohesive policy vision.

The impact of the pandemic is being evaluated globally for the short, medium and long term. Data shows that a weak negative unconditional correlation exists between income and the pandemic impact that was higher for the developed economies in the short term and more for the developing economies in the medium term (Yeyati and Filippini, 2021). Various models have been proposed to understand the magnitude of this macroeconomic impact using the general equilibrium model (McKibbin and Fernando, 2021), neoclassical model (Jordà, Singh and Taylor, 2022) and the SIR model (Angelini et al., 2020; Bayraktar, Cohen and Nellis, 2021). Among the developed economies, country specific studies have quantified the macroeconomic impact by studying variables such as GDP slow down, output losses and public

debt for cases such as Romania (Albu et al., 2020) and Spain (Sanchez, 2021). Among the emerging economies, studies have focused on employment losses in the informal sector in Indonesia (Pitoyo, Aditya and Amri, 2020; Fordian and Raharja, 2022), Africa (Morsy, Balma and Mukasa, 2021) and India (Goswami, Mandal and Nath, 2021). A few studies on cross-country data have also examined select initial condition variables that were partly economic and partly epidemiological and linked them with output losses (Glocker and Piribauer, 2021; Rungcharoenkitkul, 2021).

Nevertheless, there are few studies that have looked systematically into the relationship between the initial macroeconomic conditions of the economy before the pandemic and its relation to the type of impact that was subsequently felt. This study aims to fill this gap. The original contribution of the study is in bringing out the correlation between initial conditions, especially variables relating to debt and the first order effects of the pandemic on the economy. The objective of the study is to examine 37 OECD economies to understand the relationship between initial conditions defined as the pre-existing macroeconomic characteristics of a country such as average change in GDP, imports and exports, public and private debt, growth of credit, and balance of government revenues and expenditure and the extent of the pandemic impact. The study is particularly interested in how variables indicating macroeconomic stability, trade openness and debt status of a country before the crisis impacted the duration and severity of the pandemic impact as well as the annual investment growth rate during the pandemic.

The structure of the paper is as follows. In the second section, a brief review of the empirical literature examining the relationship between initial conditions and systemic shocks are analyzed within the theoretical framework of black-swan events with special attention to macroeconomic variables. In the third section, the research question and methodology of

analysis including the identification of relevant variables, sources of data, method of data collection and model specification are provided. The fourth section discusses the econometric results. The fifth section discusses the impact of results on policy. The sixth section delineates the future strands of research and the last section concludes the main arguments of the study.

II Theoretical framework and empirical literature

Theoretical framework

The Covid-19 pandemic was initially described as a 'black-swan' event attributing to its degree of unpredictability, risk, and impact (Bensley, 2020). Black-swan is the characterisation given to an event that is rare, has a large impact on economy and society, and is predicted retrospectively (Taleb, 2007). Other scholars such as Renda and Castro (2020) argue that Covid-19 was not man-made and could be predicted ex-ante, shifting the perspective from an unpredictable and unmanageable event into an expected massive threat whose warnings were ignored.

Alternatively, systemic risk management studies have argued that Covid-19 and similar health emergencies could be categorised as 'green-swan events' that could be predicted and managed with sound ex-ante measures (Solarz and Waliszewski, 2020). From the historical perspective, Covid-19 has also been described as a 'transforming event' because its impact remains open-ended (Fishman, 2020). Furthermore, the Covid-19 pandemic has been evaluated under the taxonomy of Drucker's four problems with the insight that the pandemic might be the beginning of a new generic problem called 'pre-cursor catastrophes' (Terzic, 2020). The main observation from these historical accounts is that understanding an event as black-swan has implications on the ways its impact is surveyed and ex-post measures taken such as the official

response time and the size of stimulus package provided by the governments in offsetting the effects of the crisis.

Empirical literature

Therefore, recent literature that empirically examine the early impact of policy measures on the Covid-19 impact assumes importance. While reviewing macroeconomic impact of Covid-19 on various countries, Barua (2020) argues that a visible or measurable growth effect has not been felt yet. Nevertheless, in anticipation of the looming economic depression or even recession, countries such as the United States, the United Kingdom, China, Australia, Canada, and Malaysia have used targeted monetary policies such as lowering the bench mark of their interest rates while others such as the United States have taken additional measures such as fiscal stimulus to the tune of $2 trillion to combat the impact of the pandemic (Barua, 2020). In addition to such traditional monetary and fiscal tools, the scale and scope of the pandemic impact necessitates comprehensive, coordinated, and innovative measures nationally, and in conjunction with other countries through multilateral collaboration.

Comparing the impact of Covid-19 with past financial crises, Choi (2020) argues that economic policy uncertainty has caused more volatility in all sectors of the industry in high-income countries such as the United States than the actual impact of the crisis. Contrariwise, examining the impact of the pandemic on emerging economies of the African continent, Ataguba (2020) concludes that the pandemic has the potential to increase inflation, decrease demand for aggregate production, export and import even in the presence of strong policies because of weak pre-crisis macroeconomic conditions of the country.

Previous empirical research on contagion literature especially on the impact of the financial crisis 2008 has revealed that while the relationship between initial conditions and differential

impact is difficult to ascertain, there are variables of interest that serve as early warning signals. For example, Rose and Spiegel (2009) find that global factors such as the extent of trade linkages played a dominant role in the impact felt by many countries as a result of the financial crisis that international risk sharing was unable to offset. Lane and Milesi-Ferretti (2010) highlight the importance of various measures of buoyancy of economic activity pre-crisis such as current account deficits, credit growth rates, growth rate relative to trend, and exposure to trade in explaining the decline in output and demand growth rates. Claessens et al. (2010) identify several factors of initial conditions such as the accumulation of private sector debt, increasing dependency on external and wholesale funding, and failure to reduce public debt as among the factors that helped explain the cross-country impact of financial crisis. Frankel and Salvarelos (2012) have argued that central bank reserves and past movements in real exchange rates could be the leading indicators to signal the severity of impact of financial crisis.

Cross-country comparisons of macroeconomic impact have also been done on Covid-19 with instructive results. Fernández-Villaverde and Jones (2020) use GDP, unemployment and community mobility reports to understand the geography specific macroeconomic impact of the pandemic. Fernandes (2020) argues that the pandemic is likely to usher not only cross-country differences but asymmetrical impact on the service sector within national economies. Guerrieri et al. (2020) discuss how Keynesian supply shocks in incomplete markets exacerbate the demand shocks to create some additional impacts of Covid-19 on the macroeconomic conditions.

This study builds on these empirical predecessors to understand the relationship between initial conditions and economic growth as indicated by macroeconomic performance during Covid-19. While our findings do point to some variables of interest in the initial conditions, it also

reinforces the result of earlier studies that much of how black-swan originates and operates still remains unknown. Although a comprehensive theoretical understanding and policy prescription is not possible, the study indicates variables of interest and policy measures given the initial structural conditions.

III Methodology

Model specification

The objective of the econometric analysis was to examine how the independent variables relate to the dependent variables duration, severity and average investment growth rate. The main tool of econometric analysis was group-wise multi-variate linear regression model that was used to test the relationship between dependent and independent variables. Three models were analysed using each of the dependent variables. Furthermore, robustness check for heteroskedasticity was performed using the Goldfeld-Quandt test for each of the three models. The econometric analysis was performed using R 4.1.0 research software.

The general specification of the regression model is given in equation 1.

$R = \beta_0 + \beta_1$ (average change in GDP) $+ \beta_2$ (CAD) $+ \beta_3$ (exports) $+ \beta_4$ (imports)$+ \beta_5$ (debt-to-GDP ratio) $+ \beta_6$ (domestic credit to private sector) $+ \beta_7$ (private sector debt) $+ \varepsilon_0$ [1]

where

R- dependent variable

β_0 - constant

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$ – regression coefficients

ε_0 – error term

In the first model, the duration of the pandemic was tested against each of the independent variables for both the OECD country groups A and B. The variable duration was defined as the number of quarters through which real growth rate remained negative. This regression model accounted for the pivotal role of the duration of crisis in affecting the institutional impediments in economic growth, debt and trade variables. The generic equation for this model is presented in equation 2.

Duration = β_0 + β_1 (average change in GDP) + β_2 (CAD) + β_3 (exports) + β_4 (imports)+ β_5 (debt-to-GDP ratio) + β_6 (domestic credit to private sector) + β_7 (private sector debt) + ε_1 [2]

In the second model, the severity of the pandemic was tested against each of the independent variables for both the OECD country groups A and B. The variable severity was the defined as the cumulative change in GDP from Q1 in 2019 to Q3 in 2020. This regression model accounted for the role of the severity of crisis in affecting the institutional impediments in economic growth, debt and trade variables. The generic equation for this model is presented in equation 3.

Severity = β_0 + β_1 (average change in GDP) + β_2 (CAD) + β_3 (exports) + β_4 (imports)+ β_5 (debt-to-GDP ratio) + β_6 (domestic credit to private sector) + β_7 (private sector debt) + ε_2 [3]

In the third model, investment growth rate was tested against each of the independent variables for both the OECD country groups A and B. The variable investment was defined as the annual growth rate of investment during the period 2019-20 and accounted for the impact of investment growth rate on the initial conditions offered by GDP, trade and debt variables. The generic equation for this model is presented in equation 4.

Investment = β_0 + β_1 (average change in GDP) + β_2 (CAD) + β_3 (exports) + β_4 (imports)+ β_5 (debt-to-GDP ratio) + β_6 (domestic credit to private sector) + β_7 (private sector debt) + ε_3 [4]

Data sample

This study aims to improve the understanding of how the Covid-19 pandemic impacted the macroeconomic performance of countries based on their initial conditions. From the brief review of literature, it is clear that the pandemic impacted different countries at different points in time and through varied mechanisms. The mechanism of pandemic impact was through trade and financial links between countries which depended on the initial conditions of the countries such as average change in GDP, imports and exports, public and private debt, growth of credit, and balance of government revenues and expenditure. This is the reason macroeconomic variables of interest that determine initial conditions of an economy are selected for this study.

This paper is particularly interested in the question whether initial conditions help in explaining the differential impact of the pandemic on economies. Additionally, given the origin of the pandemic and the methods of propagation, the econometric analysis focuses on a sample of countries that are the most integrated with global trade and financial markets. This is the reason high-income advanced economies of Organisation for Economic Co-operation and Development (OECD) are chosen as the sample for the purpose of analysis. Table 1 gives the comprehensive list of the 37 member states of OECD that form the sample of the study.

Table 1. OECD member countries

Number	Country
1	Australia
2	Austria
3	Belgium
4	Canada
5	Chile
6	Colombia
7	Czech Republic
8	Denmark
9	Estonia
10	Finland
11	France
12	Germany
13	Greece
14	Hungary
15	Iceland
16	Ireland
17	Israel
18	Italy
19	Japan
20	Latvia
21	Lithuania
22	Luxembourg
23	Mexico
24	Netherlands
25	New Zealand
26	Norway
27	Poland
28	Portugal
29	Slovak Republic
30	Slovenia
31	Spain
32	South Korea
33	Sweden
34	Switzerland
35	Turkey
36	United Kingdom
37	United States

Source: OECD (2020a)

Note: The list includes only member countries as of December 2020 based on the ratification of the Convention on the OECD.

The empirical approach adopted by this study is similar to the approaches taken by research

that looks into initial conditions in times of exogenous unexpected events of large-scale impact

especially that of Claessens et al. (2010). Considering the diversity in the mechanism of physiological and economic progression of the pandemic and the role of differential exposure of the countries to global trade and financial markets, the first step in the analysis was to determine the different timelines at which the countries entered technical recession defined as having negative real GDP growth rate for at least two consecutive quarters. From table 2 it is clear that the countries in groups 1 and 2 entered recession in the second and third quarters of 2019 well before Covid-19 impact was felt. On the other hand, the countries in group 3 were recession-hit coinciding with the contagion in the first quarter of 2020. Countries in group 4 did not technically enter recession at all even though they exhibited negative real GDP growth rate for at least one quarter in 2020. All the data given in table 2 has been updated until the third quarter of 2020.

What emerges from table 2 is also a preliminary appraisal of the group-wise impact of Covid-19 on OECD economies. The set of countries to technically enter recession coinciding with Covid-19 timeline in group 3, which is the focus group of the study, comprise a diverse group of countries with direct and indirect trade and financial links with the originator country of the pandemic. The countries in group 1,2 and 4 were those who were relatively the least impacted and whose link with the origin is indirect or remained relatively inactive in the weeks leading up to the crisis. These observations are in agreement with other studies on crises timelines and comparative impact as in AlAli (2020).

Table 2. Country sub-groups based on recession timeline

Group 1 Q2/Q3 2019	Group 2 Q4 2019	Group 3 Q1 2020	Group 4 No recession
Finland	Austria	Australia	Chile
Mexico	France	Belgium	Greece
	Italy	Canada	Lithuania
	Japan	Columbia	Sweden
		Czech Republic	Turkey
		Denmark	
		Estonia	
		Germany	
		Hungary	
		Iceland	
		Ireland	
		Israel	
		Korea	
		Latvia	
		Luxembourg	
		Netherlands	
		New Zealand	
		Norway	
		Poland	
		Portugal	
		Slovak Republic	
		Slovenia	
		Spain	
		Switzerland	
		United Kingdom	
		United States	

Source: Authors' calculation based on the Quarterly National Accounts Dataset, OECD (2019-2020)

The regression models will compare the two sub-groups as given in table 3. Groups 1, 2 and 4 have been combined together as group A and group 3 renamed as group B.

Table 3. Sub-groups for modelling

Group A	Group B
Austria	Australia
Chile	Belgium
Finland	Canada
France	Columbia
Greece	Czech Republic
Italy	Denmark
Japan	Estonia
Lithuania	Germany
Mexico	Hungary
Sweden	Iceland
Turkey	Ireland
	Israel
	Korea
	Latvia
	Luxembourg
	Netherlands
	New Zealand
	Norway
	Poland
	Portugal
	Slovak Republic
	Slovenia
	Spain
	Switzerland
	United Kingdom
	United States

Source: Authors' compilation

Data sources

The study uses panel data for 37 OECD countries between 2019 and the third quarter of 2020. The variables selected were sourced from OECD database for individual countries as well as world development indicators of the World Bank for the relevant period. The descriptive statistics are based on country statistics for the most recent year for which the complete dataset is available for the country as of the third quarter of 2020. Missing values were dropped from analysis. The variables current account balance, trade in goods and services, general government debt, private sector debt data, duration, severity and investment growth rate were

sourced from OECD database whereas domestic credit to the private sector was obtained from World development indicators of the World Bank.

IV Results

Descriptive statistics

Initial conditions beyond trade and financial links were probed through a wide set of macroeconomic variables to illuminate their correlations with macroeconomic performance during the pandemic. Table 4 examines seven macroeconomic variables such as average change in GDP, current account deficit, proportion of exports and imports, private sector debt, domestic credit to private sector and debt-to-GDP ratio to understand the role of initial vulnerabilities in experiencing the impact of the pandemic. All the data in table 4 was collected from the national account and statistical base of OECD countries as well as world development indictors of the relevant period from the World Bank. Missing values were dropped from the analysis of central tendency statistics given in Table 4.

Table 4. Independent variables

Variables	Group A		Group B	
	Mean	S.D.	Mean	S.D.
Average change in GDP *2019-2020*	1.21	1.15	2.13	1.52
Current account deficit [% GDP]	-0.28	2.46	1.90	4.28
Exports [% GDP]	35.72	14.25	59.40	41.45
Imports [% GDP]	35.26	13.72	54.30	34.57
Domestic credit to private sector [% GDP]	91.83	38.93	95.18	46.84
Private sector debt [% GDP]	200.59	51.06	222.31	87.19
Debt-to-GDP ratio	103.96	70.42	67.46	33.88

Source: Authors' calculations based on country data from OECD (2019-2020), OECD (2020d-f), OECD (2020g), and World Bank (2020).

Note: The calculations in table 4 are based on country statistics for the most recent year for which the complete dataset is available as of 2020 [Q3]. Values n.a. indicate insufficient data to calculate the parameter due to missing values. The databases include current account balance indicator, trade in goods and services indicator, and general government debt indicator from OECD (2020d-f), private sector debt data from OECD (2020g), and domestic credit to the private sector from World development indicators of the World Bank (2020).

Table 4 indicates that the countries in group B, which entered recession coinciding with Covid-19, had significantly higher average values and standard deviations in all the variables indicating macroeconomic stability and trade. However, in debt-to-GDP ratio, group A had a higher average score (103.96) and standard deviation (70.42) than the respective values in B (67.46 and 33.48). The role of debt indicators as opposed to macroeconomic and trade indicators will be examined in detail in the regression tests that follow in tables 6-8.

Table 5. Dependent variables

Variables	Group A		Group B	
	Mean	S.D.	Mean	S.D.
Duration	2.73	1.10	2.46	0.58
Severity	-2.27	5.66	-1.67	4.34
Annual growth rate of investment	-0.42	5.46	5.84	14.62

Source: Authors' calculations based on OECD dataset (2019-2020), OECD (2021a,b).

Table 5 examines the group-wise central tendencies of the dependent variables. The variable duration is defined as the number of quarters through which real growth rate remains negative while severity is the defined as the cumulative change in GDP from Q1 in 2019 to Q3 in 2020. The variable investment refers to the annual growth rate of investment in 2019-20. In table 5, it emerges that the countries in group B whose recession coincided with Covid-19 had a greater average measure of severity of impact (-1.67) compared to the duration of impact (2.46). the annual growth rate of investment was significantly higher for this group (5.84) as compared to group A (-0.42). This might be an indication that the countries in group B were severely impacted by Covid-19 perhaps due to their intense trade and financial links. But the lesser duration of the impact and improvement in investment growth rate suggests a combination of robust initial conditions and policy responses helped them to bounce back from the first wave of the pandemic faster than their counterparts in group A.

Econometric result

Table 6-8 report the formal results of econometric analysis with all the three models for groups A and B. The first point of interest is that all the three models remain significant to various degrees for group B and none for group A. This is entirely in line with the theoretical expectation that countries in group B that entered recession coinciding with Covid-19 have variables of the pandemic correlated with variables of initial macroeconomic conditions. Second, for both groups, there is no single independent variable that is significantly correlated with all the three dependent variables under analysis namely duration, severity and annual investment growth rate. However, from tables 6-8, it is clear that the indicators of debt such as domestic credit to private sector, private sector debt and debt-to-GDP ratio are significantly correlated with all the three dependent variables. Finally, there is no independent variable that is negatively correlated with any of the dependent variables suggesting the absence of inverse relationship.

Model 1

Table 6. Model 1 regression results

Dependent variable: Duration				
Group A				
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	-2.17813	3.03954	-0.72	0.6
Average change in GDP	-0.78414	0.54154	-1.45	0.38
CAD	-0.31029	0.36599	-0.85	0.55
Exports	0.21733	0.31982	0.68	0.62
Imports	-0.16578	0.34188	-0.48	0.71
Domestic credit to private sector	0.00948	0.0193	0.49	0.71
Private sector debt	0.0029	0.01213	0.24	0.85
Debt-to-GDP ratio	0.0205	0.01147	1.79	0.32
Residual standard error	0.89 on 1 degrees of freedom			
Multiple R squared	0.873			
Adjusted R squared	-0.0165			
F statistic	0.981 on 7 and 1 DF			
p value	0.654			

Group B				
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	0.94386	0.63398	1.49	0.1587
Average change in GDP	0.23931	0.11601	2.06	0.0582.
CAD	0.16914	0.04257	3.97	0.0014**
Exports	-0.11061	0.03764	-2.94	0.0108*
Imports	0.12947	0.0442	2.93	0.011
Domestic credit to private sector	0.00384	0.00345	1.11	0.2846*
Private sector debt	-0.00373	0.00208	-1.79	0.095.
Debt-to-GDP ratio	0.00966	0.00368	2.63	0.0199*
Residual standard error	0.44 on 14 degrees of freedom			
Multiple R squared	0.628			
Adjusted R squared	0.443			
F statistic	3.38 on 7 and 14 DF			
p value	0.025			

Source: Authors' calculation based on OLS regression performed in R 4.1.0

Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 6 gives the result of Model 1 with dependent variable duration for both groups A and B. Entirely in line with the expectations, the group B countries which entered the recession timeline coinciding with the pandemic showed correlation with some of the variables as compared to group A. It seems that the duration was related to macroeconomic variables such as current account deficit, proportion of exports and debt-to-GDP ratio. It is reasonable to assume that at the time of complete lockdown and freezing of regular trade, the volume of trade, reserves of foreign exchange and the ratio of debt to GDP were affected. What is interesting is that along with the government, the private sector was also impacted as both domestic credit to the private sector as well as private sector debt was shown to be related to the duration of the pandemic. The results indicate that for a country whose entry into recession coincided with the timeline of Covid-19, variables that demonstrate trade links and debt status of the government as well as the private sector are significant.

Model 2

Table 7. Model 2 regression results

Dependent variable: Severity			
Group A			
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	22.7268	13.7921	1.65	0.35
Average change in GDP	-1.4675	2.4573	-0.6	0.66
CAD	2.8256	1.6607	1.7	0.34
Exports	-2.7599	1.4512	-1.9	0.31
Imports	2.7453	1.5513	1.77	0.33
Domestic credit to private sector	-0.0587	0.0876	-0.67	0.62
Private sector debt	-0.0359	0.055	-0.65	0.63
Debt-to-GDP ratio	-0.0652	0.052	-1.25	0.43
Residual standard error	4 on 1 degrees of freedom			
Multiple R squared	0.943			
Adjusted R squared	0.544			
F statistic	2.36 on 7 and 1 DF			
p value	0.464			
Group B			
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	10.04564	2.65744	3.78	0.002**
Average change in GDP	-3.89733	0.48628	-8.01	1.3E-06***
CAD	-0.5094	0.17843	-2.85	0.0127*
Exports	0.32861	0.15777	2.08	0.0561.
Imports	-0.40326	0.18529	-2.18	0.0471*
Domestic credit to private sector	-0.05185	0.01447	-3.58	0.003**
Private sector debt	0.0311	0.00874	3.56	0.0031**
Debt-to-GDP ratio	-0.0278	0.01541	-1.8	0.0927.
Residual standard error	1.9 on 14 degrees of freedom			
Multiple R squared	0.858			
Adjusted R squared	0.787			
F statistic	12.1 on 7 and 14 DF			
p value	0.0000564			

Source: Authors' calculation based on OLS regression performed in R 4.1.0

Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 7 shows the second model with the dependent variable severity against the variables of

both groups A and B. In this model also, countries in group B were impacted by the severity

as opposed to those in group A as per expectations. In this model, all the independent variables were found to be significantly related to the dependent variable to various degrees for countries in group B. Variables of macroeconomic stability such as average change in GDP and current account deficit, those indicating trade links such as proportion of imports and exports and variables signifying debt status such as domestic credit to private sector, private sector debt and debt-to-GDP ratio are correlated with the severity of the impact. Similarly, variables covering the government as well as the private sector were equally related with severity. The contrast of the impact of severity that affected nearly all the variables as against duration is notable. This finding stands with previous studies on globally synchronized recession that the impact of these crises tends to be severe and the recoveries typically slower (Rose and Spiegel, 2009).

Model 3

Table 8. Model 3 regression results

Dependent variable: Annual growth in investment				
Group A				
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	-38.8298	8.2073	-4.73	0.13
Average change in GDP	-5.3097	1.4623	-3.63	0.17
CAD	-4.9427	0.9882	-5	0.13
Exports	4.2472	0.8636	4.92	0.13
Imports	-4.0179	0.9231	-4.35	0.14
Domestic credit to private sector	0.0338	0.0521	0.65	0.63
Private sector debt	0.0684	0.0327	2.09	0.28
Debt-to-GDP ratio	0.1472	0.031	4.75	0.13
Residual standard error	2.4 on 1 degrees of freedom			
Multiple R squared	0.976			
Adjusted R squared	0.804			
F statistic	5.69 on 7 and 1 DF			
p value	0.312			
Group B				
Coefficients	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	29.9759	13.1885	2.27	0.03932*

Average change in GDP	-9.9152	2.4134	-4.11	0.00106**
CAD	-1.5741	0.8855	-1.78	0.09719.
Exports	0.9737	0.783	1.24	0.2341
Imports	-1.2695	0.9196	-1.38	0.18907
Domestic credit to private sector	-0.3019	0.0718	-4.2	0.00088***
Private sector debt	0.1874	0.0434	4.32	0.0007***
Debt-to-GDP ratio	-0.0226	0.0765	-0.3	0.77198
Residual standard error	9.2 on 14 degrees of freedom			
Multiple R squared	0.772			
Adjusted R squared	0.658			
F statistic	6.77 on 7 and 14 DF			
p value	0.00124			

Source: Authors' calculation based on OLS regression performed in R 4.1.0

Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 8 shows the third model with annual growth of investment as the dependent variable for independent variables concerning both the groups. Following the expectations, countries in group B were impacted more than that of group A. For group B, the dependent variable investment was significantly related to variables of debt such as domestic credit to private sector and private sector debt as well as those indicating macroeconomic stability such as average change in GDP and current account deficit. Thus, both private and government sectors were affected in the areas of macroeconomic stability and debt. Curiously, annual investment does not seem to have a relation with variables of trade such as imports and exports. This might suggest that annual growth in investment rate might be more impacted by general macroeconomic variables than the volume of trade. However, indirect effects such as interest rates which may slow down investment growth rate might in turn affect volume of trade.

Robustness test

In order to ensure that the results of the three models were not spurious and the fundamental assumptions of linear regression were followed, robustness test was carried out for the assumption of homoscedasticity of residual errors. Homoscedasticity is one of the fundamental

assumptions of linear regression models that states that the residual error is the same across all values of independent variables. The residuals of the models were plotted against the fitted values to graphically examine whether the variance was equal across all values as shown in figure 1 (a,b,c).

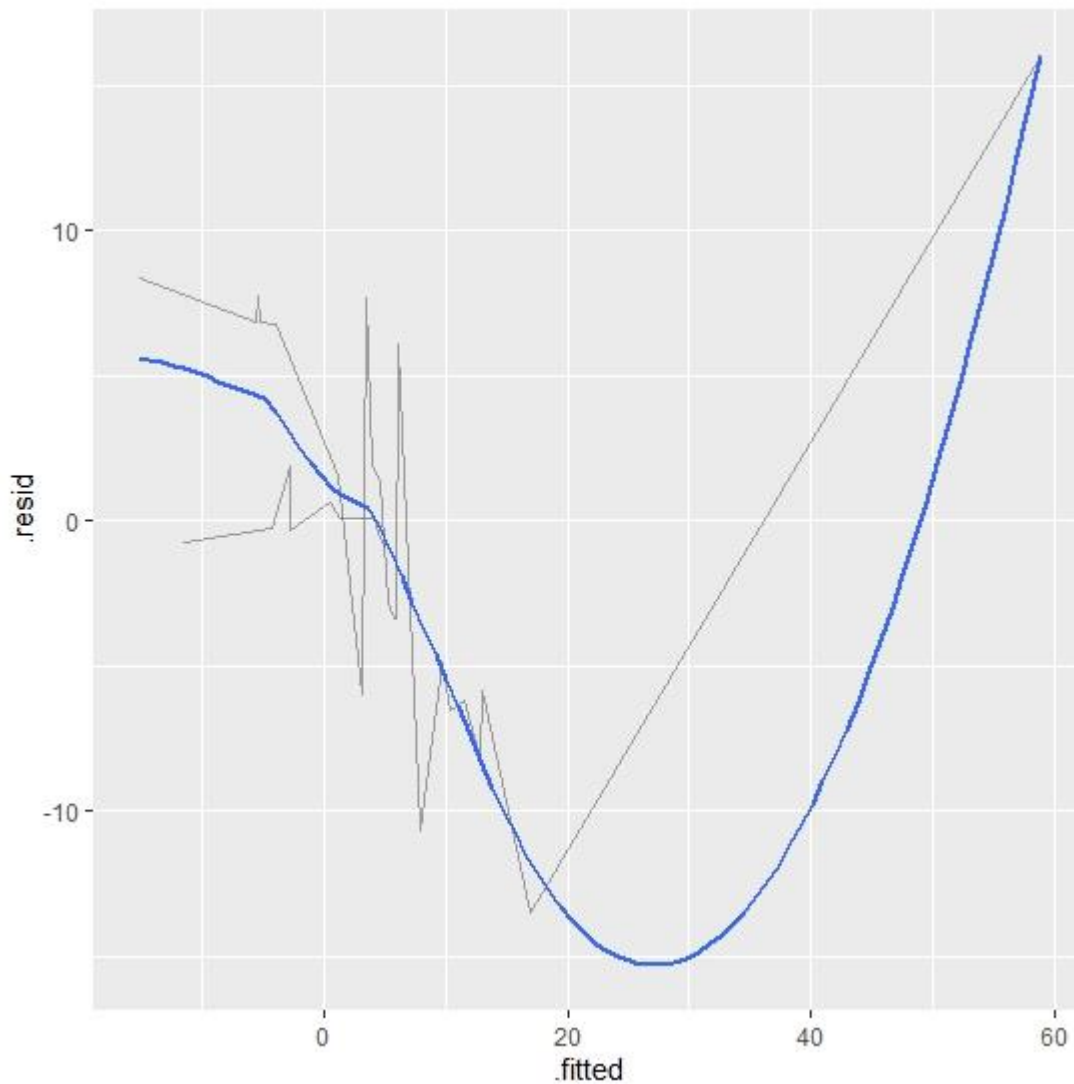Figure 1.a Residual Plots of Model 1
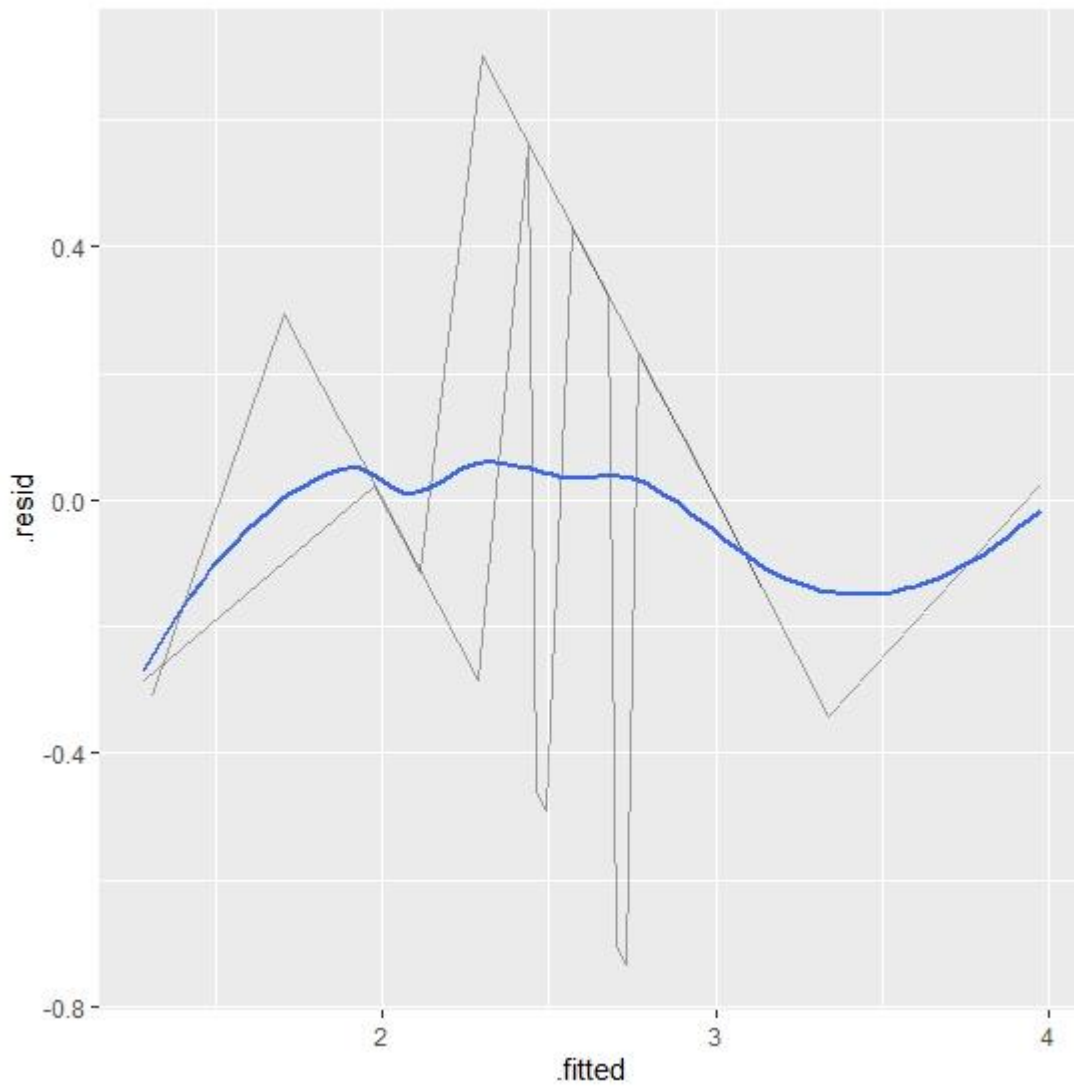
Source: Authors' compilation

Figure 1.b Residual plot of model 2
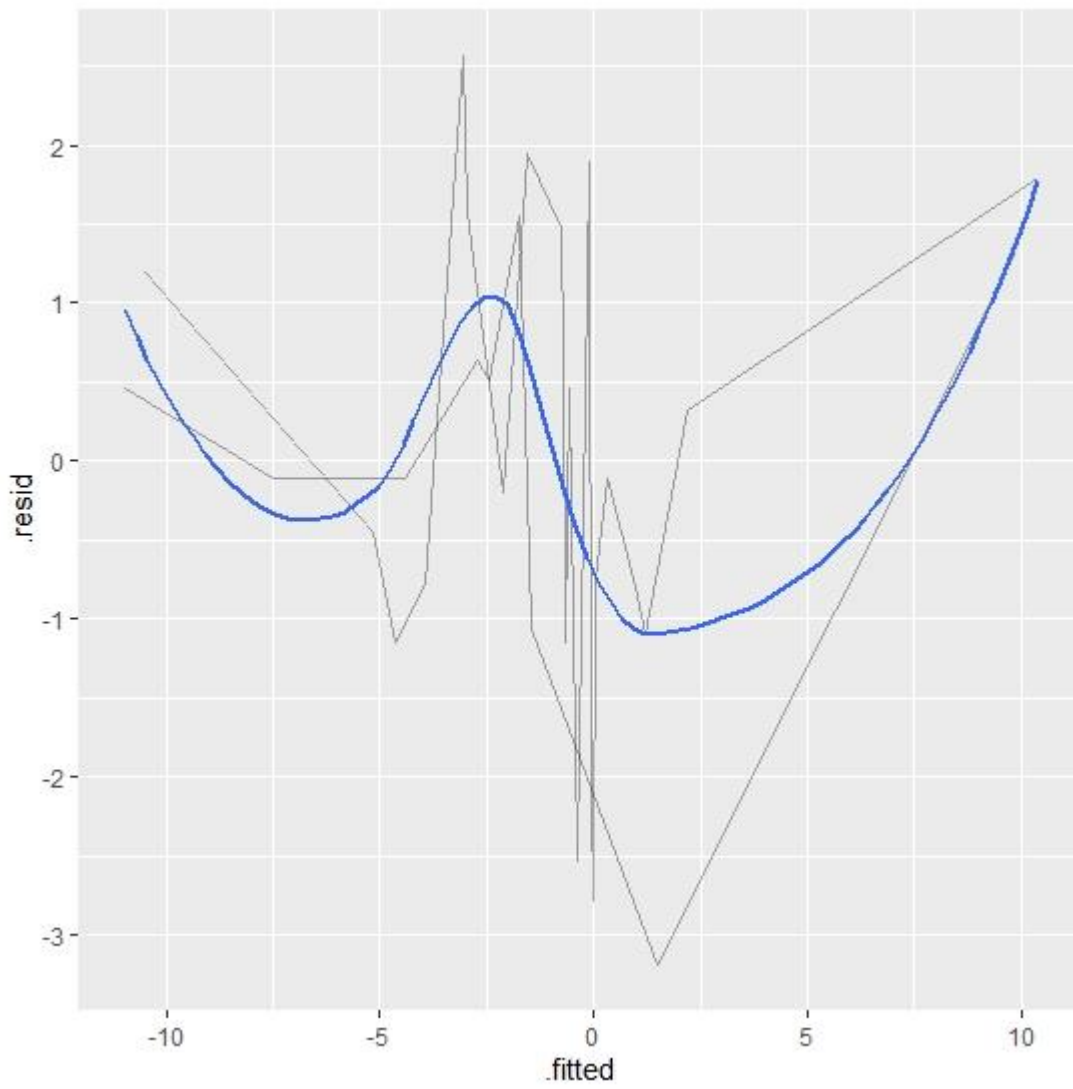
Source: Authors' compilation

Figure 1.c Residual plot of Model 3

Source: Authors' compilation

A formal test of robustness was then performed on group-wise regression results of all the three models using the Goldfeld-Quandt heteroscedasticity test. This test is appropriate when the regression model to be tested includes an indicator variable among its regressors as is the case with this study. The test compares the variance of one group of the indicator variable (group A) to the variance of the benchmark group (group B). The Goldfeld-Quandt heteroscedasticity test calculates the F statistic for all the models with a lower tail critical value (Flc) and upper

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tail critical value (Fuc). If the calculated value of the F statistic is lower than the upper tail value (Fuc), then the variance of error term is assumed to be homoscedastic. As table 9 shows, the calculated F statistic is lower than the Fuc value for all the models demonstrating that the variance of error term follows the assumption of homoscedasticity and the models are robust for this assumption.

Table 9. Goldfeld-Quandt test results

Model	Flc*	Fuc^	F statistic
Model 1	0.001017783	6.297939	3.995131
Model 2	0.001017783	6.297939	4.681609
Model 3	0.001017783	6.297939	0.06730926

Source: Authors' calculation done in R 4.1.0

Note: * Flc and Fuc refers to lower tail critical value and upper tail critical value respectively.

V Discussion and policy implications

The three models in this study explain the role of initial conditions through macroeconomic, trade and debt variables to understand the duration and severity of the pandemic as well as its impact on annual growth in investment. As per the expectations, in all the three models, countries in group B which entered recession coinciding with the pandemic were impacted by the variables under study in comparison with those countries in group A. The second feature of interest is that both government and the private sector were equally affected by the duration and severity of the crisis as the results demonstrate. A third notable observation is that severity of the crisis was related to nearly all the variables more than the duration as a comparison between the first and second model shows. This observation stands with the results from previous empirical studies on financial crises that have concluded that globally synchronized crises tend to be severe and the recoveries slow. Fourth, the annual growth rate of investment

does not seem to be particularly correlated with the volume of trade. Finally, the primary results indicate that variables concerning debt status are significantly linked to all the dependent variables under study compared with variables of macroeconomic stability and trade. To take the research trajectory further, the impact on dependent variables has to be examined taking time-lag effect and second-order effect into consideration. Furthermore, comparing an extended pre-crisis time period with the period of Covid-19 impact might also augment the interpretations with the help of trend analysis.

The results imply some policy scenarios for developed and emerging economies in the short, medium and long term. An unexpected large-scale event such as the pandemic has the potential to transform into systemic risk at the secondary and tertiary levels and create enduring structural impact through the interlinkages shared by financial institutions to households, firms, and other players in the market (Milne, 2020). The recovery of national economies post-pandemic could therefore take the quick V-shaped trajectory or the lagged U-shaped trajectory depending on initial conditions and the extent of shock (Samaddar, Sreenivas and Ghosh, 2020). Such a transformation invariably results in policy implications for the short, medium, and long-term as well as at micro and macro levels.

In the short-term, the traditional approach to monetary and fiscal policies seems to be in favour to revive economies from the lockdown. Monetary policy focusing on inflation control and public account stability remains top priority in the short term. For example, high-income and upper middle-income countries have reduced the benchmark of interest rates to boost economic demand (Barua, 2020). But such a measure might not be available to emerging economies and other countries whose interest rate benchmark is already low. In fiscal policy measures, quantitative easing, fiscal stimulus, and direct government interventions remain the preferred

route out of the pandemic. For instance, the $ 2 trillion package announced by the United States to be distributed among individuals and families, small and large business, as well as public and health services is an example of emergency-related stimulus (Denning, 2020). In contrast, in 2020, Denmark effectively nationalized the private pay-roll for a three-month period covering 70-90 percent of employee compensation to prevent mass lay-offs as well as rent and other recurring expenses for small businesses through the example of direct intervention costing the state $ 6.2 billion (Goodman, 2020). Given the extent of impact, these traditional approaches would only help in the short term.

In the medium term, innovative and non-traditional approaches aiming to boost the economy and build resilience in the system should be of priority. In this regard, there are three promising avenues to innovate namely institutional coordination, advanced data gathering and analysis, and regulatory response. The first is that of institutional coordination and information sharing. Critiquing Covid-19 as a 'grey rhino' rather than a 'black-swan' event shifts the burden of priority to policy outcomes focused on risk management, resilience and sustainability. Consequently, critical infrastructure, social inclusion and sustainability has returned as priority areas for fiscal expenditure. For example, examining the rapid and effective response system in Western Australia, Cavanagh et al. (2020) argue that timely, synchronized and aligned action within community and at all levels of government, alignment of health and economic measures, and strict border regulations were crucial in eliminating the negative impact of the pandemic rapidly from the system.

Secondly, the importance of information flow and the role of new digital technology in accessing advanced type of data have also gained prominence in responsiveness and mitigation strategy. For example, digital infrastructure can use passive intelligence gathering measures to

foretell a massive disruptive event such as Covid-19 and finetune our response accordingly (Gupta, 2020). But such data gathering abilities has to be within the acceptable social norms of trust and transparency and an attendant legal framework that allows proactive and participatory building of new regulatory institutions. Not enhancing digital capabilities can hamper even regular ordinary functions in the new normal. For example, Davola (2020) argues that a lack of harmonized regulatory response in measuring consumer credit worthiness can result in banks and other credit lending institutions not being able to properly discriminate between the quality of potential borrowers, and risk overexposure to losses. Such measures remain important in the light of the finding of this study that private sector debt is significantly related to the severity of crisis impact.

From the examination of data capturing and information processing abilities enhanced by digital finance, it can be concluded that the introduction of time variant parameters, high frequency data, futures contracts as data, use of trading volumes, and data from emerging markets can enhance our understanding of mechanisms and predictive capabilities (Yarovaya et al., 2020). There is also a certain degree of centralisation of capabilities that needs to be worked out for advanced and synchronized data gathering and analysing capabilities, which can be challenging given the increased advocacy towards deglobalization, reliance on local economies through measures such as onshoring, and preference for shorter supply chains that is gaining momentum (Platje, Harvey and Rayman-Bacchus, 2020). More than ever, the need to cooperate internationally and multilaterally in the realm of sharing capacities and technology remains urgent and important.

Finally, there is also the channel of novel regulatory responses that help invigorate the economy while also provide targeted benefits to those segments of households and industries most in

need in the medium term. For example, an instrument called 'retrospective insurance' to businesses in addition to existing mechanisms of intervention has been proposed in high-income countries such as the United Kingdom. The compensation of retrospective insurance is calculated based on the ratio of wages, rent and profit to revenue as recorded in the most recent annual accounting statement for each firm or self-employed worker and its objective is to minimize job losses and enterprise closure (Milne, 2020). Regulatory sandboxes such as financial technology mechanisms to enhance information and investment for small business enterprises could also be initiated to help small and medium enterprises survive the secondary and tertiary shocks.

The long-term measures to deal with the impact of Covid-19 has to examine the issue of cyclicality of crises. As Skidelsky (2020) has argued, public investment, counter-cyclical employment such as public sector jobs and tax policy are required to offset the imbalance beyond inflation targeting and stimulus. Leaving two crucial macroeconomic variables such as employment generation to emergency measures and wealth and income distribution to market mechanisms is not sustainable. However, the main challenge in modifying structural aspects of the economic system is political will especially quality leadership that can assume responsibility and accountability for adaptive challenges that the pandemic has given rise to.

VI Future strands of research

Within the purview of the research question, the study can be expanded further in a few meaningful ways. For example, the same question may be ascertained after three years to understand the impact of time-lag variables. Additionally, impact itself may be understood as first-order and second-order effects and suitable methodology employed to bring them out. In this manner, spill-over effects can be examined in detail. Secondly, the findings of the impact

on economic growth can be read with an analysis of stock market response to yield meaningful understanding on risk. The economic and psychological factors that affect investment decisions in markets, the impact of information dissemination, and the role of expectation in risk management are some of the relevant questions. In this strand, methodological innovations such as the study of small probabilities and the scope of big data analysis on passive data collection and analysis is of much interest. Finally, comparative accounts of different sets of economies may prove valuable in indicating the impact on high-income, middle-income, and low-income economies. The main challenge in undertaking such a study is the availability of comparable and discernible data for emerging economies.

Outside the framework of the research question this study engaged in, the larger fields of interest in the pandemic studies are the justification of the economic growth paradigm and its attendant convergence and divergence scenarios in an era of inequalities, the role of state in setting up market conditions through industrial and innovation policy, the emergence of corporate monopolies and regulation, and the future of sustainability.

After an unprecedented crisis such as Covid-19, what will the new normal look like? A cataclysmic event such as Covid-19 has the potential to question the efficacy and legitimacy of the existing world order leading to the restructuring of the socio-economic systems. Using socio-technical order as the framework, Wells et al. (2020) argue that there are four distinct scenarios for building the future that comprises business as usual approach, chaotic transition, managed transition, and managed degrowth. Furthermore, modelling managed transition reveals five stages such as resolve, resilience, return, reimagination and reform before stable equilibrium status is reached (Sneader and Singhal, 2020). The length and intensity of each stage depends on the historical, geographical, and institutional context of a country. The future

landscape of macroeconomic analysis appears unchartered. Coupled with the shifts in research and policy perspectives brought in by big data and artificial intelligence, the pandemic might usher in a paradigmatic change in scale and scope of research investigation, timeline horizons of policy contexts, and above all value framework that determines what questions remain meaningful and relevant.

VII Conclusion

This paper examined the relationship between initial conditions of a country and the impact of the Covid-19 pandemic on economic growth using the sample of OECD economies. Some of the preliminary observations from the study are that countries that had the closest link through human contact were the first economies to be impacted. Those countries who had strong and sustained trade and financial links were susceptible later but were affected more severely. Countries that were farthest removed from the origin of the crisis had the least impact on the economies.

The study examined three types of variables that indicated initial conditions namely macroeconomic variables, trade variables and debt variables to examine the performance of a country during the pandemic as revealed by the duration, severity and annual investment growth rate. From formal econometric analysis, the main findings are that macroeconomic variables of debt such as domestic credit to the private sector, private sector debt and debt-to-GDP ratio have significant relationship with the duration and severity of the crisis impact as well as annual investment growth rate. The correlation between initial conditions and first order effects is the major contribution of this study.

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