GTAP 2021 Conference

Analysing the impact of COVID-19 on the global economy.

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Introduction

The COVID-19 pandemic and associated policy responses aimed at containing the virus are having far-reaching economic consequences. The pandemic has had an impact on human health and behaviour, and governments deployed considerable virus containment and economic support measures. In several countries citizens were required to work from home, social interactions were limited, schools, shops and restaurants had to be closed, and governments placed various restrictions on public transport and travel both within and across international borders. This has virtually shuttered economic activity in certain sectors of the economy while other sectors were relatively unaffected (and some increased). At the same time, many governments have deployed unprecedented financial and other means to support incomes, employment and prevent pandemic-related bankruptcies. Currently, it is unknown which of these effects will be short-lived and which might last longer.[1] The latest data on different containment measures and their stringency suggest that, as of the beginning of 2021, several measures introduced in the second quarter of 2020 remain in place in several countries (Figure 1).

The pandemic and the associated policy responses are estimated to have had major macroeconomic impacts, with world GDP and international trade estimated to have contracted in 2020 by, respectively, 4.5 and 10.3 per cent (OECD, 2020[1]). The impacts were heterogeneous across countries and regions, with the Euro area, for example, recording more pronounced GDP decline than the United States or Japan, and China recording a positive growth rate[2]; effects were also heterogeneous in terms of their structure.[3] While data on economic impacts of the pandemic at sector level is scarce, where such information is available, it suggests that these impacts were also highly unequal[4] due to, among others: different degrees to which consumption and production of different products relies on personal contacts; changing consumer preferences; and differences across sectors in productivity effects associated with new working arrangements (e.g. teleworking), as well as disruptions in supply chains. These suggest significant impacts on product and factor markets, the distribution of incomes, savings, prices, consumption, production, employment, as well as directions and product composition of trade flows across the world economy. This paper aims to assess the economic impact of the COVID-19 pandemic and the associated policy responses on the global economy and international trade using the OECD METRO Model.

[1] Note that this distinction is relevant for policy response formulation. Short-lived effects might not call for a policy response, or may call for a different type of responses or accompanying policies. Responses to long-term changes depend on the assessment of desirability of their effects.

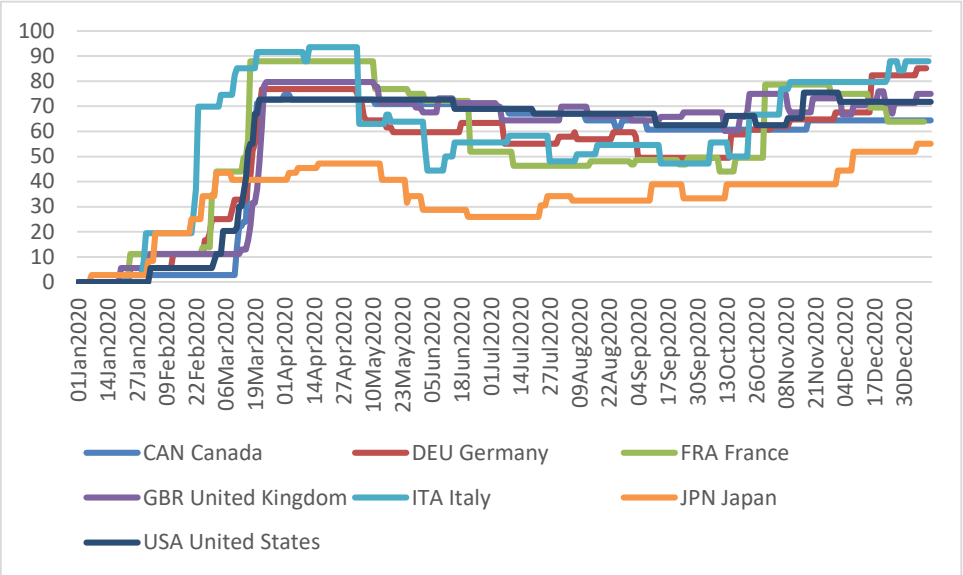
[2] China's GDP is projected to have increased by 1.8 per cent in 2020, while that of the Euro area, United States and Japan to have declined by 7.5, 3.7 and 5.3 per cent (OECD, 2020[1]).

[3] For example, there are considerable differences in changes to main macroeconomic aggregates such as consumption, investment or governments' fiscal stances [see (OECD, 2020[1])].

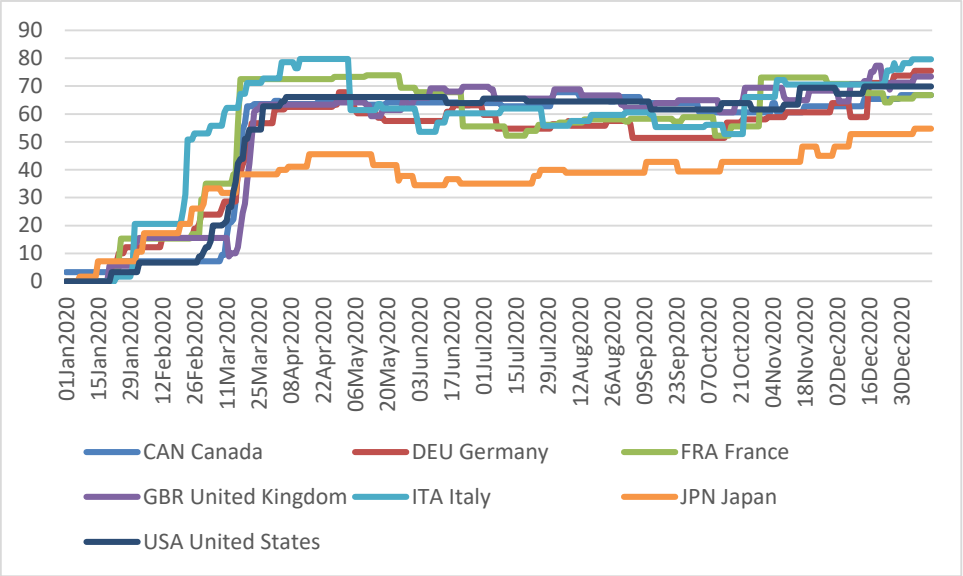
[4] For example, in some OECD economies, arts, recreational and personal as well as accommodation and food services registered declines of more than 20% between February and September 2020 while manufacturing and construction registered declines of 5 to 8 per cent, and some sectors, such as wholesale and retail trade, recorded even positive growth rates (OECD, 2020[1])

Figure 1. Stringency of COVID-19 related measures in selected OECD economies

Panel A. Stringency of containment measures*



Panel B. Index of government response**



Note: Panel A shows a composite measure capturing stringency of virus contained measures such as requirements to stay at home or bans on public gatherings while Panel B shows an index of government policies aimed at alleviating the negative economic effects of the pandemic. Both measures are rescaled to a value from 0 to 100 (100 = strictest / strongest).

Source: Oxford Coronavirus Government Response Tracker.[5]

[5] The Oxford Tracker is available at: https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker.

Data on the structure of economies, such as the data on output, consumption or trade by product or sector, or distribution of income are published with considerable time lags[6], impeding thereby a timely analysis of structural changes at major turning points such as the COVID-19 pandemic. It is for this reason that economic models, computable general equilibrium (CGE) models in particular (see Section 2 below), are often used in order to fill in the missing information and to provide insights into the effects of shocks and possible policy responses. The OECD CGE trade model METRO is a unique analytical tool which can shed empirical light on structural changes to world production and trade due to the COVID-19 pandemic which cannot yet be seen in real-time data and which are not consistently reported in macroeconomic projections. It is also a unique tool that can be used to assess trade policy options which can support economic recovery going forward, such as for example the effects of trade facilitation measures or of non-tariff measures reforms. It can also be used to assess the possible effects of specific trade and trade-related policies considered in some countries in the context of the COVID-19 pandemic (such as for example those regarding supply chains, see e.g. (Arriola et al., 2020[2]).

Relation to existing work

CGE modelling featured prominently among the recent studies used to assess the economic impacts of COVID-19. This is because the CGE approach allows consistent accounting for complex economic interactions and general equilibrium effects, which is particularly useful for understanding developments in recent periods when much of the statistical data is not yet available as well as for projections of different scenarios relating to future. The study in (Arriola et al., 2020[2]) used the OECD METRO model to first construct a COVID-19 base simulation and second to develop a set of scenarios on top of that base to explore risks and vulnerabilities in global value chains. The COVID-19 baseline featured changes in labour supply- and productivity as well as demand shocks and trade cost changes estimated to have occurred in the first half of 2020 only and did not include government support measures.

One of the first CGE analysis[7] of the economic effects of COVID-19, published in early March 2020, was (McKibbin and Fernando, 2020[4]). The study explored macroeconomic and financial market effects of different scenarios of geographical spread of the virus and illustrated what economic costs could be avoided by greater investment in public health infrastructure. In April 2020, a Bank of International Settlements note on macroeconomic effects of COVID-18 provided a review of CGE (and other) studies on the economic costs of earlier pandemics, drawing possible lessons for the COVID-19 pandemic (Boissay, 2020[5]). The early April WTO's trade forecast was produced, amongst others, using the WTO's CGE model for predicting GDP and trade effects on the basis of assumptions regarding the effects of the COVID-19 pandemic on costs, labour supply, falling demand in sectors affected by social distancing, and supply chain frictions, among others (WTO, 2020[6]). The April 2020 World Bank analysis also examined the potential impact of COVID-19 on GDP and trade using a CGE model (Maliszewksa, Mattoo and van der Mensbrugghe, 2020[7]). The study focused on short-term impacts on GDP and trade of an illustrative scenario incorporating assumptions on the underutilisation on labour and capital, increase trade costs, reduced demand for international travel services, and shift in demand from sectors with close human interaction (like hospitality, restaurants, domestic

[6] For example, consistent data for international trade by traded product and trading partner typically appear with about a two-year time lag.

[7] The study combined a dynamic stochastic general equilibrium (DSGE) and a CGE model.

transportation) towards goods and other services sectors. A European Commission's analysis of the impact of the COVID-19 pandemic on trade, published first in April 2020 and updated in May 2020, used a combination of two CGE models, which were used to derive predictions about the effects on global and EU trade on the basis of April 2020 IMFs' GDP forecasts (European Commission, 2020[8]).

A number of recent country and sector-specific CGE-based studies of COVID-19 effects are also available. A New Zealand Institute of Economic Research study used a CGE model to investigate the potential local and regional impacts of COVID-19 in New Zealand with a focus on tourism (Leroy de Morel, 2020[9]). An academic study published in July 2020, used a CGE model to examines the macroeconomic and greenhouse gas emission impact of the COVID-19 crisis focusing on Belgium (Lahcen, 2020[10]). Another academic study, published in October 2020, used a CGE model linked to a population-wide epidemiological demographic model to estimate the potential impact of COVID-19 on the United Kingdom economy, distinguishing between direct disease effects, preventive public actions and associated policies (Keogh-Brown, 2020[11]). (UNDP, 2020[12]) conducted a CGE analysis of potential economic and social impacts of COVID-19 in Cambodia. In addition, a study by UNCTAD used CGE analysis to assessed the economic consequences of COVID-19 for the global tourism sector (Gopalakrishnan, 2020[13]).

While a fully-fledged review of all relevant studies is beyond the scope of this scoping paper, the brief version provided shows already that, within only a few months, a number of CGE-based studies of the possible economic and other effects COVID-19 have been prepared. While this literature already provides some insights into the possible short and long-term effects of the pandemic on economic activity and international trade, each of these studies has a specific focus and none of them focuses specifically on global implications for sectoral trade, regional trade effects or on long-term implications for trade policy. Moreover, as argued by for example in (Perdana, 2020[14]), given the rapid epidemiological, policy and economic developments, some of the studies prepared only a few months ago have already become outdated in terms of their assumptions.

It follows that an up-to-date study using the OECD METRO model, which is dedicated to analysis of changes in the structure of production, consumption and trade (as well as their other distributional implications), and which draws on the latest OECD insights into the impact of COVID-19 across different economic activities and policies—and updates them on a regular basis—can be a valuable contribution.

Methodology and data

The impact of the COVID-19 pandemic on the global economy and international trade

The Main features of the METRO Model

The METRO model (OECD, 2020[15]) is a computable general equilibrium (CGE) model calibrated for this analysis to 29 regions, 26 sectors, and 8 production factors. Like many CGE models, METRO rely on a comprehensive specification of all economic activity within and sometimes between countries (and therefore the different inter-linkages that tie these together). The model builds on the GLOBE model developed by (McDonald and Thierfelder, 2013[16]). The novelty and strength of METRO lies in the detailed trade structure and the differentiation of commodities by end use. Specifically, commodities and thus trade flows are distinguished by whether they are destined for intermediate use, for use by households, for government consumption, or as investment commodities.

The underlying framework of METRO consists of a series of individually specified economies interlinked through trade relationships. As is common in CGE models, the price system is linearly homogeneous, with a focus on relative, not absolute, price changes. Each region has its own numeraire, typically the consumer price index, and a nominal exchange rate (an exchange rate index of reference regions serves as model numeraire). Prices between regions change relative to the reference region.

The database of the model relies on the GTAP v10 database (Aguiar et al., 2019[17]) in combination with the OECD Inter-Country Input-Output Tables, which are the main source of the OECD Trade in Value Added Indicators and allows the model to distinguish trade for use in intermediate production or final demand. Policy information combines tariff and tax information from GTAP with OECD estimates of non-tariff measures on goods (Cadot, Gouron and van Tongeren, 2018[18]), services ((Benz and Gonzales, 2019[19]); (Benz and Jaax, 2020[20])), trade facilitation (OECD, 2018[21]) and export restricting measures. The METRO database contains 65 countries and regional aggregates and 65 commodities.

The model is firmly rooted in microeconomic theory, with firms maximising profits and creating output from primary inputs (i.e. land, natural resources, labour and capital), which are combined using constant elasticity of substitution (CES) technology, and intermediate inputs in fixed shares (Leontief technology). Households are assumed to maximise utility subject to a Stone-Geary utility function, which allows for the inclusion of a subsistence level of consumption. All commodity and activity taxes are expressed as ad valorem tax rates, and taxes are the only income source to the government.

This analysis was implemented with a version of METRO configured for short-term analysis, featuring, among others, immobile land and capital. Wages are assumed downwardly rigid. The government is assumed to maintain their expenditure in real terms by allowing their internal balance to adjust. Investment demand is assumed to be in fixed in volumes and private domestic savings is free to adjust.

Adjustments to 2014 base data

The METRO database relies heavily on the GTAP database which in some cases deviates from official statistics due to the necessary adjustments to construct a consistent and balanced database for global modelling purposes. One area where the GATP v10 database diverges is the implied savings rate of private households which is a key parameter in METRO. This contrasts with the GTAP model (and its database), which combines private households and government into one institution, with one savings rate.

As the household savings rate adjusts to maintain the balance between investment and savings, the size and sign of a region's savings rate influences how the model behaves. Accordingly, the model database is modified such that the implied 2014 savings rates reflects the information found in secondary sources (OECD or United Nations Data). The social account matrix (SAM) of regions that are net savers according to the alternative sources but have a negative savings rate in the GTAP database is calibrated by targeting both the savings rates and the net surplus or deficit of the government account. The latter is included as a target on the share of the government balance to prevent the adjustment to be fully carried by the change in government savings. The adjustment also includes updating the income tax rate in these regions.

The model database is adjusted by running a model simulation using the target rates as shock parameters along with a closure set up designed to minimize changes to a region's GDP[8].

General assumptions

Modelling the impact of COVID-19 pandemic relies on several underlying assumptions about the nature and duration of the government containment and support measures and their impact productivity, the associated demand changes in the sectors directly impacted by the policies, and the extent of that impact. These assumptions, which are elaborated briefly below, are computed on the basis of the latest available data, the existing CGE analyses of COVID's economic impact and the more general growing economic literature on the pandemic.

Labour markets

Labour markets were directly affected by the lockdown mainly in terms of labour productivity. There were also important demand effects associated with firms closing or reducing activity and furloughing workers. The COVID-19 illness itself can have a direct effect on a person's ability to participate in the labour market if that person falls ill and is required to stay at home or, in the worst case, dies from the illness. A healthy person may be required to stay at home to be a caregiver, either to a sick relative or to a child whose school has been closed as a preventative measure or because of a lockdown. As part of the containment measures, many governments have also required or recommended teleworking from home whenever possible. For a variety of reasons – such as "lack of coordination, shirking, and a lack of interaction between people decreasing creativity" and negative effect on productivity of certain professionals who can work, but must work from home, has been posited in the literature (WTO, 2020[6]). On the other hand, there is some evidence that the net impact of teleworking could actually be positive (OECD, 2020[23]), (Barrero, Bloom and Davis, 2020[24]). For the simulation, a 4% of labour productivity loss is assumed. The productivity loss is adjusted by the share of work in the sector that can be done at home (Espinoza and Reznikova, 2020[25]).

Demand

Social distancing measures have also forced closures of restaurants, gyms, "non-essential" businesses and cancellation of travel, recreation and cultural activities. The fear of contamination and thus the resulting change in consumption behaviour as well as the containment measures put in place by governments translated into a decline in demand in many sectors. The extent of the decline is not only sector specific but it depends also on the nature of measures and the length of periods during which they were in place. For example, travel restrictions affect more directly the demand for air transport while gathering restrictions directly affect hotel, food services sector and wholesale trade sectors.

Ideally the model and data should be calibrated to match the changes in consumer demand in 2020. Consumer demand, however, information is not available at a detailed sectoral level for many countries. Instead yearly information on National Accounts from various sources are used to compute the changes in output by broad product category for all the countries in the database, and with this information, the model can be used to calibrate the

[8] Specifically, the government income and expenditure are assumed fixed and the internal balance remains flexible. The regional savings rates, which is the combination of the government and household savings and income is fixed. Lastly, exchange rates are assumed fixed and a region's trade balance are allowed to vary.

consumer demand shock. Specifically, the gap between the sector output change in 2020 produced from the National Accounts information and the ouptut change resulting from implemenation the other shocks into the model is the implied change in sectoral output change resulting from the change in consumer demand from the virus containment measures. The model framework is then used to determine the consumer the demand shock needed to produce this sectoral output change.

Trade costs for goods and services

The costs of transporting some goods and services have increased during the COVID-19 pandemic. While some efforts were made to minimize border delays even with additional health and saftey checks to reduce the spread of the virus across international borders, reinforced border controls, new protocols at the border, and additional documentation requirements for transporting goods and services across borders due to containment measure result in delays. While many measures were taken with the aim of controlling the spread of the virus and protecting the people handling and inspecting the goods, they have nevertheless translated into additional costs for traders.

As far as goods trade is concerned, the OECD Trade Facilitation Indicators and information collected by the OECD Trade and Agriculture Directorate on COVID-19 related policies is used to compute ad valorem estimates of the delays from the additional measures, and follows the approach in (OECD, 2017[26]). It aims to also take into account the lengths of periods in which these measures remained in place. The calculated rise in trade cost would be implemented in METRO as an increase in the iceberg cost of goods imported into the region. The increase in cost is then adjusted by number of weeks border restrctions were in place.

Regulatory restrictions on the movement of people across international borders have also been implemented as part of strategies to contain the spread of COVID-19. The simulations would use the Services Trade Restrictiveness Indicator (STRI) and the OECD COVID-19 policy tracker to quantify the cost of the increase of restrictions on business travel, intra-corporate transfers, and mutual recognition of qualifications and licenses, along with other airport restrictions not related to the movement of people. The increase of restrictions on business travel and mobility would be translated into ad valorem equivalents following (Benz and Jaax, 2020[20]) and, as for other assumptions, they would be scaled so as to reflect the lengths of periods in which these measures remained in place in each country.[9] Moreover, the increase in cost also takes into account the share of work in a sector that can be done remotely. Leverage estimates from (Espinoza and Reznikova, 2020[25]), the increase in services trade cost is applied to the share of work in the sector that cannot be done remotely.

Government support

Calibration of assumptions related to government support will be based on OECD estimates wherever possible and IMF estimates where OECD ones are unavailable. These refer to changes in the underlying primary balance (in the case of OECD data) or general government structural balance (in the case of IMF data) expressed as % points change (in

[9] The effects estimated in (Benz and Jaax, 2020[20]) are mid-term effects and a scaling approach would be devised to reflect these as well as the lengths of periods in which the measures remained in place in each country. Note also that it is possible to distinguish between policy measures restricting trade within the European Economic Area (EEA) with those with outside partners (MFN).

% of potential GDP where both the OECD and the IMF have their own estimates).[10] They thus aim to filter out cyclical changes in government balances and only leave what is 'discretionary', and taking changes means we are only taking what is supposed to be special to 2020.

Estimates will also be made to portions of support directed to households and firms based on the December Economic Outlook (OECD, 2020[1]), which contains some information on contributions to household disposable income growth in 2020 of social transfers.[11]

Preliminary Results

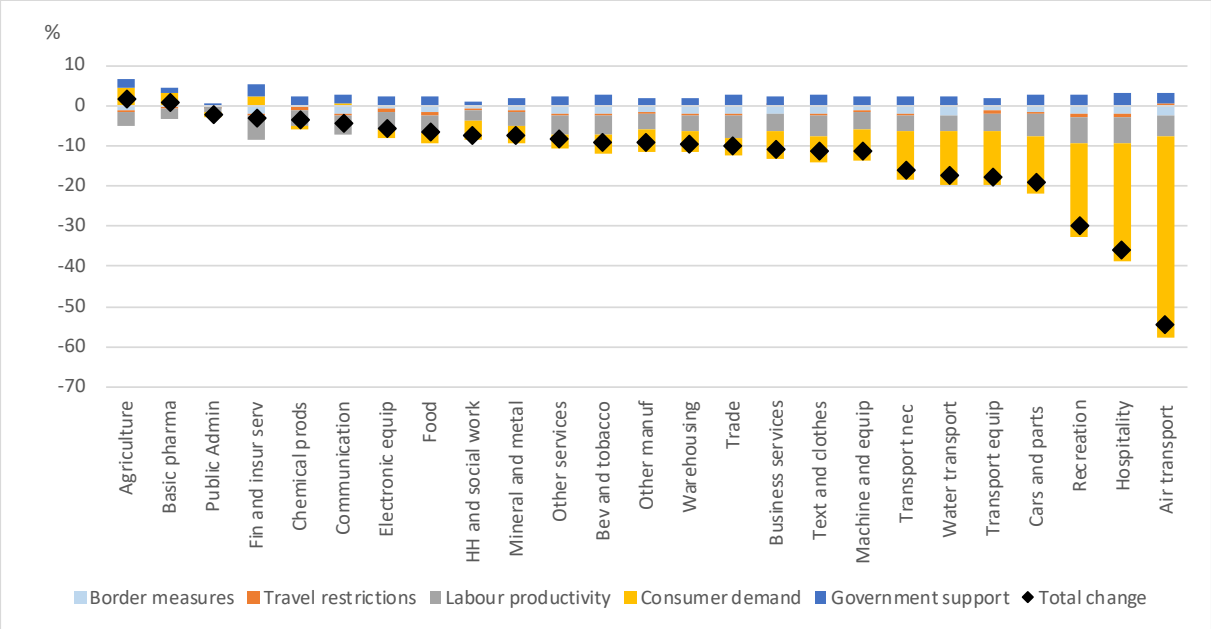
Preliminary results how that sectors that containment measures that aimed at reducing social interactions to limit the spread of the virus had unequal impact across industries (Figure 0.1~~Figure 4.1~~). The drop in demand in sectors that required more face to face interaction such as hospitality, recreation, and transportation accounted for a larger share of the decline in sector output. Shifts in demand to other sectors with less social interactions or alternative means of procureuemnt, such as online retrail trade, food and electronics, helped minimize the drop in consumer demand.

Many governments also provided financial support to households, workers, and firms negatively impacted by the COVID-19 containment measures. Government subsidies had a relatively small effect in sectors where consumer demand was basically shut down to contain the virus compared to the impact of the contaniment measures. Government subsidies had a larger positive effect in consumer related sectors such as hospitality, clothing, beverages, and cars. Output increases associated with the government support were upto one percentage point more in than in industries such as minerals and metals and other manufacturing. The consumer related sectors are helped by both the producer and household subsidies.

[10] The OECD estimates are slightly different already on the level of methodology (OECD excludes interest payments on existing debt and the two institutions have their own estimates of potential output). However, they seem close enough for countries for which they can be compared and since these are estimates and since uncertainty around these is considerable (take up of programmes) these are probably as good as we can get at this stage.

[11] For now information on sector-specificity of these measures is scarce although some monitoring exercises provide such information. See for example the World Bank's Tracker of Subsidies and State Aid to mitigate COVID-19 Effects available here: www.worldbank.org/en/topic/competitiveness/coronavirus

Figure 0.1. Percent change in real output



Source: OECD METRO Model and country National Accounts

Conclusions

The COVID-19 pandemic and associated government responses aimed at containing the virus are having far-reaching and unprecedent economic consequences. The impact of the measures have been unequal across countries and sectors. Sectors hardest hit has been those that required more physical interactions. Government support to industries and persons hardest hit by the pandemic have had small but postive effects.

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Annex A. Model aggregation

Table A B.1. Analysis region aggregation

Analysis Regions	Original Regions
Argentina	Argentina
Australia and New Zealand	Australia
	New Zealand
Brazil	Brazil
Canada	Canada
China and Hong Kong	China
	Hong Kong
United Kingdom	United Kingdom
Germany	Germany
Finland	Finland
France	France
Italy	Italy
Sweden	Sweden
EU east	Czech Republic
	Estonia
	Hungary
	Latvia
	Lithuania
	Poland
	Slovakia
	Slovenia
	Bulgaria
	Croatia
	Romania
EU south	Cyprus
	Greece
	Portugal
	Spain
EU all other	Austria
	Belgium
	Denmark
	Ireland
	Luxembourg
	Malta
	Netherlands
EFTA	Switzerland
	Norway
Indonesia	Indonesia
India	India
Japan	Japan
Republic of Korea	Korea
Mexico	Mexico
Russian Federation	Russian Federation
Turkey	Turkey
United States	United States of America
South Africa	South Africa
Chile and Israel	Chile
	Israel
Latin America	Colombia
	Peru
	Costa Rica
North Africa and Saudi Arabia	Saudi Arabia
	Morocco
	Tunisia
South East Asia	Brunei Darussalam
	Cambodia
	Malaysia
	Philippines
	Singapore
	Thailand
	Viet Nam
Rest of the world	Taiwan
	Kazakhstan
	Rest of the World

Note:
1. Note by Turkey: The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.
2. Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
Source: Authors’ compilation.

Table A B.2. Sector aggregation

Analysis Sectors	Original Sectors
Agriculture	Paddy rice
	Wheat
	Cereal grains nec
	Vegetables, fruit, nuts
	Oil seeds
	Sugar cane, sugar beet
	Plant-based fibers
	Crops nec
	Bovine cattle, sheep and goats, horses
	Animal products nec
	Raw milk
	Wool, silk-worm cocoons
	Forestry
	Fishing
Natural resources	Coal
	Oil
	Gas
	Other Extraction
Food	Bovine meat products
	Meat products nec
	Vegetable oils and fats
	Dairy products
	Processed rice
	Sugar
	Food products nec
Beverage and tobacco	Beverages and tobacco products
Textile and wearing apparel	Textiles
	Wearing apparel
	Leather products
Chemical products	Chemical products
Basic pharmaceuticals	Basic pharmaceutical prods
Mineral and metal products	Mineral products nec
	Ferrous metals
	Metals nec
	Metal products
Electronic equipment	Computer, electronic & optical prods
	Electrical equipment
Machinery and equipment	Machinery and equipment nec
Motor vehicles and parts	Motor vehicles and parts
Transport equipment	Transport equipment nec
Other manufacturing	Wood products
	Paper products, publishing
	Petroleum, coal products
	Rubber and plastic products
	Manufactures nec
Trade	Trade
Hospitality	Accommodation, Food and services
Transport nec	Transport nec
Water transport	Water transport
Air transport	Air transport
Warehousing	Warehousing and support activities
Communication	Communication
Financial services and insurance	Financial services nec
	Insurance
Business services	Business services nec
Recreational and other services	Recreational and other services
Public Administration and defense	Public Administration and defense
Human health and social work activities	Human health & social work activities
Other services	Electricity
	Gas manufacture, distribution
	Water
	Construction
	Real estate activities
	Education
	Dwellings

Source: Authors' compilation