Shocks, risks and global value chains: insights from the OECD METRO model

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Executive summary

The economic effects of the COVID-19 pandemic have contributed to renewed discussions on the benefits and costs of global value chains (GVCs), and in particular on whether GVCs increase risks and vulnerabilities to shocks. Questions are being raised about whether the gains from deepening and expanding international specialisation in GVCs are worth the associated risks, and whether more localised production would provide greater security against disruptions that can lead to shortages in supply and uncertainty for consumers and businesses.

To serve as a starting point for an informed conversation around these questions, this note presents the results of a set of economic model simulations, using the OECD's trade model, METRO[1]. We explore two stylised versions of the global economy, one with production fragmentation in GVCs, much as we see today, and another where production is more localised and businesses and consumers rely less on foreign suppliers. Unforeseeable shocks can occur in both economic regimes, both domestically or elsewhere in the world. The question is which version of the global economy offers better performance, in terms of both the level and the stability of economic activity in the face of shocks?

The two policy regimes and a set of stylised shocks to simulate systemic risks are used to compare both efficiency and exposure to risk outcomes. The simulations explore effects on trade, production and incomes (efficiency) of shifting towards a *localised* regime, but also the impact on the stability of production, incomes and supply of goods and services (security of supply) in the face of risks in the two regimes[2]. The findings from these simulations are clear:

- A *localised* regime, where economies are less interconnected via GVCs, has significantly lower levels of economic activity and lower incomes. Increased localisation would thus add further GDP losses to the economic slowdown caused by the COVID-19 pandemic.
- A *localised* regime has less trade and less geographic diversification of production stages in supply chains.
- Overall, a *localised* regime is found to be more - not less - vulnerable to shocks:
    - While external shocks (those that originate abroad) have fewer and narrower trade channels to propagate, the *localised* regime also provides fewer opportunities for adjustment to these shocks. This lack of adjustment channels leads to increased instability in trade, incomes, prices, and ultimately household incomes and expenditures.
    - Domestic shocks (those that originate inside the home economy) generally have bigger effects on the home economy than external shocks. These shocks are also magnified in the *localised* regime, where there are fewer options to cushion impacts through trade. Output, household incomes and expenditures become less stable in the *localised* regime.
    - Moreover, even under a *localised* regime, not all stages of production can be undertaken in the home country, and trade in intermediate inputs and raw materials continues to play an important role in domestic production. Yet more *localisation* also means more concentration in terms of reliance on fewer sources of - often more expensive - inputs. In this regime, when a disruption occurs somewhere in the supply chain, it is harder, and more costly, to find ready substitutes, giving rise to greater risk of insecurity in supply.

Two global regimes: impacts on production and trade

The *interconnected economies* regime captures the international fragmentation of production much as we saw it until early 2020, but also taking into account the changes already resulting from the COVID-19 crisis. These include reductions in supply and productivity of labour, reductions in demand for certain goods and services, and a rise in trade costs related to new customs procedures for goods and restrictions on temporary movement of people in services.

The *localised* -'turning inward'- regime reflects a situation where GVCs are shortened, through a global rise in import tariffs to 25%. This is combined with national value-added subsidies equivalent to 1 % of GDP on labour and capital, directed to domestic non-services sectors to mimic rescue subsidies that favour local production. It is also assumed that, in the *localised* regime, firms are more constrained in switching between different sources of products they use, making international supply chains more rigid[3]. Details of the construction of the two global regimes are in Annex 1.

While the simulations cover all sectors in the economy, the discussion in this note gives special emphasis to results on *Food*, *Basic pharmaceuticals*, *Electronic equipment* and *Motor vehicles*, all of which have been seen as essential or argued to be 'strategic' in recent policy discussions[4].

A shift to the *localised* regime is estimated to decrease welfare and global real GDP by more than 5%, on average. Reductions in economic activity are significant across all regions and countries. This underscores the gains in growth and jobs around the world from international specialisation that have been realized over the past decades, including through reductions in barriers to trade. Reductions in GDP are, naturally, most pronounced in regions that currently rely the most on trade and GVCs (Table 1). In some cases, these reductions would undo several years of economic growth.

Table 1. Both the global economy and all national economies would be smaller in a *localised* regime

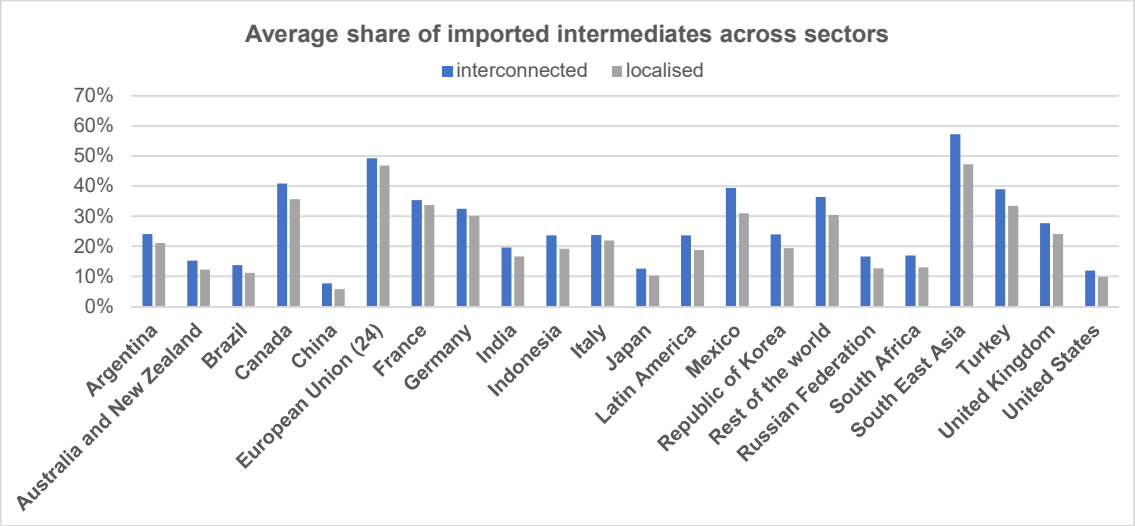
	real GDP change (bln USD)	real GDP % change	Domestic production % change	Import demand % change	Export demand % change
Argentina	-15.2	-2.9	-3.2	-13.5	-8.3
Australia and New Zealand	-139.7	-8.8	-8.6	-21.7	-19.6
Brazil	-57.1	-2.5	-2.5	-16.0	-15.2
Canada	-224.1	-13.1	-15.1	-25.0	-30.0
China	-259.9	-2.6	-2.4	-23.4	-18.4
France	-140.3	-5.1	-5.6	-9.9	-12.5
Germany	-191.3	-5.1	-5.4	-11.4	-9.6
United Kingdom	-348.5	-12.2	-13.4	-24.4	-33.0
Italy	-66.0	-3.2	-3.5	-9.6	-9.0
European Union (24)	-269.0	-4.2	-4.4	-7.9	-7.4
Indonesia	-27.9	-3.2	-3.8	-21.3	-18.6
India	-20.7	-1.1	-0.7	-11.4	-14.8
Japan	-163.2	-3.9	-4.8	-20.4	-21.8
Republic of Korea	-99.7	-7.4	-9.1	-24.1	-22.5
Mexico	-73.9	-5.9	-8.2	-23.1	-26.8
Russian Federation	-62.5	-3.4	-2.9	-22.1	-11.2
South Africa	-23.1	-6.9	-6.8	-22.2	-20.7
Turkey	-41.1	-5.2	-7.0	-16.7	-29.5
United States	-1,095.5	-6.9	-7.1	-20.0	-28.3
Latin America	-47.4	-5.5	-6.0	-22.8	-21.8
South East Asia	-159.6	-10.8	-15.2	-28.1	-28.8
Rest of the world	-587.7	-6.3	-7.5	-20.2	-17.2

Source: OECD METRO database and simulations

Import and export demand fall in real terms proportionally more than real GDP and domestic production, with the result that, in the *localised* regime, exports and imports come to account for smaller shares of GDP.

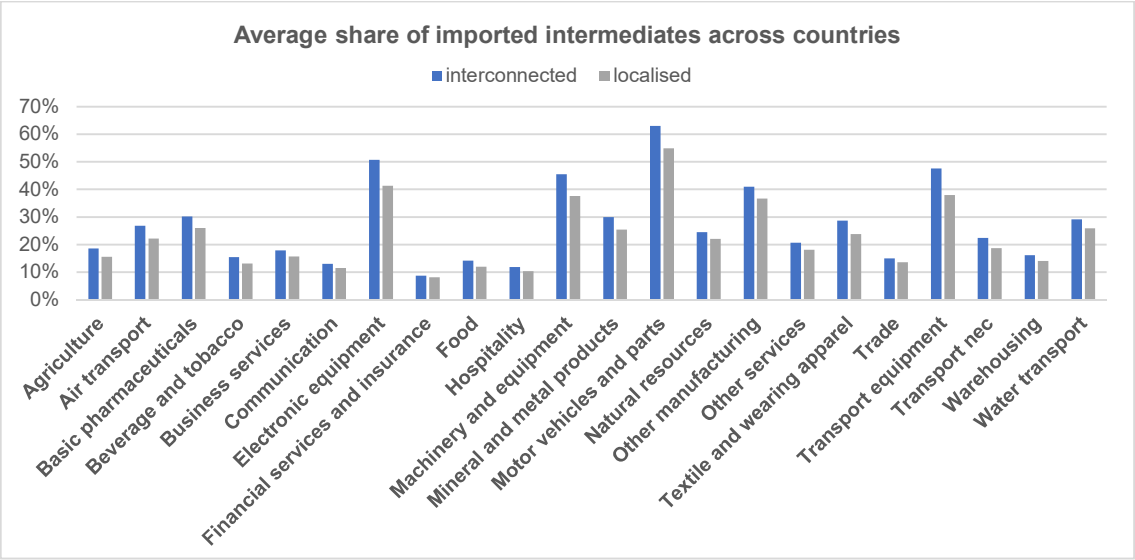
In the *localised* regime, on average, producers in all countries and in all sectors rely less on foreign inputs (Figure 1 and 2, respectively). While a decline in import intensity of intermediate inputs has already been observed since 2011, the drop in the *localised* regime is more than 3 times larger[5]. The average share of foreign-sourced intermediate inputs falls, for example, by some 10 percentage points in Southeast Asia and by some 3 percentage points in the United States. The most globalised sectors, such as *Electronic equipment* and *Motor vehicles,* reduce foreign sourcing by, respectively, about 10 and 9 percentage points. Within these averages, changes in foreign sourcing are more pronounced in specific sectors and countries[6].

Figure 1. Reliance on imported inputs falls in all countries in the *localised* regime



Source: OECD METRO database and simulations

Figure 2. Drops of imported inputs are particularly large in some sectors in the *localised* regime



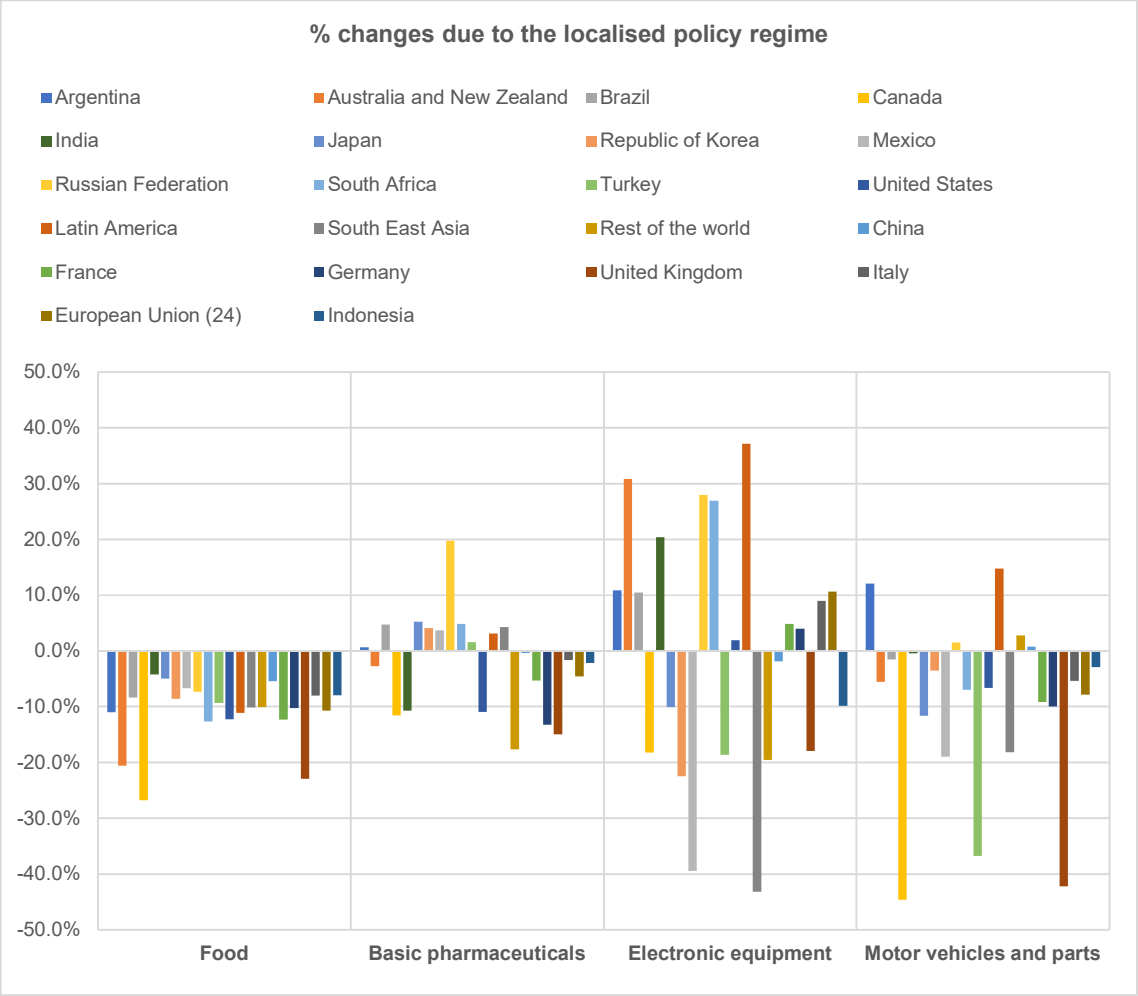
Source: OECD METRO database and simulations

There is considerable heterogeneity in the impacts on production across different industries and across countries. Domestic industries that rely more on sourcing from abroad shrink, as do industries that mainly serve foreign downstream partners or consumers (Figure 3). *Food* and *Motor vehicles* record reduced production in almost all countries.

Drops in global food production of this magnitude threaten food security and livelihoods in some parts of the world where food and agriculture are a big part of economic activity and GDP. They also highlight that food systems, like other sectors, also depend on imports, exports and well-functioning GVCs – in agriculture, key imported inputs include animal feed, fertilizer, chemicals, seeds and machinery. Moreover, given geographical and climatic factors, countries and regions also specialise in certain types of agriculture, and trade is essential to connect producers to diversified consumer demand around the world. The *localised* regime breaks those linkages and, since the essential production factor—land—is immobile across countries, the burden of adjustment falls on domestic producers and consumers, giving rise to risks for food security in some regions.

In contrast, there is some reallocation among countries in *Basic pharmaceuticals* and *Electronics*: countries experiencing output increases tend to be those which not only relied extensively on foreign inputs prior to localisation, but also had significant domestic production. Yet even these increases occur in the context of reductions in economic activity for the national economy as a whole (Table 1).

Figure 3. The *localised* regime sees output drop in key sectors



Source: OECD METRO database and simulations

Two global regimes: impacts on the level and stability of supply of goods and services

A key question is not just the efficiency impacts in terms of overall supply, but also the performance of these different economic regimes in terms of the exposure to, and impacts of, shocks. While the previous section focused on the efficiency losses from moving to the *localised* regime, this section focuses on the impacts on stability of key economic variables as a measure of the ability of the two global regimes to insulate domestic economies from the effects of shocks, both foreign and domestic.
To explore how the *interconnected economies* and the *localised* regimes compare in terms of the propagation of, or insulation from shocks, we explored a stylised set of 'supply chain risk' shocks based on a 10 % increase in costs of bilateral exports and imports between a given region and all other countries[7]. A shock which decreased trade costs by 10% would have effects of the same magnitude, but in the opposite direction, allowing illustration of both the downside and upside stability of key economic variables in the two regimes. Since countries experiencing the shocks are both sources and destinations of intermediate and final products, the set of shocks mimics the kind of disruptions experienced during lockdowns to contain the COVID-19 pandemic, when transport, labour and logistics disruptions affected both exports and imports of different products to a similar extent.

International supply chains can be exposed to a wide spectrum of uncertain shocks, some of which can be sector- and country-specific, or which can occur simultaneously in space and time. For the purposes of this analysis and to facilitate discussion of basic concepts, mechanisms and results, the focus in this note is on a narrow set of stylised, equally probable and spatially uncorrelated, shocks. The shocks are *country-specific*, as was the case with COVID-19, where supplies across many industries were initially grounded in China and subsequently in other countries. The shocks are *sector-generic* – that is, they are applied equally across all sectors to capture the fact that sectors source from a range of different industries (e.g. car producers do not just source from other firms in the car industry, but also from other sectors), and to allow for comparison across different value chains. More detail on the shock specification is in Annex 2.

In the *localised* regime, shocks result in a drop in the stability of GDP, production and consumption, (Table 2)[8] for most individual countries. While some countries gain marginally in terms of stability in the *localised* regime, this comes at the cost of a much lower level of economic activity (Figure 4) [9]. This is because the *localised* regime offers less flexibility for adjustment in the face of shocks. While in the *interconnected economies* regime, part of the adjustment is carried by international markets and is more diversified, in the *localised* regime, domestic markets must take relatively more of the adjustment burden. Hence, prices, and wages, and quantities of supply and demand tend to move relatively more in the *localised* regime.

Table 2. Shocks result in a drop in the stability of key economic variables in the *localised* regime

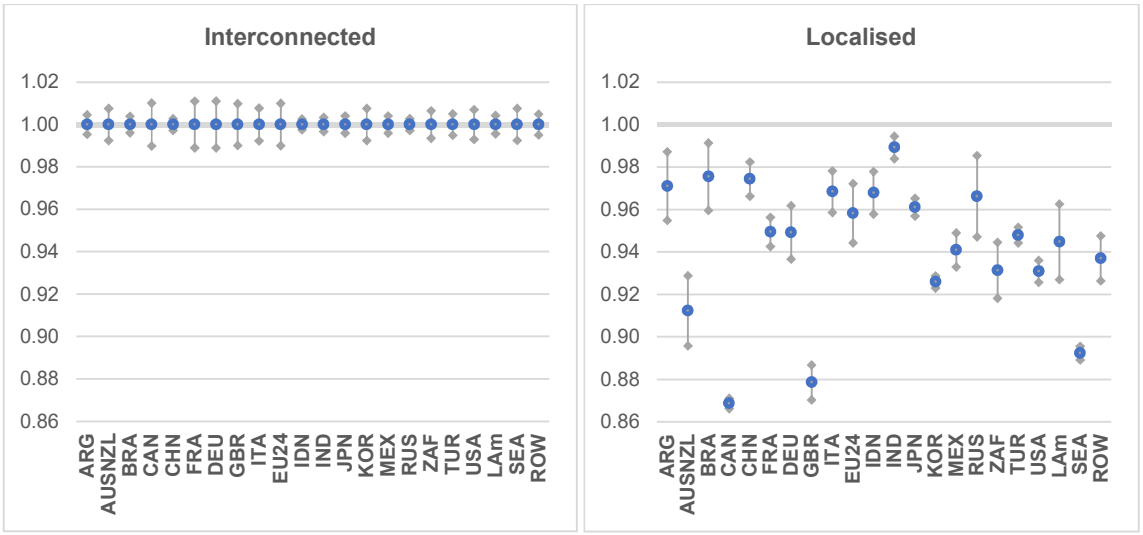
Average percentage deviation from regime's base across all negative shocks*, countries and sectors (% of base value)

	interconnected	localised
real GDP	-0.63	-0.82
real production	-0.66	-1.00
real consumption	-1.77	-2.06

Note: *these are average deviations for the set of negative trade cost shocks (increases in trade costs). If the shock were a decrease in trade costs of the same magnitude, deviations would have the same values but opposite signs.

Source: OECD METRO database and simulations

Figure 4. In the *localised* regime, shocks also result in lower levels and lower stability of real GDP



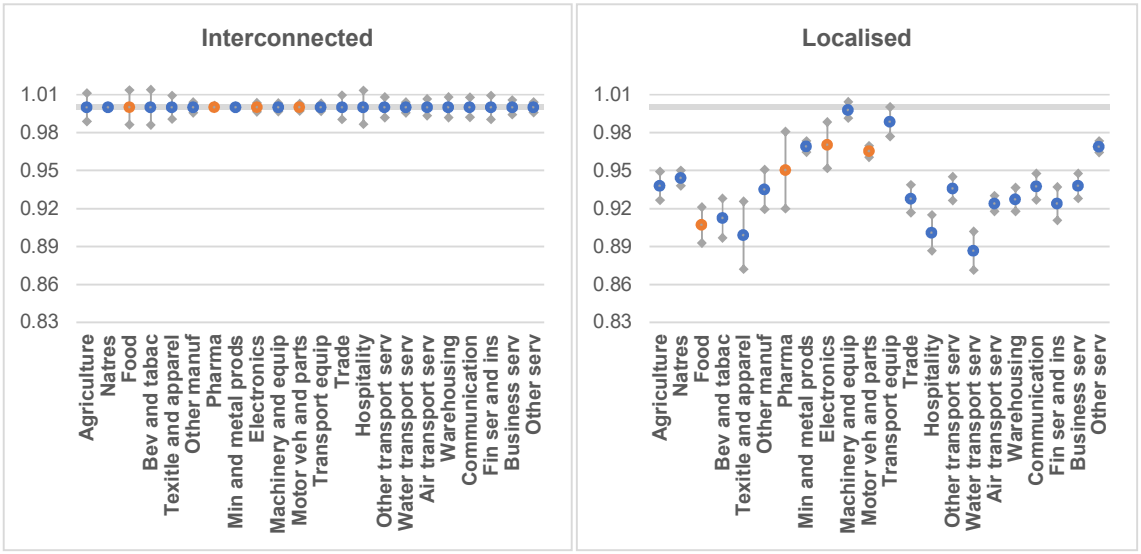
Note: All changes in variables are relative to the level of the interconnected regime base scenario which is set to equal 1. Blue dots show the base in the given regime relative to the interconnected base, and whiskers show average deviations for negative and positive trade cost shocks.

Source: OECD METRO database and simulations

For individual sectors, both the average level and the deviations due to shocks show large disparities under the *localised* regime (Figure 5). For all strategic sectors, and *Basic pharmaceutical* and *Electronics* in particular, the deviations are larger in the *localised* regime. This suggests that a *localised* regime does not in fact shelter output from external shocks. In addition, a further decomposition of the results shows that if a shock occurs domestically, inside the country, the *localised* regime offers less mitigation options through redirecting sourcing towards imports.

For *Food* markets there is an additional and hugely important benefit from trade that comes from the pooling of production risks across countries. In particular, the costs of a domestic harvest failure are much more severe in countries that are weakly integrated with international markets. Severe international shocks to *Food* sectors occur from time to time, but domestic shocks are more frequent and, if markets are not integrated, likely to be more severe[10].

Figure 5. For all strategic sectors, stability of output falls in the *localised* regime

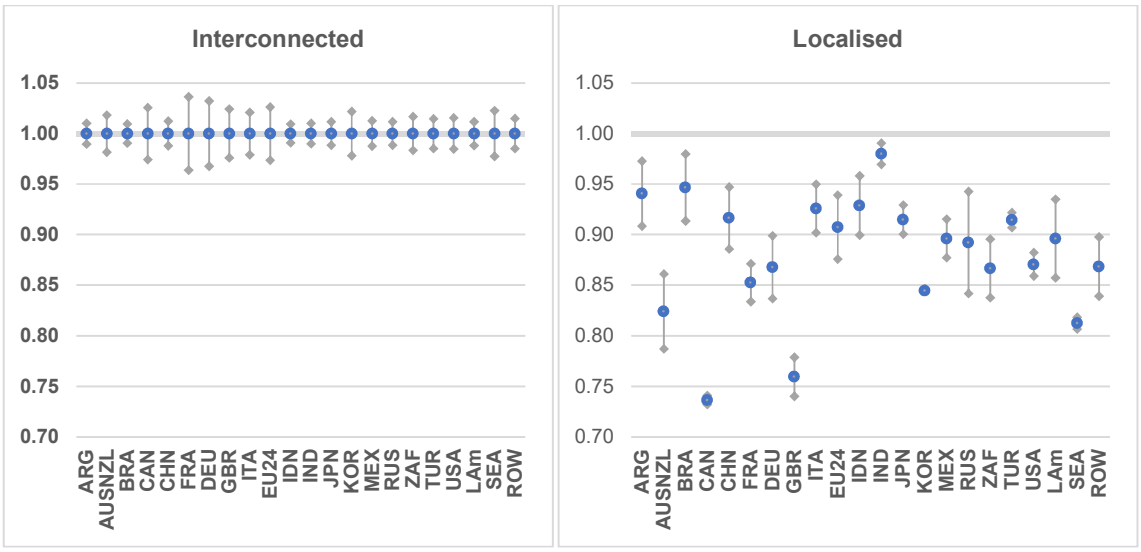


Note: All changes in variables are relative to the level of the interconnected regime base scenario which is set to equal 1. Blue dots show the base in the given regime relative to the interconnected base, and whiskers show average deviations for negative and positive trade cost shocks.

Source: OECD METRO database and simulations

Domestic markets need to shoulder most of the adjustment pressures in the *localised* regime. Domestic prices and quantities have to adjust relatively more, which is leading to less stable consumption for most countries, more so than real GDP and production (Figure 6). Put differently, trade helps smooth shocks to supply of globally consumed products.

Figure 6. Consumption levels are lower and less stable in the *localised* regime

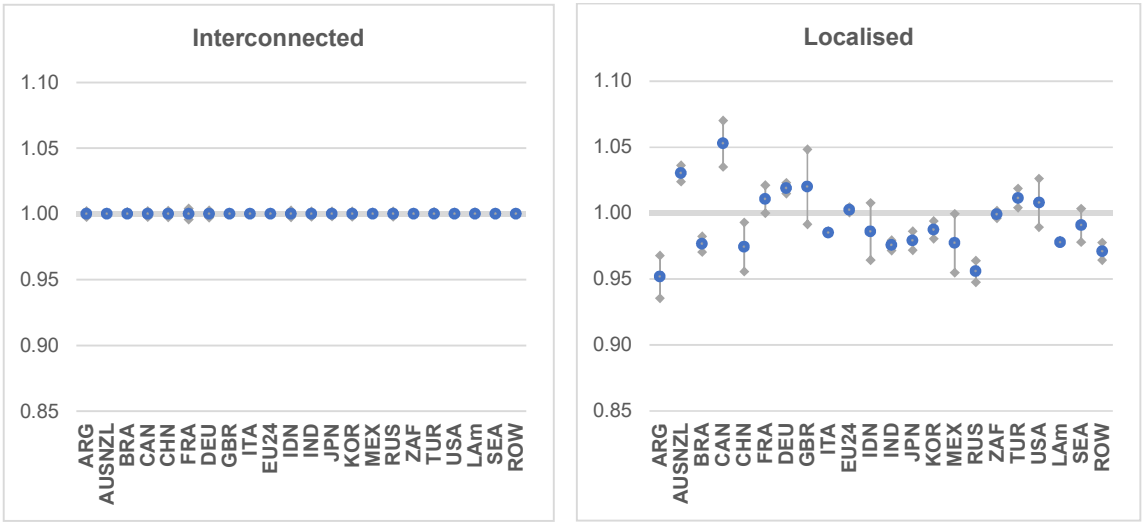


Note: All changes in variables are relative to the level of the interconnected regime base scenario which is set to equal 1. Blue dots show the base in the given regime relative to the interconnected base, and whiskers show average deviations for negative and positive trade cost shocks.

Source: OECD METRO database and simulations

The terms of trade (ratio of export to import prices) for the *Food* sector is of particular importance for lower income countries and its stability falls under the *localised* regime (Figure 7). Volatility in terms of trade for food products means uncertainty for farming business and households, and deterioration of food terms of trade is especially worrying for low income countries, where more households depend on agriculture for their livelihood. If terms of trade worsen and become more variable, the incentives to invest in future food production capacity are also reduced, with potentially further negative consequences for food security and rural incomes.

Figure 7: *Food* terms of trade show bigger swings in the *localised* regime



Note: All changes in variables are relative to the level of the interconnected regime base scenario which is set to equal 1. Blue dots show the base in the given regime relative to the interconnected base, and whiskers show average deviations for negative and positive trade cost shocks.

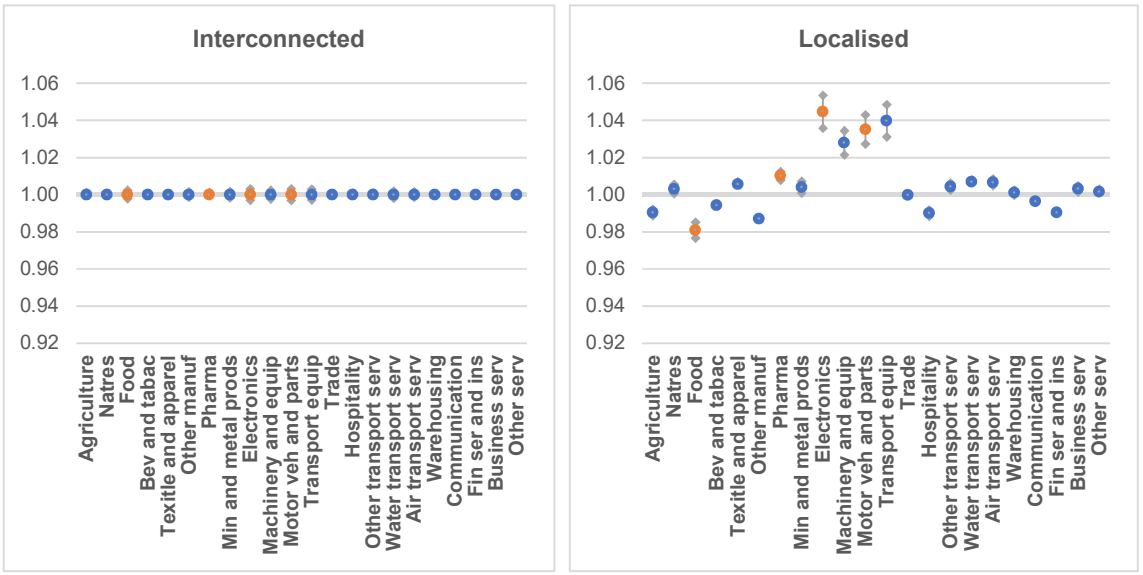
Source: OECD METRO database and simulations

An important question in the context of the impact of shocks in GVCs is whether a *localised* regime provides greater insurance against sudden increases in input costs following an external shock that disrupts trade.

Input costs can be a good indicator of the transmission of shocks to industries, since prices capture the relative scarcity of goods. In the face of a negative shock, a trade disruption in intermediate goods reduces supply to international markets and this usually shows up first in higher prices. This in turn makes it harder for domestic producers to control production costs, especially when many of the inputs are sourced internationally.

In the *localised* regime, the average deviations of unit input costs due to shocks are larger than in the *interconnected economies* regime in all strategic sectors (Figure 8).[11] This suggests that, in a world that is more inward looking, a disruption somewhere in the *Food*, *Basic pharmaceuticals*, *Electronics* or *Motor vehicles* supply chain implies that it is harder, and more costly, to find substitutes, and creates larger swings in costs. This is because, even with a *localised* regime, not all stages of production can be undertaken domestically and not all inputs can be sourced domestically, so trade in intermediate inputs still plays an important role in domestic production. A *localised* regime thus means reliance on fewer sources of often more expensive inputs, and fewer sourcing alternatives when disruptions strike.

Figure 8. Unit input costs are more variable in strategic sectors in the *localised* regime



Note: All changes in variables are relative to the level of the interconnected regime base scenario which is set to equal 1. Dots show the base in the given regime relative to the interconnected base, and whiskers show average deviations for negative and positive trade cost shocks. Orange dots denote the strategic sectors of food, basis pharmaceuticals, electronic equipment, and motor vehicles.

Source: OECD METRO database and simulations

Conclusions

Re-localisation of supply chains would not only increase costs for businesses and for consumers, but also, importantly, would fail to shelter economic actors from uncertainty.

All countries would lose from a shift away from *interconnected economies* to a *localised* regime of production; in some cases, real GDP losses could reach double digits. Output changes associated with the shift to the *localised* regime are even more pronounced than overall GDP changes, but they vary by sector. *Food* and, to a lesser extent, *Motor vehicles* are clear losers from a shift away from *interconnected economies* in all countries, while there is a more mixed impact (due to some reallocation between countries) in the *Electronics* and *Basic pharmaceuticals* sectors.

Under the *localised* regime, trade shocks are more difficult to accommodate. Less international diversification of sourcing and sales means that domestic markets have to shoulder more of the adjustments to absorb shocks, and this translates into larger price and quantity changes. This is also the case for all four strategic sectors (*Food*, *Basic pharmaceuticals*, *Motor vehicles* and *Electronics*) where output changes due to shocks are more pronounced in the *localised* regime. In sum, the *localised* regime provides less protection from the impact of shocks.

Thus, while the argument about GVCs is often posited as one of efficiency versus security, this study illustrates that greater localisation fails to achieve either. Both security of supply and stability for households can be better assured through interconnected economies more effectively than through localised regimes.

Annex 1: The interconnected economies and the localised regime

The interconnected economies regime

The *interconnected economies* regime uses an updated OECD METRO model baseline that incorporates assumptions about the global economy resulting from the COVID-19 crisis. Specifically, the changes to the base incorporate three assumptions about the pandemic and its associated containment measures: 1) there is a reduction of labour supply and productivity; 2) there is a reduction in the demand for products of certain sectors; and 3) there is a rise in trade costs for goods and services.

The METRO model is a comparative static model that calculates a new economic equilibrium following shocks, but it does not provide information on the transition path. The model is configured for this study to reflect adjustments over the medium term, which is taken to mean about five years between the initial and the new equilibrium. While the economic shocks are big during the lockdown period, they do not persist forever, and a gradual rebound towards pre-shock levels can be assumed. Fully weighing the non-permanent COVID–related shocks into the post-COVID global economy in the medium term would overestimate structural effects. With this in mind, the size of the shocks is adjusted to reflect an impact over five years. For example, if labour productivity declines initially by 5%, and then rebounds to initial levels, it is assumed that an average decline of 1% over the five-year period remains. Such adjustments are made for all COVID-related shocks that are discussed in more detail below.

Labour Markets

Labour markets are affected by the lockdown in terms of available labour supply, as well as labour productivity. 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. Additionally, 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. The reduction of labour supply applied in the COVID-19 *interconnected economies* baseline combines the labour supply reduction from McKibbin and Roshen (2020)[12], which assumed a global pandemic following an outbreak in China, with the WTO (2020)[13] estimates of labour supply changes due to school closures.

Moreover, as part of the containment measures, many governments have required 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" (WTO, 2020) -- there is a productivity loss for those who can work, but must work, from home. The *interconnected economies* COVID-19 baseline assumes a 5% labour productivity loss of *office managers and professionals,* as well as *technical and assistant professionals,* during eight weeks of lockdown over the five-year period covered by the METRO model.

Social distancing measures have also forced closures of restaurants, gyms, "non-essential" businesses and cancellation of travel, recreation and cultural activities. The containment measures put in place by governments translate into a decline in demand in many sectors, and the extent of the decline will depend on how long the sector remains under lockdown. The assumed changes in demand and the length of the lockdown are broadly in line with the OECD Economic Department's 'single hit' projections and are summarized in Annex Table 1.

Annex Table 1. Assumed length of lockdown measures by sector

	Assumed period of lockdown measures			
	8 weeks	16 weeks	20 weeks	Assumed change in demand over 5 years (%)
Pharmaceuticals				0.33
Manufacturing of transport equipment	x			-0.55
Wholesale and retail trade	x			-0.45
Air, water, and other transport services			x	-1.38
Hotel and food service			x	-1.38
Communication services	x			-0.42
Business services	x			-0.49
Other services*	x	x	x	-0.38

* Other services include construction, real estate and arts & entertainment. The decline in demand for other services is a weighted average of the assumed decline during the lockdown (weighted by the sectors share within the total final demand of the other services sectors).

Source: Authors' own elaboration of assumptions used in the OECD Economic Outlook.

With the exception of basic pharmaceuticals, for sectors listed in Annex Table 1, real demand is assumed to decline by 33%, with restrictions in place for eight weeks. Adjustments to this general assumption are made based on the number of weeks a sector is under lockdown and the extent to which products can be delivered electronically (retail trade, communication and business services, for example). Additionally, since the reduction in demand for transport services sectors is due to the decline in passenger traffic, the assumed 33% decline is applied only to final demand. Moreover, as with the assumptions in the labour market, the assumed decline in demand is distributed over the 5 years covered by the METRO model.

The decline in demand is applied in the model through a tax on consumption. The size of the tax is based on two factors: the expected decline in the sector and the elasticity of demand of each sector in each region. The latter is computed using a model simulation, which adds 1% to the existing value added tax. The resulting percent change in the equilibrium quantity demanded by households is then used as a proxy of the elasticity and is used to determine the size of the tax needed to achieve the expected change in consumer demand.

Trade costs for goods and services

The costs of transporting goods and services are expected to increase. Reinforced border controls, new protocols at the border, and additional documentation requirements for transporting goods across borders due to containment measure result in delays. While many measures are taken with the aim of controlling the spread of the virus and protecting the people handling and inspecting the goods, they can nevertheless translate into additional costs for traders. Using the OECD Trade Facilitation Indicators and information collected by the OECD Trade and Agriculture Directorate on COVID-19 related policies, *ad valorem* estimates of these delays are computed following the approach in OECD (2017)[14], with the assumption that the measures remain in place for 20 weeks.

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 use the Services Trade Restrictiveness Indicator (STRI) and the OECD COVID-19 policy tracker[15] 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 are translated into *ad valorem* equivalents following Benz and Jaax (forthcoming)[16]. The estimates are at the sector and country level and are assumed to be active for 20 weeks.

The localised regime

The *localised* regime involves three additional changes:

(1) imposition of import tariffs of 25% by all trading regions;
(2) granting of subsidies to labour and capital in the agriculture and manufacturing sectors by each trading region;
(3) lowering of import elasticities to mimic lower flexibility of firms and consumers in choosing between domestic and foreign intermediate and final products.

The combination of changes (1) and (2) attempts to mimic a stylised scenario where importing from abroad is made significantly more costly and, at the same time, domestic agriculture and industry are subsidised by national governments. Imposition of a 25% import tariff corresponds approximately to a shift to the average advanced economy import tariff in the first years following the Second World War. The subsidy shocks are scaled for each region so as to add up to 1% of GDP for each region imposing the shock. These subsidy shocks aim to approximate the scale of COVID-19 rescue packages directed to national economies by OECD countries to date, and it is assumed that subsidies of a similar magnitude are deployed by other regions. These subsidies are applied to value added (i.e. they subsidise national labour and capital costs) and thus favour local production.

Elasticities which determine the flexibility of substitution between (i) domestic and imported intermediate and final products and (ii) different varieties of imported intermediate and final products, are halved in the new regime. This means that, in the *localised* regime, when, for example, an imported intermediate product becomes more (less) expensive, the decrease (increase) in its use is less pronounced than in the *interconnected economies* regime. This mimics the situation where firms are less reactive to international price shocks -- as was the case in earlier stages of globalisation and GVC fragmentation, when firms, due to higher trade and information and communication costs, were more constrained in choosing between domestic and foreign sources source of inputs into production.

Annex 2: The nature of supply chain shocks

Supply chain risks can take many forms (e.g. trade or productivity shocks); they can occur in different geographic locations; and they can be either specific to individual value chains or generic. They can also be independent from each other (as can be the case with, e.g., natural disasters such as earthquakes or floods) or correlated with each other (as can be the case with, e.g., infectious disease pandemics). Supply shocks can also be either negative (when, e.g., access to intermediate inputs is disrupted) or positive (e.g., due to trade costs improvements, positive productivity or harvest shocks, or industrial inventions). With GVCs, firms and countries are, on the one hand, exposed to negative shocks but, on the other hand, they are also ready to profit from positive shocks.

The analysis in this note assumes that supply chain shocks are region-specific and affect equally the costs of importing and exporting to and from the specific region. It is also assumed that the shocks are independent from each other and have the same probability of occurring in a specific region. In the event of a negative shock, costs of importing by, and exporting to, the region experiencing the shock increase by 10%. The shocks are implemented as 'iceberg' trade cost shocks, which means that, in the event of a negative shock, only a proportion of the originally shipped product is assumed to arrive at its foreign destination (i.e. with a 10% negative shocks, only 90 USD of the originally shipped value of 100 USD of products arrives).

The simulated supply chain shocks have many elements of the supply chain disruptions experienced during the COVID-19 crisis when, during lockdowns, both exports and imports of different products where affected. The generic nature of the shocks (i.e. region rather than supply chain specificity, and symmetry between exports and imports and across regions) has the additional advantage of facilitating comparison of outcomes.

Annex 3. Sensitivity analysis with respect to the assumption of more rigid sourcing in supply chains

Annex Table 2. The global impact of shocks in the two regimes on stability of key economic variables

Average percentage deviation from regime's base across all shocks, countries and sectors (% of base value)

	interconnected	localised	localised (with unchanged trade elasticities)
real GDP	-0.63	-0.82	-0.62
real production	-0.66	-1.00	-0.62
real consumption	-1.77	-2.06	-1.83

Source: OECD METRO database and simulations

Endnotes

[1] The METRO model is a computable general equilibrium model (CGE) that traces complex international interdependencies in a theoretically and empirically consistent framework, and can provide quantitative information on the role of GVCs in propagating and absorbing economic shocks. More information is found here: [https://www.oecd.org/trade/topics/metro-trade-model/

[2] This analysis considers both upside and downside variability, while most of the current policy concern is related to risks of downside variability of supply.

[3] This means that trading agents require prices of foreign supplies of intermediate inputs to fall relatively more in order for them to substitute imports for domestic sources; and similarly, they require larger price changes in order to switch between alternative foreign suppliers. This is achieved by lowering elasticities of substitution between domestic and foreign varieties of products and elasticities of substitution between different varieties of foreign products. An additional set of simulations without the assumption of lower trade elasticities was run to analyse the sensitivity of results to this assumption. The results of these simulations are presented in Annex 3. They generally do not significantly alter the conclusions from the analysis of the *localised* regime.

[4] Albeit for different reasons: basic pharmaceuticals are seen as an essential for public health but they are often imported; and electronic equipment has been essential for continuing economic activity during the confinement necessitated by the virus, while motor vehicles have been long argued to be cornerstone of industrial development and they also provide the essential manufacturing base required to enable ramping up of other goods in situations of national need.

[5] For a documentation of the slowdown of GVC expansion see, Miroudot, S. and H. Nordström (2019), "Made in the world revisited", RSCAS Working Paper No. 2019/84, European University Institute. They estimate a drop of about 2-3 percentage points in global import intensity of production between 2011 – 2017.

[6] Reductions in foreign sourcing are most pronounced in countries and sectors which have been relying most extensively on foreign inputs. Two examples are Mexico and Turkey, where sectors such as *Electronic equipment*, *Machinery and equipment*, *Motor vehicles* and *Transport equipment* record double digit percentage point reductions in foreign sourcing.

[7] Costs of all other bilateral trade flows are left unchanged in any given model simulation. With this shock specification, the model with the aggregation used for this study is solved 44 times: 2 (regimes) x 22 (country/region-specific shocks).

[8] This is measured as average deviation from the regime's base across all shocks. The assumption of more rigid supply chain sourcing is one driver of this result but in the localised regime without this assumption, stability of GDP and production improve only marginally and stability of consumption deteriorates (see Annex 3). Moreover this marginal improvement in stability in the localised regime with flexible sourcing is mainly driven by the effects of domestic shocks; when only foreign shocks are considered stability deteriorates also in this variant of the localised regime.

[9] 7 out of the 22 economies in Figure 4 experience slightly smaller instability of real GDP, and that can partially be explained by the fact that these are some of the most open countries in the interconnected economies regime. On the one hand, these economies experience the largest reductions in trade (and thus sourcing of intermediates from abroad) as well as in incomes. On the other, they are still more open in the localised regime than many other countries, meaning that adjustments in international markets still help them better adjust to the shocks.

[10] See: Brooks, J. and A. Matthews (2015), "Trade Dimensions of Food Security", *OECD Food, Agriculture and Fisheries Papers*, No. 77, OECD Publishing, Paris, https://doi.org/10.1787/5js65xn790nv-en. And: OECD (2015), *Managing Food Insecurity Risk: Analytical Framework and Application to Indonesia*, OECD Publishing, Paris, https://doi.org/10.1787/9789264233874-en.

[11] Figure 8 shows a lower average unit cost for agriculture and food in the *localised* regime. This is a consequence of the drop in price of primary agriculture, which in turn is for a large part explained by declining land rents in that sector, combined with the subsidy to labour and capital. The lower price of primary agriculture means that intermediate inputs sourced from the sector itself (e.g. raw milk going into dairies) become relatively cheaper.

[12] McKibbin, W. and Fernando, R. (2020), "The Global Macroeconomic Impacts of COVID-19: Seven Scenarios", CAMA Working Paper No. 19/2020. http://dx.doi.org/10.2139/ssrn.3547729

[13] WTO (2020). "Methodology for the WTO Trade Forecast of April 8 2020". https://www.wto.org/english/news_e/pres20_e/methodpr855_e.pdf

[14] OECD (2017), "METRO Development: Modelling Non-Tariff Measures an Estimation of Trade Facilitation Impacts", TAD/TC/WP(2016)/20/FINAL.

[15] http://www.oecd.org/coronavirus/en/#policy-responses

[16] Benz S. and A. Jaax (forthcoming), "The costs of regulatory barriers to trade in services: New estimates of ad valorem tariff", OECD Trade Policy Paper.

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