(Unintended) Consequences of export restrictions on medical goods during the Covid-19 pandemic

MARCO GRASSIA

Dip. Ingegneria Elettrica, Elettronica e Informatica,Università di Catania, Catania, Italy

GIUSEPPE MANGIONI*

Dip. Ingegneria Elettrica, Elettronica e Informatica,Università di Catania, Catania, Italy
*giuseppe.mangioni@unict.it

STEFANO SCHIAVO

Scuola di Studi Internazionali, Università di Trento, Trento, Italy

SILVIO TRAVERSO

Dip. Economia, Università di Genova, Genova, Italy

The outbreak of the Covid-19 pandemic led several governments to impose restrictions on the export of medical supplies. Despite being at odds with the canonical prescriptions of the economic theory, non-cooperative measures of this kind remain popular tools in times of crisis. By modelling the diffusion of the effects of export restrictions on the domestic availability of medical goods through the international trade network, we study the zero-sum game logic that lies behind these policies. We show that, even if one abstracts from the complex and non-linear real world dynamics that characterize global crises, unilateral trade restrictions are not helpful. In fact, while restrictions would be beneficial to a country implementing them in isolation, we observe that their generalized use makes most countries worse off relative to a no-ban scenario. Moreover, the results also indicates restraining from export bans has negligible costs even when other countries apply them. In terms of normative analysis, our results provide new evidence against unilateral trade policies which go above and beyond the context of the current pandemic.

1. Introduction

At the beginning of 2020, the Covid-19 outbreak led several countries to embrace non-cooperative trade policies aimed at curbing the export of those medical goods deemed as essential for the domestic response to the pandemic. This was a predictable outcome, though, since trade restrictions and export bans have always been popular policy tools in times of crisis. Indeed, stopping external leakages looks like one of the most sensible actions to be taken when a product becomes increasingly scarce and therefore, unsurprisingly, these measures are often welcomed as appropriate and pragmatic by the general public. Beside from being aligned with common sense, their political appeal stems also from the fact that, at seemingly no cost, they represent a way in which policy-makers can prove that they are *doing something* [10, 11]. As a result, during the first months of year 2020, more than 50 governments have imposed some curbs on the exports of medical supplies, ranging from licensing requirements to outright export bans [7, 15].

Economic theory, however, warns that unilateral trade policies of this kind are likely to produce adverse effects on global markets and, ultimately, they may end up damaging all the countries involved [3, 14]. In particular, several works highlight the indirect negative effects that unilateral trade restrictions can have on global value chains and, therefore, on countries' domestic production [13, 17]. For this reason, an export ban on a given product may not only contribute to the disruption of international trade, but it also risks destabilizing the domestic market of the countries which impose it. Moreover, other studies point out that non-cooperative policies will induce trade partners to reciprocate, leading to international standoffs that generate uncertainty and disrupt mutual trust, a key element in bilateral trade. Indeed, in times of crises, the introduction of export curbs by a single country can exacerbate shortages and thus increase the incentive for other governments to follow suit, triggering a *domino effect* [14].

This work aims at studying the consequences of unilateral export restrictions adopting the *zero-sum game* logic on which non-cooperative policies are based, namely that a country's gains will come at the expenses of trade partners. To do so, we abstract from most of the real-world dynamics that characterize global crises and define a simple model of shock diffusion that simulates the effects of export bans on the domestic availability of medical goods. In the model, the shock triggered by export restrictions (which lower the availability of certain goods on international markets) is transmitted though trade and a country's gain (in terms of the amount of goods available in the domestic market) corresponds to a loss for others. This mimics the scramble for goods that lies behind most restrictions implemented in times of crisis. For the same reason, namely the desire to replicate the short-termism of such decisions, we do not consider any changes in supply and demand.[1]

Despite its bare-bone structure, the model allows us to look beyond the impact of restrictions on a country's direct trade partners and study how the shock further propagates through the international trade network, potentially looping back on initiating countries [2, 6]. Moreover, abstracting from demand spikes lets us forcefully show that even under relatively favorable conditions export bans do not necessarily increase the domestic availability of goods, unless very specific conditions are met, namely that the country is a net exporter of the targeted products. This is not often the case for countries that have curbed exports of medical products during the Covid-19 pandemic, and all countries result to be net importers for at least one of the product categories analyzed in this study.

Overall, our simulations indicate that, in most of the cases, export restrictions fail to deliver what they promise. In fact, the vast majority of countries that impose them end up with a worse trade balance than in the *business-as-usual* (BAU) scenario, that is without trade restrictions. In other words, the gains are concentrated among a handful of countries while many others (including most of the countries that impose export restrictions) experience a reduction in net imports. What is more, in a set of counterfactual simulations we show that whether or not countries react to restrictions by imposing their own export bans makes little difference. This suggests that there is almost no reason for adopting this kind of measures and countries should avoid getting caught into a *restriction frenzy*.

While this work contributes to the literature that investigates the consequences of Covid-19 on international trade [4, 5], our approach can find applications above and beyond the current pandemic. Indeed, the simulations allow for a better understanding of the interactions that characterize the international trade system and that are necessary to inform national and international policies aimed at providing an effective response to global crises. Our contribution provides a clear policy message against the adoption of unilateral trade policies. Specifically, while we do not aim to predict which countries will

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[1]Demand spikes that cannot be met by increased supply in the short term, such as those experienced during the early stage of the pandemic, would only exacerbate the problems created by export bans. Thus, abstracting from them works, if anything, against our results.

experience the most severe unavailability of medical goods, we show that the logic behind these policies turns out to be flawed even if we constrain ourselves to the most down-to-earth reasoning, that is the one of a *zero-sum game* which abstracts from the many real-world complexities and interdependencies that standard economic analysis takes into account.

The remainder of the paper is organized as follows. Section 2 formally introduces the model and the data used to build the network, Section 3 presents and discusses the results, while Section 4 concludes.

2. Data and Methods

2.1 *Data*

The analysis combines data on international bilateral trade flows as reported in the CEPII-BACI dataset [12] with information on export restrictions collected by Global Trade Alert [15]. Bilateral trade data are reported in thousands of US dollars and metric tons. Data on GDP and population are taken from the World Bank [22].

We focus on export bans implemented between January 1st and April 30th, 2020 that concern a list of 32 Covid-relevant products organized in six categories: test kits, protective garments, disinfectants, other medical devices, consumables, and soap. A seventh category, thermometers, features no export restrictions and is therefore excluded from the analysis. For a detailed list of relevant products comprised in each category, see [15]. We do not consider other forms of export restrictions, such as licensing requirements, which have been used by some governments. For each initiating country, that is countries imposing export bans, we identify the specific category of goods concerned and the trade partners affected by the restriction.

It should be noted that using 6-digit HS codes to identify Covid-related medical supplies treats all products within a given 6-digit category as a single item. This may be problematic when the same product code includes a wide range of goods. In those cases, a country's import and export flows may involve different items so that the mechanism whereby a country facing an export ban reacts by curtailing its own exports might not work. Since the data at hands represent the finest level of detail for which internationally comparable data are available, we have no other options that making this assumption, which is customary in the trade literature.

2.2 *International trade networks of medical goods*

International trade data for year 2018 (the latest available at the time of writing) are used to build a BAU scenario that represents the pre-shock reference point. Using countries with a population of at least one million as nodes and bilateral trade flows as links, we build a weighted and directed network for each of the six product categories and let a shock diffuse through each of them, originating from the countries imposing an export ban.

In formal terms, the network of each product category p is represented by a weighted directed graph $G^p = (V^p, E^p, W^p)$, where $V^p = \{c_i : i \in \{1, ..., N\}\}$ is a set of nodes ($N = 148$), $E^p = \{(c_i, c_j) : i, j \in \{1, ..., N\}\}$ is a set of directed edges between pairs of nodes, and $W^p = \{W^p_{c_i c_j} : i, j \in \{1, ..., N\}\}$ is the set of the weights associated with the edges (i.e., the monetary value of the export of product p from country c_i to country c_j).

Table 1 reports a wide set of indicators in order to give an overview of the topological properties of the networks through which the shocks diffuse in our simulations. The number of countries (nodes) is the same for all product categories (148) whereas the link density of the different networks varies from a minimum of 0.22 to a maximum of 0.33. This translates into a number of edges ranging from $4,890$ to

$7,264$, and to an average degree that goes from 33.04 to 49.08. Link weights are reported in thousands of US dollars and display high heterogeneity: average values varies from 2.250 to 42.351, while the average strength goes from 148K to 1.6M.

Bilateral density (also known as reciprocity, defined as the share of edges e_{ij} such that the edge e_{ji} also exists in the network) goes from 0.49 to 0.65. The average (unweighted) local clustering coefficient [21] (the fraction of possible triangles that exist through a given node) varies from 0.79 to 0.84, whereas transitivity [18] (defined as the fraction of all possible triangles) goes from 0.55 to 0.65.

There are between 4 and 21 Strongly Connected Components (SCCs, sub-networks such that there is a directed path between each pair of vertices) in the networks, with the largest in each product category including a minimum of 127 countries, up to 145. On the other hand, if directionality is ignored, in each network there is only a Weakly Connected Component (WCC). The undirected diameter (the shortest path length between the most distant nodes in the network) is 2 for all networks except for the one of soap, where it is 3; both the directed and undirected average path lengths are between 1.5 and 1.7 hops.

We also analyze the assortativity of node degree and strength. In particular, we compute the node-level Pearson's correlation coefficients between degree and Average Nearest Neighbor Degree (ANND) [19], and also between strength and Average Nearest Neighbor Strength (ANNS) [20].

$$\text{ANNS}_i^{\alpha/\beta} = \frac{\sum_j^{\mathcal{N}_i^\alpha} s_j^\beta}{k_i^\alpha} \tag{2.1}$$

where $\alpha, \beta \in [\text{in}, \text{out}]$, i.e., we consider the different in-out link directions, and $\mathcal{N}_i^\alpha$ is the α neighborhood of i. Moreover, we also report the aggregated ANNS quantity where $\alpha = \beta = tot$ and the *in* and *out* neighbors are aggregated. For the ANND case, instead of the strength s_j^β we consider the degree d_j^β. All networks feature a strongly disassortative binary structure, something that is common in international trade; the correlation remains negative, albeit at lowers levels, also in the case of node strength.

A summary of the topology measures is reported in Table 1, whereas in Figures 1a and 1b we show respectively the degree and strength distributions of the protective garments network, the main focus of this study.

2.3   *Diffusion model*

The adoption of export restrictions by certain countries reduces the availability of goods for their trade partners and represents the initial shock, which then propagates through the trade network. In particular, countries facing a shortage of imported goods will (try to) compensate by reducing their own exports [8]. This implies that domestic demand has higher priority relative to foreign demand. When exports cannot be reduced further, the country registers a *demand deficit*, that is a situation whereby the amount of medical goods available in the country is lower than in the BAU scenario.[2]

Contrary to other works that study the diffusion of shocks over economic networks [1, 16], our modeling strategy takes a radical stance as it does not allow for any fraction of the shock to be absorbed domestically if it can be passed to third countries by reducing export. In fact, while in both [16] and [1] diffusion occurs only if the shock is larger than a given fraction of domestic production, we impose that adjustment falls entirely on trade, so that any reduction in the amount of available imports triggers a similar fall in exports, up to the point when export is zero. Albeit crude, this approach is appropriate to capture the short-run and panic-induced reaction that lies behind export bans.

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[2]Here we stick to the terminology introduced by [8], although the shock we describe represents, strictly speaking, a shortage of supply relative to demand (and not vice-versa).

The model assumes that no new bilateral trade relationship can be established in the short run and that the reduction in exports will affect partners to a degree that is inversely proportional to their economic size, measured in terms of GDP. This second assumption represents a major departure from previous studies [8] and is meant to capture the different importance of countries in world markets, that we postulate depends on either size or purchasing power [9].

We also abstract from any increase in domestic demand and any value-chain effect (whereby lack of imported supplies hamper domestic production, thus exacerbating the negative effect of trade restrictions). While at odds with reality, incorporating either demand spikes or global value chains would complicate the model without bringing any additional insights: the negative effect of export bans would be reinforced, while the qualitative assessment remains the same. In fact, the model aims at capturing the simple logic that lies behind export restrictions, namely the notion that international trade is a zero-sum game, rather than replicating precisely the real-world dynamics observed during the pandemic.

When postulating that countries facing export restrictions respond by curtailing their own exports, we are implicitly assuming that prices are fixed and adjustments take place via quantity changes. This short-run perspective is consistent with the fact that no new trade links can be established in out simulations, production capacity cannot adjust to match a shortage of goods, and demand does not change.[3]

To formally introduce our shock diffusion model, we first define the equilibrium domestic demand (i.e., before the shock) of the generic county c_i for product p as

$$dem_{c_i}^p(t) = prod_{c_i}^p(t) + imp_{c_i}^p(t) - exp_{c_i}^p(t) \qquad (2.2)$$

in which $prod_{c_i}^p$, $exp_{c_i}^p$, and $imp_{c_i}^p$ indicate domestic production, export and import of product p respectively. Note that in network terms

$$exp_{c_i}^p(t) = \sum_{j=1}^{N} W_{c_i c_j}^p(t) \qquad (2.3)$$

$$imp_{c_i}^p(t) = \sum_{j=1}^{N} W_{c_j c_i}^p(t). \qquad (2.4)$$

We assume $prod_{c_i}^p(t)$ to be constant, so that all adjustment falls on trade flows. We believe this hypothesis is plausible in the short run, and, moreover, it is consistent with the aim of the paper, that is to isolate and study the impact of unilateral export bans.

In the initial time step 0, a country c_s that imports from a partner c_r imposing an export ban will face a shock equal to the amount of the bilateral import flow and, everything else equal, a demand deficit of the same magnitude:

$$dd_{c_s}^p(t=0) = \sum_{r=1}^{N} b_{rs}^p \cdot W_{c_r c_s}^p(t=0) \qquad (2.5)$$

where b_{rs}^p is an indicator variable taking value 1 if country r imposes a ban on exports of product p to country s, and zero otherwise. According to our model, c_s will then try to offset this demand deficit by reducing its own export by the same amount, that is, aiming at $dd_{c_s}^p(t=1) = 0$. Hence, in the next step, the new level of export of c_s will be:

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[3]It should be noted that, as long as the BAU scenario represents an equilibrium, once export restrictions are imposed, global markets no longer clear as the availability of goods goes down while demand remains at its pre-shock levels. This is the reason why some countries will end up with a demand deficit.

$$exp^p_{c_s}(t=1) = max\{exp^p_{c_s}(t=0) - dd^p_{c_s}(t=0), 0\} \tag{2.6}$$

This, in turn, induces a cascading effect on those countries that import from c_s. In fact, after the initial step, the shock propagates in the network producing a demand deficit in a generic country c_i at time step t given by

$$dd^p_{c_i}(t) = dem^p_{c_i}(t) - prod^p_{c_i}(t) - imp^p_{c_i}(t) + exp^p_{c_i}(t). \tag{2.7}$$

To face this demand deficit country c_i tries to reduce its export to:

$$exp^p_{c_i}(t+1) = max\{exp^p_{c_i}(t) - dd^p_{c_i}(t), 0\}. \tag{2.8}$$

It is easy to see that if imports and exports do not change, the demand deficit equals zero $dd^p_{c_i}(t) = 0$.

Variations on exports and/or imports are, in network terms, implemented by changing the weights associated with the edges connecting countries, as detailed in equations (2.3) and (2.4). While at the beginning of the simulation the reduction of exports mimics the actual policy choices of countries imposing the ban, in the following steps the shocks spread in a way that is inversely proportional to the GDP of out-neighbors. Formally, if $dd^p_{c_i}(t) > 0$, the reduction in exports will be distributed among the countries that import from c_i as:

$$W^p_{c_i c_j}(t+1) = max\{W^p_{c_i c_j}(t) - dd^p_{c_i}(t)F_{c_i c_j}(t), 0\} \tag{2.9}$$

where:

$$F_{c_i c_j}(t) = \begin{cases} \frac{\sum_{c_h \neq c_j} GDP_{c_h}}{\sum_{c_h} GDP_{c_h}} * \frac{1}{k^{out}_{c_i}(t) - 1} & \text{if } k^{out}_{c_i}(t) \neq 1 \\ 1 & \text{otherwise} \end{cases} \tag{2.10}$$

In equation (2.10) c_h ranges over those neighbors of c_i for which $W^p_{c_i,c_h}(t) > 0$, GDP_{c_h} is the GDP of the generic out-neighbor c_h, and $k^{out}_{c_i}(t)$ is the out-degree of country c_i at step t (i.e., the number of positive outward edges departing from c_i). $F_{c_i c_j}(t)$ expresses the fraction of demand deficit of country c_i absorbed by country c_j, and it is inversely proportional to the GDP of c_j compared to the GDP of the other out-neighbours of c_i (i.e., countries importing from c_i). Eq. (2.9) and (2.10) ensures that as soon as bilateral trade between two countries c_i, c_j falls to zero, the importer will no longer absorb any remaining shock emanating from c_i. The diffusion process stops when no country facing a positive demand deficit can further reduce its exports.

In the case a country has imposed an export ban, its final demand deficit will be (partly or fully) compensated by the availability of goods that were previously shipped abroad, so that the *net* demand deficit can be expressed as:

$$net\_dd^p_{c_r}(t) = dd^p_{c_r}(t) - \sum_{j=1}^{N} b^p_{rj} \cdot W^p_{c_r c_j}(t=0). \tag{2.11}$$

3. Results

The analysis combines data on bilateral trade flows with information on export restrictions on medical goods to investigate their effects on the countries imposing them, their direct partners subject to the ban, and third countries.

3.1 *Main findings*

As reported in Table 2, the amount of trade affected by restrictions varies between less than 1% of global exports in the case of consumable medical goods (with only 4 countries imposing restrictions) to 21.5% when it comes to protective garments and disinfectants (whose exports have been stopped by 29 and 19 countries respectively).

In general, two broad patterns emerge from our baseline simulations. First of all, export bans on medical equipment imposed by just a few governments affect several countries, even those that are not directly sourcing from the initiators. The impact is often severe, with a relatively large number of countries (and share of world population) no longer able to import medical supplies. In this regard, the case of *test kits* is emblematic: while only two countries impose bans, the United Kingdom and Belgium, their combined market share is about 10%; as a consequence, 79 countries (29.4% of world population) see their imports falling by 75% or more (with 62 countries becoming unable to import from their usual sources), and 37 others experience a reduction of at least 25% of their imports (see Table 2). Complex diffusion dynamics due to the network structure imply that even though the number of heavily affected countries tends to increase with the share of total trade restricted, also bans imposed on a small share or total trade, such as those on *consumables* (0.8%), *soap* (1.2%), and *other medical devices* (3.2%), can produce sizeable effects on several countries.

Second, not all the countries imposing bans benefit from them. In the case of *protective garments*, for instance, 18 of the 28 countries that curb exports are worse-off (meaning that the domestic availability of products declines) relative to the BAU scenario (Table 3, panel a). This is linked to the observation that most of the countries that adopt restrictive measures export less than they import: this is the case for 22 out of the 28 countries under consideration, but the same pattern can be observed for all the six product categories. Only net exporters, in fact, can be sure to gain from imposing restrictions, while countries characterized by low exports to imports ratios (*exp/imp* in Table 3) are more likely to exhibit positive demand deficit (*netDD*), which indicate a decline in the availability of the good in the domestic market compared to the BAU scenario. In this regard, the US and Russia represent an interesting case in point, as the value of their exports of *protective garments* is only 10% of the value of their imports and, according to our simulations, they experience a net demand deficit amounting to 12% of initial imports for the US and 28% for Russia. From this, it is clear that initiating countries may be vulnerable to export restrictions imposed by other governments that decide to retaliate, or that are simply dragged into limiting exports by the fear of appearing weak in the eyes of the public or by sheer panic [14].

In fact, the simulations indicate that –apart from the case of test kits (Table 3, panel b), where the two countries restricting exports manage to increase the domestic availability of the product relative to the BAU scenario– many of the countries imposing a ban end up with a net demand deficit. In other words, even considering that exports are restricted and thus the goods previously shipped abroad are now available for domestic consumption, those countries are no longer able to import all the goods they need, and this is true even if we abstract from any increase in domestic demand. In particular, the share of countries that impose a ban but turn out to be worse-off ranges from 20% (*soap*) to more than 60% (*protective garments* and *consumables*).

It is worth noting, though, that the export-to-import ratio is not the only determinant of the outcome of the simulation exercise, which largely depends on the network topology and on the characteristics of the nodes. For example, while Ecuador and Serbia have both a soap export/import ratio of about 0.3 (Table 3, panel e), they end up in very different places: the South American country experiences a positive demand deficit, whereas the Balkan country would see an increase in the domestic availability of the goods.

Finally, even though our model predicts that a net exporter will always benefit from the imposition of a ban, no country is a net exporter of all the categories of medical products considered. Since imposing a ban on a specific category may induce other countries to adopt similar measures on products they export, countries should carefully consider the consequences of unilateral trade policies, especially when products are complements rather than substitutes. In such cases, in fact, actions that do not adequately consider the complementarities between different products may unintentionally undermine the domestic public health response.

The effects of export bans on world countries are graphically represented, for the case of protective garments, in Figure 2. The map clearly shows that many of the countries that impose restrictions end up with significant shortages of goods, and that *restriction frenzies* tend to benefit the few at the expense of the many.

Again, while a country's net international position is an important factor in determining the consequences of its restrictive trade policies (the export-to-import ratio is more than twice as large, 0.59 vs. 0.26, for the net importers benefiting from the ban), it is not the only factor at play. France and Bulgaria, for instance, are both net importers of protective garments, with an export-to-import ratio of about 0.45. While both countries impose a ban, only the former benefits from the policy, while the latter experience a 30% reduction of its imports.

3.2   *Counterfactual simulations*

To assess the impact of export bans on individual countries, we run a series of counterfactual simulations in which (i) we simulate the effect of an export ban implemented by a single country; or (ii) we exclude a single country from the list of those imposing the restrictions. For the sake of clarity, here we focus on "protective garments" only: the category mostly hit by export restrictions, both in terms of countries imposing curbs and of the share of exports covered.

In the first case, countries imposing trade restrictions experience an increase the amount of goods that are available domestically. In fact, because no other trade partner is adopting restrictive measures, but just passing along the initial shock, the worst case scenario is one where the entire shock is absorbed by the initiating country, which would then end up in the same position as in the BAU case. In fact, we observe that all the 28 countries restricting exports of protective garments would either increase their net surplus or move from a net deficit to a net surplus (see column 2 of Table 4). The US, for instance, would jump from a shortfall equal to 11% of its imports to an "excess supply" of 6% of imports. Overall, when comparing columns 1 and 2 of Table 4, it is clear that a policy measure that might work when implemented in isolation, is very often counterproductive when its adoption is widespread. In our simulations for protective garments this happens to 18 out of 28 countries.

This result resembles the well-known "prisoner's dilemma" setup, in which strategic interaction leads to a coordination failure that damages both players. Countries would be better off by cooperating, but are dragged into adopting trade restrictions for fear of losing out.

The second counterfactual investigates this issue by assuming one single country restrains from imposing a ban, while the other 27 continue to do so. Column 3 of Table 4 shows that for almost all the countries, playing a "cooperative strategy" would not be very costly. While some countries are actually penalized, these are the net exporters, which move from experiencing a net surplus in the baseline simulation to zero, thus suffering no deterioration with respect to the initial BAU scenario. The only one that would experience a negative effect is Russia, but the additional negative effect is limited, as its demand deficit increases from 28.3 to 28.5% of initial imports. Overall then, the costs of a cooperative strategy are very small, further reducing the rationale for export bans.

4. Discussion

We have shown that, even by confining ourselves to the *zero-sum game* logic that seems to motivate the adoption of export restrictions in times of crises, export restrictions are by and large counterproductive. Our simulations suggest that most countries imposing a ban face lower availability of goods. Moreover, they would not lose much in case they avoided restrictions, even if other countries were still implementing them. Finally, even though net exporters benefit from the imposition of a ban, we observe that no country is a net exporter in every product category and therefore even net exporters should carefully consider the indirect consequences of unilateral trade bans when there is complementarity among goods.

Two main reasons stand behind these results. First and foremost, because international trade is organized as a complex network of bilateral connections, it is difficult to predict the consequences associated with removing even a few trade links from the system. Second, as more countries implement unilateral restrictions, the ensuing domino effect will backfire, as it makes goods even scarcer on a global scale. In fact, restricting exports does not increase the global supply of goods: export bans are based on a zero-sum logic whereby gains by one player are necessarily compensated by losses by others. On the contrary, the international division of labor behind international trade fosters efficiency and allows all parties to share the ensuing benefits.

Overall, the results presented in this work shed light on the (often unintended) consequences of non-cooperative trade policy. As such, their implications go beyond the measures adopted during the Covid-19 pandemic and offer an evidence-based contribution to the debate on the best practices to adopt during global crises.

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Figures

FIG. **1:** Protective garments degree and strength distributions.
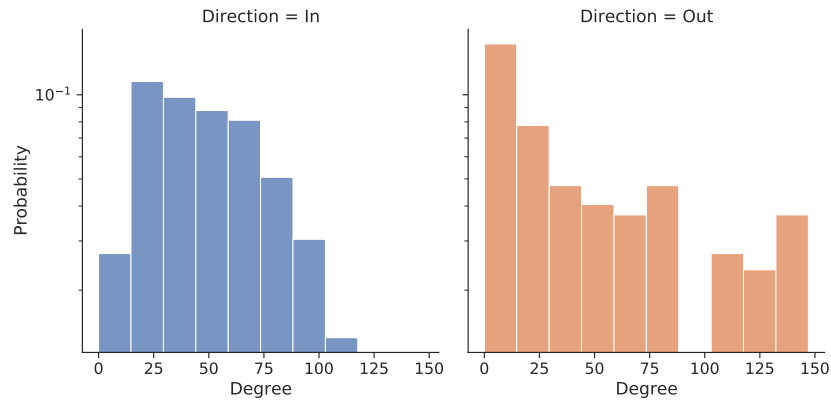
(a) In and out degree distributions.
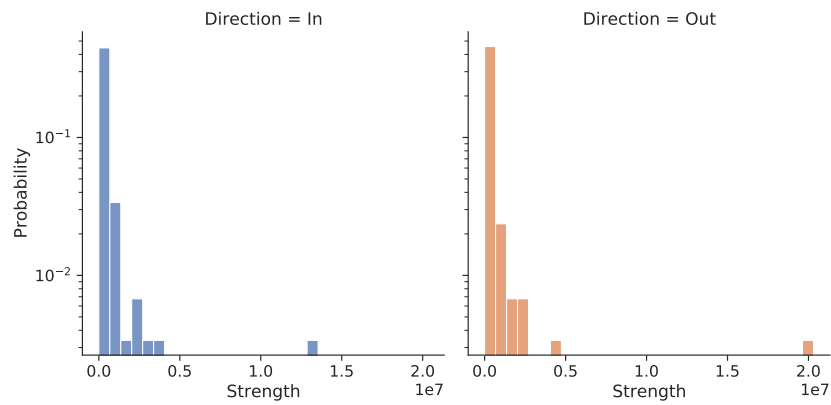
(b) In and out strength distributions (in thousand dollars).

FIG. 2: Impact of export bans on protective garments. For each country, the color indicates the value of the net demand deficit in USD per capita. The size and color of dots on the capital city of countries imposing restrictions represent, respectively, the contribution to the total shock across the world and the percentage of the country's exports that are banned (if any).
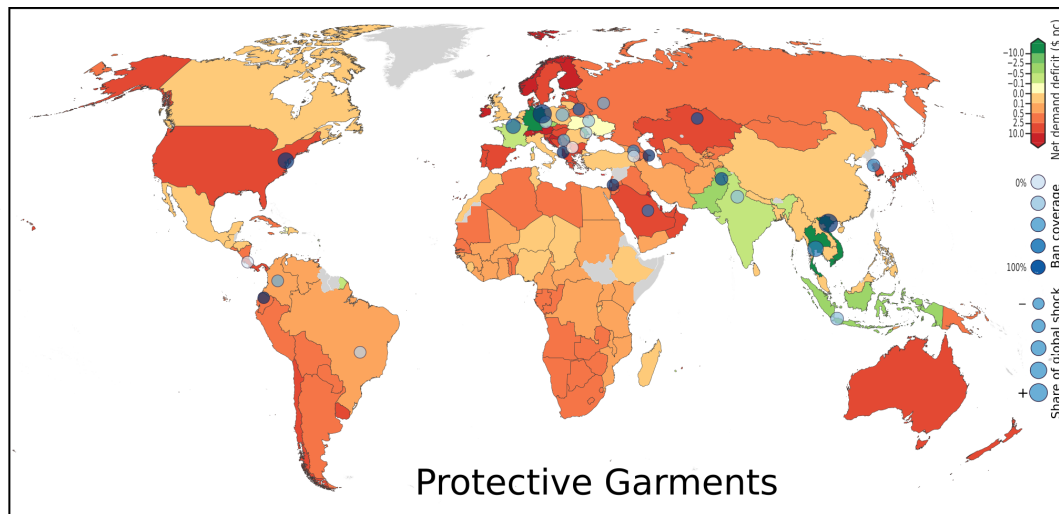
Tables

Table 1: Descriptive statistics

measure	Test kits (1)	Protective garments (2)	Disinfectants (3)	Other devices (4)	Consumables (5)	Soap (6)
Number of edges	5,569	7,264	7,040	6,728	5,456	4,890
Density	0.26	0.33	0.32	0.31	0.25	0.22
Avg. degree	75.26	98.16	95.14	90.92	73.73	66.08
Avg. link weight	21,504	6,711	42,351	10,240	7,205	2,250
Avg. strength	1,618,326	658,807	4,029,025	931,029	531,236	148,666
Bilateral density	0.49	0.65	0.57	0.61	0.55	0.53
Largest SCC*	132	145	141	141	127	136
Number of SCCs*	17	4	8	8	21	13
Avg. clustering	0.83	0.82	0.81	0.84	0.82	0.79
Transitivity	0.57	0.65	0.65	0.64	0.60	0.55
Directed avg. path length	1.61	1.66	1.67	1.63	1.56	1.74
Undirect. avg. path length	1.61	1.55	1.54	1.57	1.64	1.67
Undirect. diameter	2	2	2	2	2	3
Deg. - ANND$^{tot/tot}$ assort.	-0.95	-0.94	-0.91	-0.97	-0.92	-0.82
Deg. - ANND$^{in/in}$ assort.	-0.97	-0.94	-0.95	-0.95	-0.93	-0.62
Deg. - ANND$^{in/out}$ assort.	-0.97	-0.97	-0.94	-0.98	-0.96	-0.83
Deg. - ANND$^{out/in}$ assort.	-0.05	-0.47	-0.05	-0.34	0.09	-0.05
Deg. - ANND$^{out/out}$ assort.	-0.22	-0.42	-0.07	-0.44	-0.03	-0.09
Str. - ANNS$^{tot/tot}$ assort.	-0.44	-0.32	-0.44	-0.38	-0.43	-0.58
Str. - ANNS$^{in/in}$ assort.	-0.45	-0.33	-0.40	-0.33	-0.40	-0.54
Str. - ANNS$^{in/out}$ assort.	-0.46	-0.24	-0.36	-0.35	-0.42	-0.57
Str. - ANNS$^{out/in}$ assort.	-0.13	-0.13	-0.10	-0.16	-0.13	-0.18
Str. - ANNS$^{out/out}$ assort.	-0.11	-0.13	-0.12	-0.18	-0.11	-0.18

Notes. The number of nodes in all networks is 148. * SCC: strongly connected component.

Table 2: Impact of export bans on net imports relative to a *business-as-usual* scenario

		Impact on net imports						
Product category	coverage	reduction > 75%	reduction 25 − 75%	reduction < 25%	no effect	increase < 25%	increase 25 − 75%	increase > 75%
Test kits	2	79	37	7	23	0	1	1
	[9.9%]	(29.4%)	(33.7%)	(4.0%)	(31.8%)	(0.0%)	(0.9%)	(0.2%)
Protective garments	29	35	53	20	32	2	0	6
	[21.5%]	(6.6%)	(15.8%)	(15.7%)	(33.9%)	(1.3%)	(0.0%)	(26.8%)
Disinfectants	19	80	34	8	19	2	2	3
	[21.5%]	(25.9%)	(17.1%)	(21.0%)	(12.9%)	(3.0%)	(1.0%)	(19.2%)
Other medical devices	8	50	37	11	46	1	0	3
	[3.2%]	(12.2%)	(13.6%)	(10.2%)	(42.5%)	(18.1%)	(0.0%)	(3.4%)
Consumables	4	2	41	45	59	0	1	0
	[0.8%]	(0.2%)	(6.2%)	(22.2%)	(53.3%)	(0.0%)	(18.1%)	(0.0%)
Soap	5	2	7	51	84	2	1	1
	[1.2%]	(0.4%)	(1.8%)	(10.5%)	(67.0%)	(1.4%)	(18.1%)	(0.7%)

Notes: the column *coverage* indicates the number of countries which have imposed a ban and, in squared brackets, the share of total trade affected by the restrictions; the columns showing the *Impact on net imports* report the number of countries and, in brackets, the share of world population affected; *no effect* includes all the cases in which the absolute value of the variation is below 2%.

Table 3: Impact of export bans on countries imposing them

(a) Protective garments				(d) Disinfectants		
Country	exp / imp	netDD (%imp)	netDD (p.c.)	Country	exp / imp	netDD (%imp)	netDD (p.c.)
ALB	0.512	0.44	2.545	ALB	0.006	0.994	42.516
ARM	0.439	0.55	1.325	ARM	0.165	0.835	22.339
AZE	0.005	0.758	1.414	AZE	0.015	0.985	17.512
BGR	0.479	0.316	2.542	BEL	1.233	-0.87	-976.085
BLR	0.374	0.446	2.116	COL	0.209	0.72	14.515
BRA	0.035	0.128	0.247	DZA	0.004	0.996	15.379
COL	0.157	0.172	0.44	EGY	0.06	0.603	6.358
CRI	0.051	0.703	6.577	EST	0.307	0.693	179.642
CZE	0.682	-0.043	-1.713	FRA	1.388	-0.966	-175.153
DEU	0.673	-0.234	-10.793	GBR	1.096	-0.576	-123.393
ECU	0.047	0.481	1.173	GRC	0.837	-0.131	-22.46
FRA	0.448	-0.006	-0.204	HUN	1.386	-0.675	-176.16
GEO	0.528	0.028	0.177	IDN	0.646	0.354	0.637
IDN	3.603	-1.962	-1.246	IND	10.551	-9.639	-7.824
IND	2.091	-1.146	-0.246	KGZ	0.016	0.984	14.913
JOR	0.107	0.403	1.149	PAK	1.185	-0.159	-0.298
KAZ	0.028	0.314	2.587	RUS	0.069	0.526	22.785
KOR	0.348	0.131	2.526	SRB	0.258	0.661	75.435
MDA	1.774	-0.813	-3.699	UKR	0.084	0.812	26.262
PAK	4.107	-3.723	-1.353				
POL	0.56	0.001	0.021	**(e) Soap**			
RUS	0.095	0.283	1.401	Country	exp / imp	netDD (%imp)	netDD (p.c.)
SAU	0.057	0.373	3.29				
SRB	0.735	0.102	0.561	COL	1.568	-1.05	-0.789
THA	8.258	-6.393	-18.45	ECU	0.337	0.392	0.493
UKR	0.55	-0.018	-0.041	EGY	0.259	-0.109	-0.08
USA	0.109	0.116	4.756	IND	0.953	-0.734	-0.065
VNM	8.757	-8.534	-26.317	SRB	0.315	-0.053	-0.205

(b) Test kits				(f) Other devices		
Country	exp / imp	netDD (%imp)	netDD (p.c.)	Country	exp / imp	netDD (%imp)	netDD (p.c.)
BEL	0.983	-0.898	-589.077	ALB	0.035	0.634	3.39
GBR	0.750	-0.438	-43.011	ARM	0.107	0.807	6.858
				BRA	0.056	0.068	0.278
(c) Consumables				COL	0.076	0.223	1.291
Country	exp / imp	netDD (%imp)	netDD (p.c.)	CRI	7.129	-6.809	-226.571
				IND	0.315	-0.206	-0.158
ALB	0.191	0.217	0.392	PAK	1.214	-0.794	-0.598
IND	0.901	-0.682	-0.219	POL	0.938	-0.783	-13.629
KAZ	0.053	0.188	0.633				
RUS	0.077	-0.012	-0.036				

Notes. NetDD stands for the final demand deficit net of previously exported goods that are available domestically due to the export bans. A negative figure implies a surplus, that is a situation where the domestic availability of goods is larger than in the BAU scenario. Per capita values in current USD.

Table 4: Impact of a country's behavior on its own demand deficit.

country	baseline (1)	isolated ban (2)	no ban (3)
ALB	44.0%	-48.0%	44.0%
AZE	75.8%	-0.3%	75.8%
ARM	55.0%	-15.4%	55.0%
BRA	12.8%	-1.6%	12.8%
BGR	31.6%	-10.6%	31.6%
BLR	44.6%	-31.4%	44.6%
COL	17.2%	-9.6%	17.2%
CRI	70.3%	-1.6%	70.3%
CZE	-4.3%	-33.3%	0.0%
ECU	48.1%	-4.2%	48.1%
FRA	-0.6%	-37.9%	0.0%
GEO	2.8%	-40.1%	2.8%
DEU	-23.4%	-51.2%	0.0%
IDN	-196.2%	-196.2%	0.0%
KAZ	31.4%	-2.4%	31.4%
JOR	40.4%	-10.0%	40.4%
KOR	13.1%	-25.8%	13.2%
MDA	-81.3%	-81.3%	0.0%
PAK	-372.3%	-372.3%	0.0%
POL	0.1%	-33.6%	0.1%
RUS	28.3%	-5.9%	28.5%
SAU	37.3%	-4.6%	37.3%
SRB	10.2%	-47.9%	10.2%
IND	-114.6%	-114.6%	0.0%
VNM	-853.4%	-856.6%	0.0%
THA	-639.3%	-639.3%	0.0%
UKR	-1.8%	-28.8%	0.0%
USA	11.6%	-5.7%	11.6%

Notes. The Table illustrates the net demand deficit for all countries implementing an export ban on protective garments. Values are in percentage of imports; negative numbers represent surpluses. Column (1) displays the results from the baseline simulation that considers export bans by all 28 countries. Column (2) presents simulations assuming that the export ban is implemented by each country in isolation. Results in column (3) are based on the assumption that each country restrains from imposing a ban while the others continue to implement restrictive measures. **Boldface** marks countries for which values in Columns (1) and (3) are different.