

The propagation of worldwide sector-specific shocks

MARIO IZQUIERDO, ENRIQUE MORAL-BENITO,
ELVIRA PRADES AND JAVIER QUINTANA

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The implementation of policies that target specific sectors such as environmental regulations to fight climate change, the emergence of supply bottlenecks in the production of certain goods or the pandemic-induced digitalization of services are some of the topics gaining policymakers' attention recently. Even if each of these phenomena arises for distinct reasons, a common feature they share is their highly asymmetric impact across productive sectors. Still, although they originate in very specific parts of the economy, the impact of these shocks on aggregate output may be substantial. Another characteristic of these phenomena is their global character as firms operating in the same productive sector face very similar challenges independently of the country in which they are located. In our paper we analyze the effect on aggregate output of large sectoral shocks, affecting simultaneously the same sector in several countries.

A basic fact to understand the propagation of sector-specific shocks is that economies consist of linked networks of industries. These industries rely on each other for their production processes, purchasing inputs from their suppliers in other sectors and selling their output to final consumers or other industries as intermediate inputs. Moreover, in open economies, those customers and suppliers are located both inside and outside a country's borders. Thus the aggregate consequences and propagation of industry-specific shocks will reflect the input-output structure of the economy. The existing literature shows that, provided the shocks are small, sectoral size -measured as sales share, also known as Domar weights- is a good approximation of the effect on a country's GDP when there is a change in the productivity of a single sector.

THE ROLE OF CORRELATED SHOCKS

However, these shocks rarely occur in isolation; rather, it is typically observed that several sectors experience

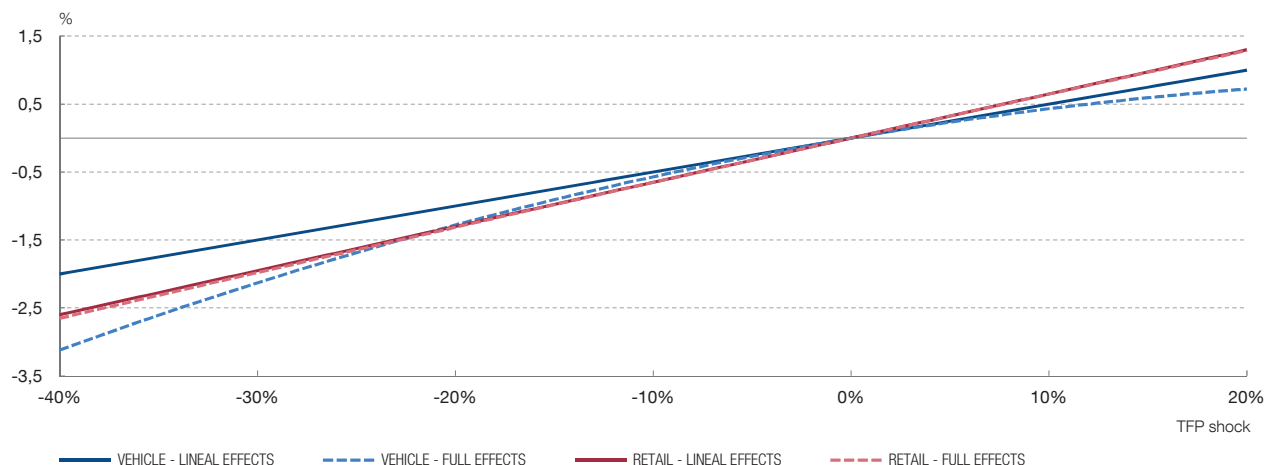
simultaneous productivity shocks that arise for various reasons. Sometimes such simultaneous shocks affect sectors that are far apart in the global value chains and with little interaction between them. If that is the case, considering each shock separately and summing their effects is a good enough approximation of their joint impact. Yet, in practice, these shocks often affect sectors with important interactions between them. For example, sometimes all sectors of an economy are exposed to a country-wide shock. Another example is when, as in the case we discuss in our paper, the same sectors located in several countries experience a common shock. In our paper we show that in this case, and under usual assumptions about the complementarity of production factors, the aggregate effect of simultaneous productivity shocks can substantially exceed the sum of their effects considered separately.

We address a particular case of correlated industry-specific shocks, more precisely, a common shock affecting simultaneously the same industry across different countries. In this case, the non-linear effects due to changes in the production networks can be particularly relevant. The reason stems from the large intra-industry trade flows existing in some industries. In many cases, producers of the same industry located in different countries have large trading flows among each other. Because of that, a shock affecting simultaneously to all of them will have implications for their own production but also the one of their main clients and suppliers. We provide an estimation of the aggregate impact of these shocks and discuss for which particular industries this effect is particularly relevant.

DEPARTING FROM PERFECT INPUT SUBSTITUTION

Methodologically, we base our analysis upon the existing literature of production networks. More precisely, we rely on Baqaee and Farhi's (2019) setting which allows studying a flexible production network with arbitrary elasticities of substitution and the existence of a variety of industry-specific shocks. We make use of their framework to introduce our contribution. Using the World Input-Output Table (WIOT), we estimate the effect for the largest

Chart 1

EFFECT ON GDP (SPAIN) OF SECTOR-SPECIFIC PRODUCTIVITY SHOCK

SOURCE: Own calculations based on WIOD.

NOTE: These graphs plot the aggregate impact on Spanish GDP following a sector specific TFP shock for sector C29-Manufacturing of motor vehicles (in red) and to sector G47-Retail trade (in blue), under two scenarios: [A] the linear impact based on Domar weights without input complementarities and [B] considers the case where there are both input complementarities. In both cases the shock affects each sector in every EU country.

European economies of correlated industry shocks across countries. Our estimates can accommodate cases with different shock sizes as well as different sets of countries exposed to them. The latter exercise provides novel insights that are not yet documented in the literature. Typically, analyses of the aggregate impact of sector-specific shocks consider either sector-specific shocks in a particular country or country-specific productivity shocks affecting every industry. This framework also allows to analyze the role of input complementarities. Under these complementarities, which imply that sectors have little flexibility to adapt their input mixes, a large shock to sector productivity can significantly alter the structure of the production network. Thus, when such changes occur, non-linear second-order effects of sector-specific shocks appear.

THE AGGREGATE IMPACT OF SECTOR-SPECIFIC POLICIES

Our work can be a useful tool for several policy-relevant scenarios. A practical example would be the implementation of new international environmental standards. This result is

particularly relevant for European economies because it allows predicting the effects of productivity shocks linked to sector-specific supranational regulations, as in EU directives. The effect of Covid-induced digitalization in services would be another policy question that our setting can contribute to shed light on.

Our findings indicate that the aggregate impact of a negative TFP shock to manufacturing industries increases significantly when this shock is common to several countries. The difference between considering independent or correlated multi-country sector shocks is larger in industries with highly integrated global value chains, as it is the case of European motor and airplane vehicle manufacturing or pharmaceutical industries. Conversely, this amplification effect is much more muted in the case of non-manufacturing industries.

As an example, Figure 1 shows the effects on Spanish GDP of a productivity shock affecting the vehicle manufacturing or retail trade simultaneously in all EU countries. For each of the two sectors we show both the linear effects of the shock

and the full effects when taking also into account the nonlinearities that we consider in the paper.

Between the two sectors, retail trade sales are around 30% higher in Spain than those of vehicle manufacturing. Therefore, the linear effects of a productivity shock of a given size are larger in the former. However, vehicle manufacturing is a highly integrated sector in the European economy. So much so that the vehicle manufacturing sectors in France and Germany are the two most important suppliers of intermediate inputs for this sector in Spain. Thus, when the productivity shock affects all of them simultaneously, non-linear effects appear. In addition to the drop in the sector's productivity in Spain, its main inputs have also become more expensive.

On the contrary, in the case of retail trade, intra-sector trade between the different European countries is very limited, so that the presence of simultaneous shocks has very limited non-linear effects. Thus, when the shocks are relatively large in magnitude, the nonlinear effects of vehicle manufacturing have a greater impact on GDP despite the fact that its relative size is smaller than that of retail trade.

REFERENCES

Baqaei, D., & Farhi, E. (2019). Networks, barriers, and trade (Tech. Rep.). National Bureau of Economic Research.