



A Data-Driven Resilience Strategy in a Globalized World

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Since the supply disruptions caused by the pandemic, the idea of economic resilience in a globalized world has been at the heart of public debate in France. The government's recovery plan highlights the goal of economic sovereignty "not as a nationalistic retreat but as a renewed capacity for independence for France and Europe". In this *Note*, we analyse the economic arguments underlying this new debate and the main difficulties to overcome to develop a realistic and effective resilience strategy.

The first challenge is to identify the potential sources of vulnerability among France's imports, in order to implement highly targeted policies. We do so by analysing granular customs data, concluding that about 4% of French imports may be vulnerable to external shocks. France should focus its resilience policies specifically on these inputs, with the goal of significantly reducing the number of vulnerable products in the medium term. Using this strategy, it should be possible to strengthen resilience in a cost-effective way. The success or failure of resilience policies could then be assessed over the long term.

We propose that the resilience strategy be deployed along three lines: encouraging the diversification of imports and building strategic partnerships whenever

other commercial partners can be involved, particularly at the European level; when diversification is impossible, storage should be subsidized, particularly for low value-added products; finally, for vulnerable products that are close to the technological frontier, it is important to foster innovation to produce competitively on the national territory.

This targeting strategy would reduce the costs of resilience by favouring domestic production only for inputs at the technological frontier, which create technological externalities in other areas. Acquiring the ability to innovate in strategic sectors enhances resilience by strengthening the ability to adapt to unforeseen shocks. Support for innovation should adopt best practices in public investment governance and be subject to *ex post* program evaluations. Priority should be given to vulnerable inputs with high technological content for which it is plausible that France could acquire or maintain global technological leadership.

To ensure its effectiveness, the resilience strategy must be organized around very specific inputs. Imperfectly targeted industrial policies would be costly for consumers, without fundamentally enhancing resilience, and could be interpreted by our trading partners as hidden protectionism.

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^a London School of Economics (LSE), Member of the CAE; ^b CREST-Polytechnique, IP-Paris, Member of the CAE.

We analyse the economic case for economic resilience, highlighting a central message: the resilience strategy must be organized around very specific inputs to ensure its effectiveness. In addition, the resilience strategy must address the impact of globalized trade on the environment and inequality.

Reducing vulnerability to external shocks for a limited number of critical inputs

The first challenge facing a resilience strategy is to identify strategic inputs that are exposed to external shocks *via* globalized trade. We show how to conduct this analysis using trade flow data and a “stress test” methodology, which can be implemented at the national level but will be even more useful at the European level.

Globalized production methods: Productivity gains but increased exposure to supply risks

During the pandemic, supply disruptions for certain products, such as masks, were interpreted as revealing inherent weakness in global trade, suggesting that globalization intrinsically contributes to the instability of the economy.

Economic analysis shows, however, that on average globalized trade does not necessarily lead to more volatility, as several factors with opposite effects are at work. For example, international trade is a way of diversifying demand risks, which helps reduce the volatility of the national economy (Caselli *et al.*, 2020).¹ At the same time, globalized trade also leads to sectoral specialization, which amplifies an economy’s volatility by increasing its exposure to sectoral shocks, especially if the specialization occurs in a sector that is itself particularly volatile. Empirically, there is no stable

statistical relationship between a country’s trade openness and the volatility of its GDP.²

Nonetheless, international trade and especially globalized value chains can create vulnerabilities in the supply of specific inputs. It is therefore important to identify these vulnerabilities in order to limit risks. International trade leads to a reallocation of market shares from less productive to more productive firms (Bernard *et al.*, 2006; Berthou *et al.*, 2019).³ This reallocation is efficient from the perspective of productivity, but it increases inequalities in firm size by concentrating activity in a small number of very large firms (di Giovanni *et al.*, 2011).⁴ The resulting high “granularity” of the economy increases its exposure to microeconomic supply shocks (di Giovanni *et al.*, 2014).⁵

Moreover, the organization of production into fragmented value chains heightens vulnerability to localized supply shocks. Supply disruptions occurring at a single point in the production chain have consequences for the entire chain, making the whole system more fragile (Barrot and Sauvagnat, 2016; Boehm *et al.*, 2019).⁶ This vulnerability is all the greater as international value chains are organized in a “granular” manner, with a single firm possibly being in charge of the entire production at a given point in the chain. This increase in vulnerability is the counterpart of efficiency gains, since the international fragmentation of the productive process is a way for companies to gain competitiveness by maximizing the gains from specialization.

Externalities in risk-taking may justify targeted public intervention

International value chains increase vulnerability for critical inputs, where production is more concentrated. These effects may generate externalities, since risk-taking at the level of an individual firm will have consequences beyond

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¹ Caselli K., M. Koren, M. Lisicky and S. Tenreyro (2020): “Diversification through Trade”, *Quarterly Journal of Economics*, vol. 135, no 1, pp. 449-502.

² Several studies suggest that international trade reduces volatility, *cf.* Bejan M. (2006): *Trade Openness and Output Volatility*, Mimeo; Buch C., J. Dopke and H. Strotmann (2006): “Does Trade Openness Increase Firm-Level Volatility?”, *Deutsche Bundesbank Discussion Papers*; Cavallo E. (2008): “Output Volatility and Openness to Trade: A Reassessment”, *Economia*, vol. 9, no 1, pp.105-152; Haddad M., J. Lim and C. Saborowski (2010): “Managing Openness and Volatility: The Role of Export Diversification”, *World Bank Other Operational Studies*, no 10203; Parinduri R. (2012): *Growth Volatility and Trade: Evidence from the 1967-1975 Closure of the Suez Canal*, Mimeo; Burgess R. and D. Donaldson (2010): “Can Openness Mitigate the Effects of Weather Shocks? Evidence from India’s Famine Era”, *American Economic Review: P&P*, vol. 100, no 2, pp. 449-453). While other studies point to an increase in volatility, see Rodrik D. (1998): “Why do More Open Economies Have Bigger Governments?”, *Journal of Political Economy*, vol. 106, no 5; Easterly W., R. Islam and J. Stiglitz (2001): “Shaken and Stirred: Explaining Growth Volatility” in *Annual World Bank Conference on Development Economics 2000*, Pleskovic and Stern (eds); Kose M., E. Prasad and A. Terrones (2003): “Financial Integration and Macroeconomic Volatility”, *IMF Working Papers*, no 2003/050; di Giovanni J. and A. Levchenko (2009): “Trade Openness and Volatility”, *Review of Economics and Statistics*, vol. 91, no 3, pp. 558-585.

³ Bernard A., J. Jensen and P. Schott (2006): “Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of US Manufacturing Plants”, *Journal of International Economics*, vol. 68, no 1, pp. 219-237; Berthou A., J. Chung, K. Manova and C. Sandoz (2019): “Trade, Productivity and (Mis)Allocation”, *CEPR Discussion Papers*, no 14203. These reallocations result in a phenomenon of concentration of activity on a few very large firms. For example, the 100 largest firms in France account for 22% of value added and 20% of exports by value.

⁴ Di Giovanni J., A. Levchenko and R. Rancière (2011): “Power Laws in Firm Size and Openness to Trade: Measurement and Implications”, *Journal of International Economics*, vol. 85, no 1, pp. 42-52.

⁵ Di Giovanni J., A. Levchenko and I. Méjean (2014): “Firms, Destinations and Aggregate Fluctuations”, *Econometrica*, vol. 82, no 4, pp. 1303-1340.

⁶ Barrot J-N. and J. Sauvagnat (2016): “Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks”, *Quarterly Journal of Economics*, vol. 131, no 3, pp. 1541-1592; Boehm C., A. Flaen and N. Pandalai-Nayar (2019): “Input Linkages and the Transmission of Shocks: Firm Level Evidence from the 2011 Tohoku Earthquake”, *Review of Economics and Statistics*, vol. 101, no 1, pp. 60-75.

the the firm itself, by spreading to the firm’s production network. In addition, there may be information externalities: a firm may be indirectly exposed to vulnerable inputs, without knowing it, through its suppliers’ purchases of foreign inputs. These externalities may justify public intervention, which requires taking into account a trade-off between efficiency and resilience. Indeed, supply concentration yields efficiency gains, which will be foregone if public intervention reduces concentration to increase resilience.⁷ By targeting resilience policies on very specific products, it would be possible to strengthen the French economy without a significant increase in production costs.

Observation 1. Globalized value chains increase the concentration of production for certain critical inputs, which reduces production costs but increases the risk of supply disruptions. To be effective, a resilience strategy must identify and target a limited number of vulnerable strategic inputs.

A resilience strategy must be structured around a diagnosis of the vulnerability of French and European value chains

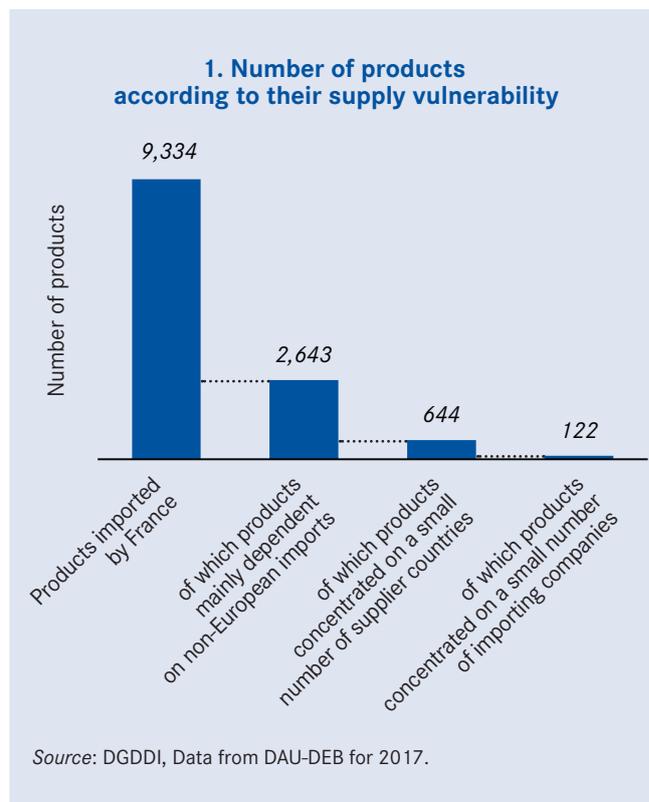
To identify vulnerable inputs, we present a two-step method: identify the inputs for which imports are most concentrated, and then estimate the risks with a “stress test” analysis.

Hundreds of inputs are vulnerable to external shocks

By analysing customs data at a very fine level of disaggregation with the eight-digit Combined Nomenclature used in Europe, which covers about 10,000 products, it is possible to establish a very precise list of vulnerable inputs. For example, we classify an input as vulnerable if its imports come mainly from suppliers outside the European Union and are concentrated on a small number of supplier countries: the Herfindahl index calculated across the different supplier countries is greater than 50%, i.e. if the typical foreign supplier represents more than half of French imports. Jaravel and Méjean (2021) provide a complete description of the methodology.⁸

According to these criteria, we identify 644 products for which the majority of supply comes from outside the European Union and is particularly concentrated in a small number of supplier countries (see Figure 1). Vulnerable inputs constitute

a small share of all goods traded on international markets: they represent only 4% of the value of France’s total imports.⁹



A high concentration of imports is a source of vulnerability, since a failure of the production system abroad or geopolitical tensions in the supplier country could compromise supply to all French companies. The 644 inputs include ores such as tungsten, inorganic chemical products such as iodine, organic chemical products including some antibiotics, and medical devices such as MRIs. The list also includes a number of everyday consumer goods for which foreign dependence is unlikely to pose a strategic risk, such as videogame consoles or beach umbrellas hence the importance of restricting the list to inputs that are both vulnerable and strategic.

Among these 644 vulnerable products, 122 products are more vulnerable because of the granularity of demand: a single French company is responsible for at least 90% of French imports. These products are highly concentrated in the chemicals sector, which accounts for more than a third of these more vulnerable products (about half of which are organic chemicals, including imports of active ingredients for

⁷ The costs of reducing vulnerability (which may include diversification of sources, storage, or domestic production) are the “cost of insurance”.
⁸ Jaravel X. and I. Méjean (2021): “Quels intrants vulnérables doit-on cibler ?”, *Focus du CAE*, no 057-2021, April. Other statistical criteria can be used to define vulnerable inputs, for example by modifying the geographical base of supplier countries (outside NATO, etc.).
⁹ Compared to what is obtained from the 5,000 products in the 6-digit nomenclature by Bonneau and Nakaa (2020), the frequency of “vulnerabilities” that we obtain is about three times higher, see Bonneau C. and M. Nakaa (2020): “Vulnérabilité des approvisionnements français et européens”, *Trésor-Éco*, no 274. This difference illustrates the importance of the aggregation bias (see Jaravel and Méjean, 2021, *op. cit.* for the comparison with Bonneau and Nakaa).

medicines). About a third of these products are purchased mainly from the United States and 15% from China (see Figure 2).

Establish a short list of vulnerable strategic inputs

The statistical analysis thus leads to a very precise list of vulnerable inputs. To define the resilience strategy, this list should be narrowed down based on sectoral classifications, for example by focusing only on inputs used by sectors identified as “strategic” in the Recovery Plan: aeronautics, automotive, nuclear, agri-food, health, electronics, chemicals, materials, metals, and 5G telecommunications.¹⁰ The list should also be narrowed based on partner countries, in order to reduce vulnerabilities to specific countries whose strategic interests might diverge from those of France, for example China. A committee of experts should be involved in defining this list of “strategic” inputs.¹¹

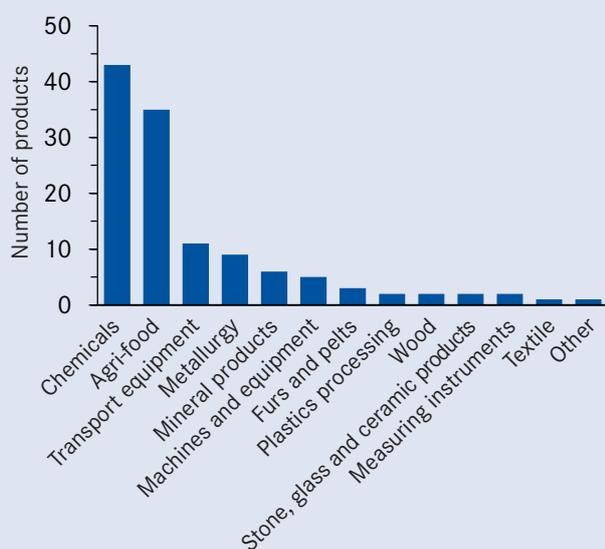
To illustrate the degree of precision in targeting that can be achieved with customs data, we present the list of vulnerable

inputs from China in the “chemicals and pharmaceuticals” sector (see Table).¹²

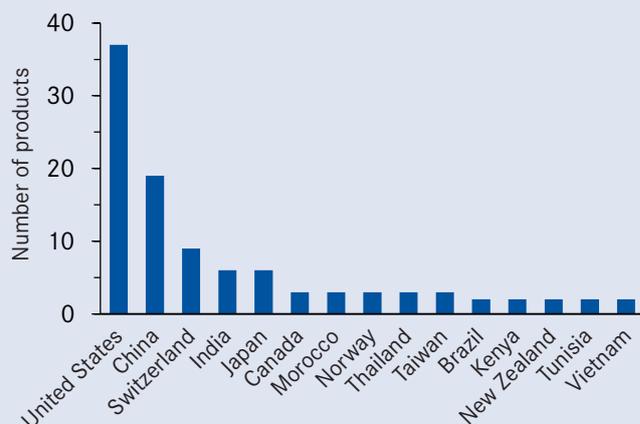
The list of vulnerable strategic inputs will make it possible to set resilience targets. For example, France could aim to reduce the number of strategic products identified as vulnerable by a factor of two or three within the next five or ten years, or to have no vulnerabilities at all within fifteen or twenty years. It is essential to organize the resilience strategy around very specific inputs in order to guarantee its effectiveness and to avoid the pitfall of imperfectly targeted support policies. Such policies would be costly for the consumer without fundamentally strengthening resilience, and would be a symptom of protectionist tendencies in a climate of distrust of globalization. The use of statistical tools to draw up the list of targets for resilience policy would provide objective criteria for a relevant industrial policy. In the absence of such objective criteria, there is a significant risk of diversion by lobbies (Bombardini and Trebbi, 2020).¹³ Moreover, without clear medium- and long-term strategic objectives that target specific inputs, it will be impossible to evaluate the success or failure of resilience policies.

2. Distribution of supply vulnerabilities (122 products with enhanced vulnerability)

a. Sectoral distribution



b. Geographical distribution



Note: 43 products are identified as highly vulnerable in the chemicals sector. Of the products with an increased vulnerability, 37 are from the United States.
Source: DGDDI, Data from DAU-DEB for 2017.

¹⁰ The list could focus on inputs used by sectors of activity for which foreign investments are subject to prior authorization by the State, in accordance with the *Code monétaire et financier* (Monetary and Financial Code) (Art. L. 151-3 and seq.).

¹¹ This *ad hoc* committee could be set up at the request of the Prime Minister and could draw on the expertise of the *Conseil national de l'industrie* (CNI), the *Conseil général de l'économie* (CGE) and the *Banque publique d'investissement* (Bpifrance). Expert committees have been mobilized as part of the recovery plan, but their expertise has not been combined with a quantitative and systematic analysis of inputs in customs data, which would allow vulnerable inputs to be identified much more precisely and ensure that there are no significant blind spots in the resilience strategy.

¹² The table takes into account only vulnerable inputs that are not subject to statistical confidentiality. Respect for statistical confidentiality does not allow the complete list to be made public.

¹³ Bombardini M. and F. Trebbi (2020): “Empirical Models of Lobbying”, *Annual Review of Economics*, vol. 12, pp. 391-413.

Selection of vulnerable inputs from the “Chemicals and Pharmaceuticals” sector

	Number of importing companies	Share of largest importing company in total imports (%)	Total value of imports (in thousands of euros)	China's share of total imports (%)
D- or DL-pantothenic acid (vitamin B3 or vitamin B5) and its derivatives	104	42	27,527.8	73.9
Carbonate; ammonium carbonates	86	55	15,393.9	72.7
Vitamin B1 and its derivatives	80	31	14,612.7	69.2
Vitamin B6 and its derivatives used mainly as vitamins	75	38	7,424.7	68.2
Calcium	42	74	6,588.5	78.4
Vitamin B12 and its derivatives used mainly as vitamins	48	40	5,263.7	75.6
o-Phenylenediamine, m-phenylenediamine, p-phenylenediamine, diaminotoluenes and their derivatives	27	72	3,316.2	88.5
Dihydrostreptomycin, its salts, esters and hydrates	12	37	2,856.8	99.2
Inositols	38	56	1,774.6	76.7
Phenylbutazone (INN)	7	71	235.0	84.7
Malonylurea (barbituric acid) and its salts	15	33	105.8	91.9

Note: Carbonate imports from China from the largest French importer represent 55% of total imports.

Sources: Authors' calculations based on foreign trade statistics from the Inputs not subject to statistical confidentiality. Direction générale des Douanes et Droits indirects.

Depending on the technological level of vulnerable inputs, the diversification of supply sources, storage and competitiveness through innovation should be combined

Based on the list of vulnerable strategic inputs, the resilience strategy can be deployed along three axes:

- Encouraging the diversification of imports and strategic partnerships when other trading partners can be mobilized, particularly at the European level;
- If the diversification of sources is not possible, facilitating or subsidizing storage, especially for low value-added products;
- For vulnerable inputs at the technological frontier, fostering innovation to produce competitively on the national territory.

This strategy would minimize the costs of resilience by encouraging domestic production only for inputs at the technological frontier, where expanding production capacity may create technological externalities in other areas.

The list of vulnerable strategic inputs should be used in the short term as part of the selection procedure for the call for projects under the “Industrial Recovery Plan –strategic sectors”.¹⁴ In the medium run, a new call for projects with dedicated funds should be launched, which should focus exclusively on the vulnerable strategic inputs retained in the list. Depending on the type of inputs, we should either subsidize the diversification of inputs, or partnerships, or storage capabilities, or innovation to increase competitiveness and production capacities.

Recommendation 1. Using French customs data, draw up a list of vulnerable strategic inputs to define a resilience strategy, aiming to reduce the number of vulnerable strategic inputs by a factor of four within ten years. Depending on the characteristics of each product, give priority to either the diversification of supply sources, strategic partnerships, storage, or innovation.

¹⁴ This call for projects aims to encourage investments in essential industry inputs but does not define specific selection criteria. The selection criteria mention “economic resilience (reduction of national or European dependence)”, without specifying which inputs are concerned.

Measuring “indirect” vulnerabilities at the European level

Existing statistics give only a partial view of vulnerabilities of the French and European value chains. Indeed, to assess the vulnerability of the system, it is necessary to consider fragilities beyond a company’s direct suppliers, by taking into account “the suppliers’ suppliers”. Such an analysis is difficult with the data currently available. The statistical sources usually used¹⁵ to analyse supply chains are too aggregated, leading to the omission of potentially costly sources of vulnerability and making it impossible to target policies accurately.

In the near future, the European statistical apparatus should be mobilized to carry out these analyses with an unprecedented level of precision. With the introduction of the single market and the disappearance of customs forms, the European Union has set up procedures for collecting intra-European shipments, making it possible to calculate VAT compensation between Member States. In France and other Member States, these “exchange of goods declarations” and “exchange of services declarations” make it possible to identify the two parties involved in a transaction, i.e. the French exporting company and its partner in Europe. From 1 January 2022, this system will be extended to all Member States,¹⁶ thus making it possible, if access to the consolidated set is authorized,¹⁷ to reconstitute all the flows relating to European value chains and to draw up a map of firm-to-firm input-output linkages in Europe. These data could be supplemented with information on trade flows with the rest of the world.

Broadening access to these new data would improve our knowledge of the structure of European value chains and its fragilities.¹⁸ First, these data would make it possible to measure indirect exposure to inputs purchased outside Europe. A French company that buys only from European suppliers may be indirectly exposed to inputs purchased outside of the European Union, *via* the purchases of its suppliers, without the company necessarily being aware of this exposure. These patterns are currently impossible to measure with existing individual statistics. Consolidating these data could therefore reduce some of the informational externalities inherent in the fragmentation of production processes, which complicate the risk analysis at the individual level. In addition, such data would make it possible to highlight

certain bottlenecks at entry into the European Union, which may constitute important sources of vulnerability. The specialization of some European ports, notably Rotterdam and Antwerp, in maritime freight activities mechanically leads to a geographical concentration of import-export flows, which implies a vulnerability to potential shocks that may affect these areas. Finally, using these data would make it possible to measure the “granularity” of the European part of the value chains: a high concentration on certain production stages may be a source of fragility in the event of climatic, geopolitical, economic or social shocks. Mobilizing all of this data is therefore a goal of strategic importance for the European Union in order to create a common public good: a map of the vulnerabilities of European production chains.

Recommendation 2. Expand the access to European trade statistics in order to map vulnerabilities of Europe’s supply chains based on the new European statistics on trade in goods and services.

Adopting the “stress test” methodology

Very granular data, such as French customs statistics or eventually European data, are the essential raw material for risk-mapping, which allows the use of “stress test” methodologies. For example, the simulations of Gerschel *et al.* (2020)¹⁹ combine theoretical modelling of the transmission of shocks in international production networks, calibration using data on these networks, and “shock” scenarios. Such simulations make it possible to quantify the potential impact of these shocks but also to identify the areas of vulnerability that lead to an amplification of the aggregate effects. The more detailed the data provided to the model, the more accurate the quantification.

This kind of analysis requires prior consideration of the nature of the shocks to be considered in the test scenarios. Multiple risks could exist, which calls for multidisciplinary expertise to consider a wide variety of scenarios: economic risks, particularly granular risks (for example, a break in the supply chain within a large industrial company), climate risks (for example, a storm in the North Sea affecting Europe’s two main seaports), or geopolitical risks (for example, a trade war with China).

¹⁵ See in particular the WIOD (World Input-Output Database) and the TiVA (Trade in Value Added) database of the OECD.

¹⁶ This legislative development aims to simplify data collection by allowing data exchange between Member States.

¹⁷ From January 2022, national statistical systems will be able to use all data related to national enterprises, whether collected by French or other Member States’ administrations. However, consolidation of all data would require an additional legislative step, as it is not currently provided for in the European regulations.

¹⁸ Intra-European data are collected at the level of each transaction, identifying both parties to the transaction; data on extra-European flows are less precise, as they do not allow the identification of a company’s extra-European partner, beyond its country of origin. Intra-European data cover a significant proportion of intermediate goods flows involving European firms, as the value chains in which European firms are involved have a more regional geography than the average international value chain, see International Bank for Reconstruction and Development/World Bank (2020): *Trading for Development: In the Age of Global Value Chains*, World Development Report.

¹⁹ Gerschel E., A. Martinez and I. Méjean (2020): “Propagation des chocs dans les chaînes de valeur internationales: le cas du coronavirus”, *Note de l’IPP*, n° 53.

Recent history illustrates these risks. For example, a disruption in the supply of air flow meters for its diesel engines led Peugeot to suspend production for a week following the tsunami in Japan in March 2011. More recently, the Covid-19 crisis has highlighted the existence of tensions between economic powers, which may result in non-cooperative trade policies in the future. The IMF has identified 120 cases of export restrictions in 2020, one-fifth of which occurred in the pharmaceutical and medical products sector (IMF, 2020).²⁰ While such restrictions may be justified in an emergency, they become counterproductive when all countries face the same crisis and unilateral export restrictions leads to retaliation by partner countries. Such geopolitical risks are particularly costly in international value chains, where the impact of trade cost increases is magnified (Antras and Chor, 2013).²¹

We therefore propose to leverage “stress tests” to identify the most important inputs, depending on the sources of the risk. The economic risk can be directly estimated statistically using customs data, based on the risks related to the granularity and volatility of each input. Geopolitical and climatic risks need to be considered within a multidisciplinary working group.

Recommendation 3. Conduct “stress tests” of the production network at national and European levels to identify supply vulnerabilities, according to the economic, climate-related, and geopolitical risk factors identified by a multidisciplinary committee.

Towards a European resilience policy

The definition of a resilience policy must be carried out at the European level. The Single Market is indeed the relevant scale for analysing the organization of the production chains in which French companies are involved. Resilience tools based on the diversification of supply sources, partnerships, storage, and innovation-based competitiveness can be used simultaneously at the European level. In particular, a European-level approach could address strategic vulnerabilities that are shared by several member States.

In the short term, strategic stockpiling or supply partnerships could reduce temporary difficulties due to imbalances in supply and demand. Such supply partnership already exist in the pharmaceutical sector and could be generalized at a European scale for vulnerable strategic inputs.

Public procurement could in principle take diversification into account in its award criteria. In practice, however, public procurement is already on average not very dependent on the rest of the world: only a small fraction of public procurement is awarded to foreign companies (about 14% in France, 17% in Germany, and 23% in the European Union, see Desrieux and Parra Ramirez, 2021). This lever therefore has limited potential.²²

Resilience through competitiveness and innovation at the technological frontier

Globalization offers opportunities to strengthen innovation at the technological frontier, and thus resilience. To better seize these opportunities, it is necessary to transform governance and the procedures for assessing the effectiveness of innovation support programs.

Globalization must be used as a lever to increase resilience through innovation

Trade with emerging countries is not the main cause of France’s manufacturing decline

The share of industrial employment in total employment has fallen sharply in France, from 14.7% in 1995 to 9.1% in 2019.²³ Manufacturing decline is a concern because manufacturing has historically been a driver of productivity growth. Globalization is sometimes thought to have contributed to France’s manufacturing decline through trade with emerging countries.

However, the main causes of this manufacturing decline in France lie elsewhere. First, consumer products have undergone structural change,²⁴ as has been observed in all developed countries for the past fifty years, i.e. well before the increase in trade with emerging countries. Second, French

²⁰ Monetary Fund (IMF) (2020): *External Sector Report 2020: Global Imbalances and the Covid-19 Crisis*.

²¹ Antras P. and D. Chor (2013): “Organizing the Global Value Chain”, *Econometrica*, vol. 81, no 6, pp. 2127-2204. The role of the Covid-19 crisis in raising awareness of value chain vulnerabilities should not be exaggerated. The crisis was ultimately marked by a relative resilience of international supply networks, cf. Bellora C., C. Bois and S. Jean (2020): “Le commerce européen dans la crise sanitaire: des problèmes de dépendance plus que de vulnérabilité”, *La Lettre du CEPII*, no 412-413. The public debate has focused on emblematic goods such as masks, for which the supply problems can be explained mainly by the very sudden increase in demand, which led to a supply deficit that would have existed regardless of the production structure, and which is therefore not essentially a problem of “dependence”.

²² Desrieux C. and K. Parra Ramirez (2021): “La commande publique peut-elle constituer un levier de relocalisation de l’activité ?”, *Focus du CAE*, no 058-2021, April.

²³ According to Eurostat data, between 1995 and 2019 the share of industry in total employment fell from 18.9% to 13.6% in the European Union (27) and from 21.1% to 17.1% in Germany. At the same time, industry’s share of output in GDP fell from 20.0% to 16.6% in the EU and from 16.6% to 11.0% in France; Germany is the exception with a much smaller fall, from 22.7% to 21.2%.

²⁴ The increase in GDP per capita leads to an increase in the consumption of services rather than of industrial goods (this is the “income effect”), as does the decrease in the relative price of industrial goods compared to services (this is the “substitution effect”).

industry suffers from low competitiveness, independently of emerging countries, as shown by France's trade balance deficit with other euro area countries.²⁵ Finally, the fall in manufacturing employment is partly explained by the growth of business services, due to technological innovations that are independent of international trade and which have led to the increased outsourcing of certain tasks necessary for industrial production.²⁶ For example, Fort *et al.* (2018)²⁷ show that the increase in non-manufacturing employment of US industrial firms has more than offset the decline in manufacturing employment of the same firms over the period 1977-2012.

Globalization offers opportunities to increase productivity and resilience

For countries that remain on the technological frontier, globalization offers opportunities to boost productivity. Globalization can strengthen firms' incentives to innovate because of their greater market potential (through economies of scale) and the spur of foreign competition. The rapid development of vaccines against Covid-19 provides a good illustration of these virtuous effects. However, if competitive pressure is too strong it can discourage domestic investment and innovation.

Recent studies show that, in fact, international trade enhances innovation and productivity in the most competitive countries, sectors, and firms. Analysis of company data (Bloom *et al.*, 2016; Pierce and Schott, 2018; Aghion *et al.*, 2018; Autor *et al.*, 2020)²⁸ indicates that innovation increases as a result of international trade, but only for the companies that are initially most productive and able to expand their export market shares, while the least productive cannot face foreign competition. Positioning on high-end products with a high technological content allows companies to differentiate themselves from competition from emerging countries and to increase their export market shares (Martin and Méjean, 2014).²⁹ Analysing sectoral data reveals that scale effects vary substantially from one sector to another (Bartelme *et al.*, 2019).³⁰ Overall, globalization can promote the growth

of manufacturing through competitiveness and exports. For example, Aghion *et al.* (2020)³¹ show that French companies that automate their production process become more competitive, manage to reduce their prices and increase their exports, and ultimately increase manufacturing employment (see Figure 3).

Being competitive and innovative in strategic sectors is likely to increase resilience in the long run, as innovation confers a capacity to adapt and rebound after shocks. An "export-led" strategy for resilience in a globalized world would thus aim to increase competitiveness in strategic sectors that make it possible both to benefit from increasing returns to scale and to address vulnerabilities. Conversely, a protectionist policy would be costly for consumers and would reduce economic growth.

Observation 2. Thanks to economies of scale, globalization offers opportunities to increase productivity and the capacity to innovate and adapt to external shocks, thereby strengthening resilience.

A better-targeted and better-evaluated industrial policy

The recovery plan contributes to such a competitiveness policy, with, for example, lower taxes on production, as well as subsidies dedicated specifically to investment and innovation. In a period of economic crisis, it may be tempting to use relocation policies as a tool for cyclical support for investment, so as to disburse the funds quickly. However, to improve the competitiveness and resilience of the French manufacturing sector, the longer-term effectiveness of public spending requires a more fine-tuned targeting than that used for cyclical purposes. It is necessary to focus precisely on the sectors most likely to generate sustainable activity, in which France can acquire and maintain technological leadership. In

²⁵ See DG Treasury's 2020 report on France's foreign trade. The trade deficit with other euro area countries stood at €38.6 billion in 2019, compared with a deficit of €35.7 billion with Asia, and €32.9 billion with China.

²⁶ In France, the contribution of business services to total employment increased from 10.4% to 15.8% from 1995 to 2019. Outsourcing concerns production support activities (accounting, IT services) but also tasks interacting more directly with production such as technical services or research and development. In this perspective, industrial policy should take better account of the growing interweaving of industrial and service activities. Business services are currently excluded from the calls for projects of the recovery plan, which is not desirable because these services contribute to the competitiveness of productive ecosystems.

²⁷ Fort T., J. Pierce and P. Schott (2018): "New Perspectives on the Decline of US Manufacturing Employment", *Journal of Economic Perspectives*, vol. 31, no 2, pp. 47-72.

²⁸ Bloom N., M. Draca and J. Van Reenen (2016): "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity", *The Review of Economic Studies*, vol. 83, no 1, pp. 87-117; Pierce J. and P. Schott (2018): "Investment Responses to Trade Liberalization: Evidence from US Industries and Establishments", *Journal of International Economics*, vol. 115(C), pp. 203-222; Aghion P., A. Bergeaud, M. Lequien and M. Mélitz (2018): "The Heterogeneous Impact of Market Size on Innovation: Evidence from French Firm-Level Exports", *NBER Working Papers*, no 24600; Autor D., D. Dorn, G. Hanson, G. Pisano and P. Shu (2020): "Foreign Competition and Domestic Innovation: Evidence from US Patents", *American Economic Review: Insights*, vol. 2, no 3, pp. 357-374.

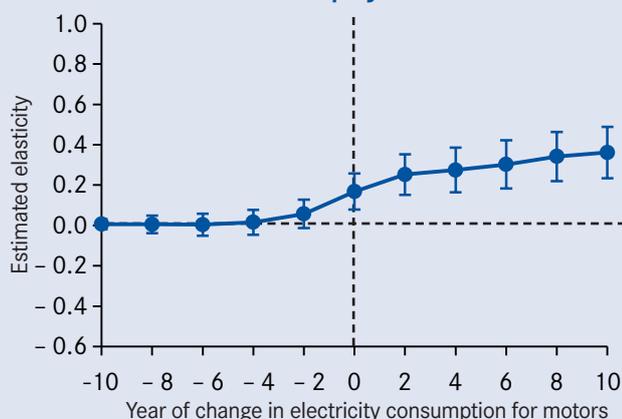
²⁹ Martin J. and I. Méjean (2014): "Low-Wage Countries' Competition, Reallocation across Firms and the Quality Content of Exports", *Journal of International Economics*, vol. 93, no 1, pp. 140-152.

³⁰ Bartelme D., A. Costinot, D. Donaldson and A. Rodriguez-Clare (2019): "The Textbook Case for Industrial Policy: Theory Meets Data", *NBER Working Papers*, no 26193.

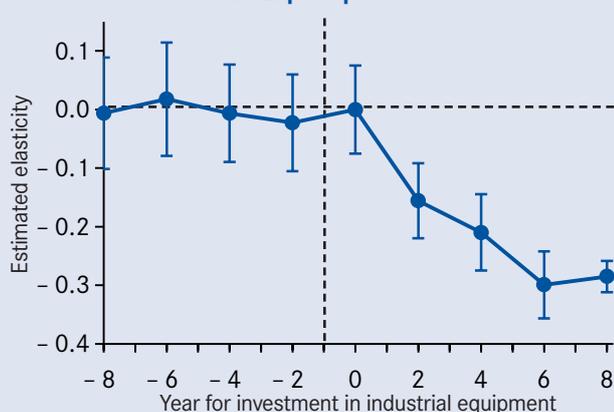
³¹ Aghion P., C. Antonin, S. Bunel and X. Jaravel (2020): *What Are the Labor and Product Market Effects of Automation? New Evidence from France*, Mimeo.

3. Automation increases competitiveness and industrial employment

a. Total Employment



b. Export prices



Note: Figure 3a shows the positive relationship between automation and employment. Figure 3b shows the negative relationship with export prices, which decrease when productivity increases due to automation.

Source: Aghion P., C. Antonin, S. Bunel and X. Jaravel (2020): *What Are the Labor and Product Market Effects of Automation? New Evidence from France*, Mimeo.

frontier, so as to be able to produce competitively. Through the analysis of triadic patents, Aghion *et al.* (2021)³² identify the sectors in which France is well positioned for global technological leadership. In addition to France's historical sectors of excellence such as nuclear and aeronautical technologies, its presence in other technological segments could be consolidated, including autonomous vehicles (navigation, obstacle recognition, etc.), computer-aided design (CAD) software, as well as data transmission. From a resilience perspective, it would be desirable to cross-reference the analysis of France's technological capabilities with the analysis of its vulnerable inputs (see above) in order to identify a number of vulnerable inputs for which it is plausible to acquire technological leadership. For these inputs, priority would be given to promoting innovation and then expanding production capacities, rather than resorting to diversification, alliances, or storage. Innovation policy would thus help build more resilient value chains for vulnerable inputs.

Effective targeting also requires good governance practices to select the projects that would benefit from grants and subsidies. These practices are well known: using independent and qualified (and often international) experts to select projects, not distorting competition between firms, evaluating interventions and publishing results, and withdrawing funding if the program does not work.³³ These practices should be adopted systematically in the recovery plan's policies to support resilience.

Given the uncertainty about the effectiveness of resilience policies, it is necessary to use quantitative *ex post* evaluation procedures (comparing a control group and a treatment group, using difference-in-differences methodologies, etc.). Recent studies show the feasibility and relevance of this approach in practice, for example in the case of subsidies for innovation.³⁴ Such evaluation work requires upstream coordination between the various actors to collect and keep the appropriate data, in particular to identify a control group.³⁵ The lack of systematic quantitative evaluations for reshoring subsidies is a symptom of the fact that the resilience strategy has not been fully defined.

this context, two complementary approaches can be used to make subsidies more effective: better *ex ante* targeting and better *ex post* program evaluation.

With regard to targeting, the challenge is to identify sectors that contribute to reducing vulnerabilities and for which it is credible for France to maintain or move to the technological

Recommendation 4. Target innovation subsidy schemes on vulnerable inputs with high technological content for which France can acquire world leadership and analyze their effectiveness using *ex post* quantitative evaluations.

³² Aghion P., E. Cohen, B. David and T. Gigout-Magiorani (2021): *Le Covid et comment repenser notre politique industrielle*, Mimeo.

³³ See in particular the 2019 evaluation report of the *Programme d'investissements d'avenir*, as well as Tirole J. (2018): *Économie du bien commun*, chapter 13, PUF, coll. "Hors collection", 672 p.

³⁴ For example, Howell (2017) estimates the effect of the small business support schemes of the Small Business Innovation Research (SBIR) programme, implemented in the United States from 1983 to 2013. These results led the SBIR programme to adjust its schemes, cf. Howell S. (2017): "Financing Innovation: Evidence from R&D Grants", *The American Economic Review*, vol. 107, no 4, pp. 1136-64.

³⁵ For example, it would be wise to systematically keep information on companies that apply for the schemes but are not selected.

Reducing current account imbalances in the euro area

Macroeconomic policies aimed at reducing current account imbalances in the euro area can be an important lever for increasing competitiveness and ultimately resilience.

Northern European countries, led by Germany, have been running current account surpluses since the early 2000s.³⁶ As a result, the current account balance of the euro area is currently running a large surplus, even though a number of member countries suffer from a lack of competitiveness on international markets. Under a floating exchange rate regime, these countries' lack of competitiveness would be compensated by a depreciation of their exchange rate. In the monetary union, with an overall positive current account balance, the euro's exchange rate remains strong, which aggravates the competitiveness problems of the countries with trade deficits.

In the context of Covid-19, the stimulus packages constitute an opportunity to better coordinate macroeconomic policies within the euro area and to reduce current account imbalances.³⁷ A more accommodating fiscal policy in countries with large surpluses would help restore current account balances. In practice, there is a risk that countries with current account surpluses, such as Germany, will be the first to make a fiscal adjustment, which would exacerbate imbalances.

Recommendation 5. Coordinate stimulus packages within the euro area to reduce current account imbalances, encouraging a more accommodating fiscal policy in countries with large surpluses.

Addressing environmental externalities and sharing the benefits of globalization more broadly

Resilience also requires strategies to mitigate the environmental and social shocks that globalization can cause.

Trade and CO₂ emissions: The role of the carbon tax

The interaction between international trade and environmental externalities is a major problem, since more than half of France's carbon footprint results from imported goods.³⁸ Defining an environmental policy without taking imported CO₂ into account, as France's "National Low Carbon Strategy" (*Stratégie nationale bas carbone*, SNBC) does, means ignoring a large part of the problem. Worse, it can create harmful incentives for companies to purchase abroad their most polluting inputs. Far from correcting these perverse effects, trade policies today accentuate these harmful incentives, since customs duties at Europe's borders are on average lower for more polluting industries (Shapiro, 2020).³⁹

Given the scale of imported emissions, the introduction of a carbon tax at the EU's borders is crucial to achieve the ambitious environmental goals of the European Green Deal. Developing carbon markets with the Emissions Trading System was a decisive step in the European policy to fight climate change. But its effectiveness is now limited by insufficient sectoral coverage: many sectors are exempted and the price of permits is often too low (see Parra Ramirez, 2021).⁴⁰ These limitations can be explained in particular by the concern to maintain the competitiveness of European companies relative to their international competitors. For example, free emission allowances were given to several industrial sectors.

To reconcile the conflicting objectives of reducing CO₂ and maintaining competitiveness, the extension of carbon markets within the European Union should be accompanied by a carbon adjustment at the borders. Extending carbon markets to the transport sector, which accounted for approximately 30% of France's greenhouse gas emissions in 2018, would notably allow for a better internalization of the environmental impact of the geographic dispersion of supply chains within and outside the European Union.

Recommendation 6. Expand the set of sectors subject to carbon markets within the European Union and introduce a carbon border tax.

³⁶ Southern European countries were characterized by the accumulation of external debt but rebalanced their current account balances after the 2011 debt crisis. France is in an intermediate position with a current account balance that is only slightly in deficit but a very negative trade balance on goods, especially vis-à-vis Germany.

³⁷ On this topic, see the analyses of France's *Conseil national de la productivité* (National Productivity Council) (2019), which includes recommendations for revising the Macroeconomic Imbalances Procedure (MIP). The 2021 report discusses these issues in relation to the Covid crisis and associated stimulus packages. See *Conseil national de productivité* (CNP) (2019): *Productivité et compétitivité: où en est la France dans la zone euro ?*, First Report of the CNP, July and *Conseil national de productivité* (CNP) (2021): *Les effets de la crise Covid-19 sur la productivité et la compétitivité*, Second Report of the CNP, January.

³⁸ See *Haut Conseil pour le Climat* (State Climate Council) (2020): *Maîtriser l'empreinte carbone de la France*, Report, October. Imported emissions come mainly from European partners, as the European Union accounts for the bulk of France's imports (56.3% in 2020).

³⁹ Shapiro J. (2020): "The Environmental Bias of Trade Policy", *NBER*, no 26845.

⁴⁰ Parra Ramirez K. (2021): "Un mécanisme d'ajustement carbone aux frontières: quelles voies possibles ?", *Focus du CAE*, no 059-2021, April. The only sectors currently covered are energy, oil refineries, and the most polluting manufacturing sectors such as metallurgy and cement.

Because of multilateral regulations, the carbon tax at the border of the EU can be applied only to products of the sectors covered by the carbon market within the EU. With the carbon tax, foreign producers will effectively pay the same amount for allowances as European producers, who will no longer benefit from the free allowances that exist today. Consequently, the carbon tax will not improve the competitiveness of European companies, unlike the protectionist policies regulated in the multilateral framework. Moreover, it will have a cost that will fall mainly on European consumers. Indeed, empirical studies on the impact of border taxes show that this type of tax is almost entirely passed on to the consumer.⁴¹ In fact, this price adjustment is necessary for the transition to more sustainable consumption patterns to take place.⁴²

Ultimately, environmental policy should be based on the introduction of a single carbon price in all sectors. We are currently a long way from this goal, including within the European Union, due to the exceptions granted to many sectors and the development of national climate policies in addition to the European policy.

Trade and inequalities: Better support for job losses through more flexible measures

Globalization increases consumers' purchasing power by lowering prices and improving product quality. At the same time, however, it leads to job reallocation, with a fall in employment in sectors subject to competitive pressures from abroad and an increase in employment in sectors with export opportunities.

Empirical studies estimate the gains in consumer purchasing power from trade to be very large. For example, with regard to trade with China in the 2000s, studies show that the annual purchasing power of each household in France increased by about 1,000 euros per household (Carluccio *et al.*, 2020),⁴³ i.e. a total annual gain of 30 billion euros for French households. This figure can be compared to the job losses in France induced by competition from products imported from China, estimated at 104,000 jobs by Malgouyres (2016).⁴⁴ This estimate can be interpreted as an upper bound on job

losses, because it does not take into account the positive effects of international trade on employment, notably *via* export opportunities. Moreover, the study estimates a relative effect –i.e. the effect on employment in a sector that is more exposed than another to competition from China– and not the effect on the total level of employment in the French economy, which should be smaller thanks to the reallocation of jobs between sectors.

These results illustrate the trade-off between gains in purchasing power and job losses. With gains of 30 billion euros in purchasing power and the loss of at most 104,000 jobs, the purchasing power gains are equivalent to 280,000 euros per job lost (at least). The results are similar for the United States (Jaravel and Sager, 2019).⁴⁵ A protectionist relocation policy would therefore have substantial costs from an aggregate point of view, by increasing consumer prices and reducing export opportunities, with a limited effect on employment. These orders of magnitude should be kept in mind in a context where protectionist responses to trade-related job losses are receiving strong popular support (Di Tella and Rodrik, 2020).⁴⁶

These high aggregate gains should not make us lose sight of the central issue of inequality. Empirically, the gains in purchasing power are largely shared between all households (Borusyak and Jaravel, 2018);⁴⁷ contrary to a widespread idea, poorer households do not consume more imported goods, and this holds even for imports from China, in part because of the role of intermediate production.

In contrast, job losses are concentrated. Empirical studies indicate that all social categories, from the richest to the poorest, have to face these reallocation shocks (Hummels *et al.*, 2014; Borusyak and Jaravel, 2018, *op. cit.*).⁴⁸ But transitions are sometimes slower and unemployment more persistent for the least skilled (Autor *et al.*, 2014).⁴⁹ This finding shows that redistribution policies have a role to play, but designing them is not straightforward because it is not easy to identify the individuals most affected: for example, there are many losers and many winners within the same income group.

⁴¹ See for example analyses of the impact on prices of the Sino-US trade war: Amiti M., S. Redding and D. Weinstein (2019): "The Impact of the 2018 Tariff on Prices and Welfare", *Journal of Economic Perspectives*, vol. 33 no 4, pp. 187-210 and Fajgelbaum P., P. Goldberg, P. Kennedy and A. Khandelwal (2019): "The Return to Protectionism", *The Quarterly Journal of Economics*, vol. 135.

⁴² To avoid a rise in inequalities, compensation to modest households can be introduced, see Bureau D., F. Henriët and K. Schubert (2019): "A Proposal for the Climate: Taxing Carbon not People", *Notes du CAE*, no 50, March.

⁴³ Carluccio J., E. Gautier and S. Guilloux-Nefussi (2020): "Dissecting the Impact of Imports from Low-Wage Countries on French Consumer Prices", *Banque de France WP*, no 672.

⁴⁴ Malgouyres C. (2017): "The Impact of Chinese Competition on the Local Structure of Employment and Wages: Evidence from France", *Journal of Regional Science*, vol. 57, pp. 411-441.

⁴⁵ Jaravel X. and E. Sager (2019): "What Are the Price Effects of Trade? Evidence from the US and Implications for Quantitative Trade Models", *CEPR Discussion Paper*, no 13902.

⁴⁶ di Tella R. and D. Rodrik (2020): "Labor Market Shocks and the Demand for Trade Protection: Evidence from Online Surveys", *The Economic Journal*, vol. 130, pp. 1008-1030.

⁴⁷ Borusyak K. and X. Jaravel (2018): *The Distributional Effects of Trade: Theory and Evidence from the US*, Harvard University Mimeo.

⁴⁸ Hummels D., R. Jørgensen, J. Munch and C. Xiang (2014): "The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data", *American Economic Review*, vol. 104, no 6, pp. 1597-1629.

⁴⁹ Autor D., D. Dorn, G. Hanson and J. Song (2014): "Trade Adjustment: Worker-Level Evidence", *Quarterly Journal of Economics*, vol. 129, no 4, pp. 1799-1860.

One proven strategy is to provide highly targeted support to individuals who lose their jobs due to international competition. Empirical evaluations show the effectiveness of such schemes in other countries.⁵⁰ For example, the Trade Adjustment Assistance (TAA) scheme in the United States targets the most affected workers in a way that has no equivalent in France or Europe to date. This scheme offers financial support and vocational training to individuals who have lost their jobs due to international competition or relocation.⁵¹ In a recent empirical study, Hyman (2018)⁵² shows that this scheme works well, with a significant effect on the return to employment.

Within the European Union, the European Globalization Adjustment Fund (EGF) aims to support workers affected by globalization by facilitating their professional transitions across sectors and firms. But its budget is far too small to fully accomplish this mission. Moreover, its operation is extremely rigid, rendering it ineffective in practice, due to an eligibility threshold of at least five hundred layoffs, the fact that “indirect” job losses are not taken into account (for example in the subcontracting network of a company that relocates its activities abroad), and the requirement that aid be approved by the European Parliament on a case-by-case basis. For example, between 2007 and 2014 the EGF assisted only

142,578 people, or 0.05% of the EU’s workforce. By comparison, the American TAA programme has an annual budget six times higher and assists more than 230,000 individuals each year, with much less restrictive eligibility criteria. It is therefore essential to reform the EGF, for example along the lines of the TAA scheme.⁵³

Recommendation 7. Reform the European Globalization Adjustment Fund by increasing its financial resources and by setting eligibility criteria that are not prohibitive.

In conclusion, this *Note* emphasizes the importance of using granular data to obtain a list of vulnerable inputs around which the resilience strategy should be defined. Without such objective criteria, resilience policies pose a number of risks: subsidies could be too scattered, production costs might increase substantially, and subsidies may be captured by lobbies. Ultimately, the resilience strategy has two sides: on the “defensive” side, reducing vulnerabilities in imported strategic inputs; and on the “offensive” side, promoting innovation at the technological frontier in strategic areas. ●

⁵⁰ Rather than targeting individuals, an alternative strategy would be to target territories. A relocation policy targeting the most affected territories could in principle reduce the local externalities induced by job destruction, cf. Bilal A. (2019): *The Geography of Unemployment*, Mimeo. Nevertheless, empirical evaluations of location subsidy programmes, e.g. Kline P. and E. Moretti (2014): “Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority”, *The Quarterly Journal of Economics*, vol. 129, no 1, pp. 275-331 and Bartik T.J. (2020): “Using Place-Based Jobs Policies to Help Distressed Communities”, *Journal of Economic Perspectives*, vol. 34, no 3, pp. 99-127, highlight the high cost of job creation (which may exceed the benefits) as well as significant deadweight effects. Moreover, these studies insist on the importance of complementing these subsidies with training programmes for the local workforce in order to adapt the labour supply to the new employment opportunities. Finally, in practice, it is difficult to identify the territories that suffer most from globalization, since export opportunities, the threat of international competition, and the availability of lower-cost inputs play a role to different degrees in each territory.

⁵¹ Individuals are also eligible if the job loss is “indirectly” related to international competition, for example, if their company’s suppliers have downsized because of foreign competitors.

⁵² Hyman B. (2018): “Can Displaced Labor be Retrained? Evidence from Quasi-Random Assignment to Trade Adjustment Assistance”, *Mack Institute Research, Strategies from Innovating Working Paper*, 20 November.

⁵³ The budget increase for the EGF remains insufficient and the trigger level too high. See also Bénassy-Quéré and Giavazzi’s (2017) proposal to reform the EGF, which suggests redeploying funds from the European Social Fund (ESF) to the EGF. The ESF has a budget five hundred times larger than that of the EGF and allocates funds to each Member State according to predefined envelopes, an operation that does not favour intra-European solidarity in the face of shocks induced by globalization, cf. Bénassy-Quéré A. and F. Giavazzi (eds) (2017): *Europe’s Political Spring: Fixing the Eurozone and Beyond*, CEPR ebook, 31 May.



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Editor Hélène Paris

Electronic Publishing Christine Carl

Contact Press Christine Carl

Ph: +33(0)1 42 75 77 47
christine.carl@cae-eco.fr