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Reshoring and plant closures in Covid-19 times: Evidence from Italian MNEs☆

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ABSTRACT

This paper provides new evidence on the reorganization of global production exploiting a novel dataset of Italian multinational firms surveyed throughout 2020 and 2021 as well as consolidated data sources. We find that Covid-19 did not spur large waves of reshoring nor plant closures. Even though the pandemic caused severe losses to firms, including multinationals, most did not stop foreign production nor are willing to do so in the near future. Trade policy uncertainty, conversely, is more likely to induce reshoring and plant closures. This evidence is consistent with a simple multi-period model, illustrating how offshoring, on the one side, and reshoring, on the other side, are asymmetric in important ways. In the presence of sunk costs, reshoring requires sufficiently large and permanent shocks to demand, trade and foreign production costs to induce behavioral changes. Covid-19 was a major shock, but it was mostly perceived as temporary, while persistent trade policy uncertainty, especially if combined with other shocks, is more likely to induce firms to revise their internationalization strategies.

1. Introduction

Since the 1980s the world economy has become increasingly globalized. International trade grew faster than world output, reaching over 30 percent of world GDP in the first decade of 2000s (World Bank, 2020). During this period, the production process was reorganized along global value chains (GVCs) where different firms often located in different countries perform specialized segments of the production. Furthermore, multinational enterprises (MNEs) set plants abroad to exploit costs differentials and comparative advantages of foreign countries.

After the 2008 Great Financial Crisis the trade-to-GDP ratio has interrupted its three-decade long growth and stabilized at its pre-crisis level. Several factors, as the increase in emerging markets wages, the advent of new technologies (3D-printing and automation)

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and new trade policy tensions, coupled with an inevitable deceleration in the degree of fragmentation of the production process, contributed to the current phase of "*slowbalisation*".[1]

Despite global activities of MNEs and their production networks set up over the years continue to constitute a major contribution to the world economy, offshore production started to become less attractive than in the past, at least from a cost-saving perspective. Meanwhile, concerns regarding the risks of this organization of production started to emerge.[2]

Against this backdrop, the Covid-19 pandemic was a major shock hitting the world economy. The shock was sudden and unexpected, and it involved all countries and all firms from China to the US. GDP collapsed worldwide and firms' losses have been severe and generalized. Confinements, production halts and export bans added to the raising trade costs and caused bottlenecks and disruptions along the supply chains. With foreign shocks propagating to the domestic economy, international trade and production networks have been rapidly regarded as contributing to the shock transmission and aggravating the crisis.

As a result, the Covid-19 gave new emphasis to the discontent of globalization and fueled the discussion on the risks and instability associated with the international fragmentation of production. Among observers and policy makers, some have called for reshoring or at least for a rethinking of GVCs organization and of MNEs location choices, claiming that more localized production would lower uncertainty for consumers and businesses, and secure supply. Several governments introduced measures to encourage firms to source more inputs domestically or to diversify suppliers and to repatriate, or at least "nearshore", production. In April 2020, for instance, the Japanese government announced subsidies to encourage diversifying or reshoring supply chains. In January 2021, the U.S. President signed an executive order aimed at forcing the federal government to buy more goods produced domestically, as a key part of his *Buy American* programme to revive domestic manufacturing. More recently, a study by the European Parliament discussed the pros and cons of reshoring for the EU in the context of Covid-induced supply shortages.[3] However, despite these measures and the uncertain environment, no widespread reshoring seems to be happening.[4] The Global Value Chain Development Report (Adb et al., 2021, November) maintains that: "So far, there has been no generalized reshoring of production back to the US or Europe, nor would that likely be effective as a response to most of the risks that have emerged. GVCs are more likely to evolve than to shut down". Indeed, the Shanghai American Chamber of Commerce's China Business Report 2020, conducted between June and July, shows that 71% of more than 200 US companies surveyed have no plans to close their facilities in China.[5] Some 14% are relocating production, but not to the US. Only 3.7% reshored. A survey conducted by the Confederation of Swedish Enterprise gives similar results; only 2% of Swedish companies declared that they would bring home their foreign production.[6] In order to improve risk management, about 15% of Swedish companies will increase the share of sourcing from Sweden, while 13% of large companies will increase the number of countries from which they source production inputs. Despite finding evidence supporting a reconfiguration of global supply chains in the medium to long term, the Euler Hermes survey on MNEs based in the US, the UK, France, Germany and Italy found no support for massive reshoring, as only 15% of the firms is considering this strategy.[7] Along these lines, the European Round Table for Industry (2021) objects to the need of policy measures to incentivize reshoring/nearshoring by stressing the ability of companies to adapt autonomously to new global scenarios.

At the time of writing, while the debate on de-globalization and reshoring is mounting in the media as well as among policy makers and scholars, the evidence is still scant and mostly anecdotal. This lack of information calls for academic research on the topic to offer support to an informed debate.

This paper is a step in this direction. First, we exploit original representative firm-level data to provide new empirical evidence on internationalization strategies of Italian MNEs in the most recent years and in the aftermath of the Covid-19 pandemic. Second, we rationalize our empirical findings with a theoretical framework that highlights the possible mechanisms behind the observed patterns and we compute possible responses to different shocks.

Our contribution is twofold. This study is one of the first to provide an econometric assessment of the impact of the Covid-19 shock on MNEs and on the possible reduction of their international exposure.[8] More specifically, we inform the debate on de-globalization and reshoring by providing new evidence that goes beyond case studies and by investigating empirically the possible determinants of closures of foreign production facilities. Furthermore, we propose a multi-period theoretical model to interpret and shed light on our empirical findings and on the possible mechanisms at work. Therefore, we also contribute more in general to the literature on the decision making process of MNEs by stressing the conditions under which they may choose to reduce their degree of internationalization.

We find no evidence of widespread reshoring among Italian MNEs nor of other major changes in their internationalization strategies in the aftermath of Covid-19. Moreover, we find that MNEs have proven more resilient and have been less affected by the

[1] The term slowbalisation (i.e. slow globalization) has been used in Antràs (2020) and *Slowbalisation: The steam has gone out of globalisation*, The Economist, January, 24th 2019: 34-43.

[2] Such as increase of energy and transport costs, delays, interruptions of supply chains etc.

[3] "Post Covid-19 value chains: options for reshoring production back to Europe in a globalized economy". European Parliament, Policy Department, Directorate-General for External Policies, March 2021. ISBN 978-92-846-7831-0. DOI 10.2861/118324.

[4] "Coronavirus-induced 'reshoring' is not happening", Alan Beattie, Financial Times, September 30, 2020; "Is a wave of supply-chain reshoring around the corner?", Free Exchange, The Economist, December 16, 2020; "North America will not see significant supply chain reshoring in 2021-25", The Economist Intelligence Unit, June 16, 2021.

[5] AmChamShanghai's2020ChinaBusinessReport.

[6] SvensktNaringslivSurvey.

[7] EulerHermesGlobalSupplyChainSurvey.

[8] Todo et al. (2021) in a paper similar to our, use a Covid-19 survey for firms in ASEAN and India and analyze the resilience and robustness of supply chain linkages. Our work, which is on Italy, one of the most severely hit countries in the West, adds to theirs by focusing on the ownership network of the firm.

Covid-19 shock than their domestic counterparts. Among MNEs, those with a more diversified network of foreign plants performed even better than average MNEs. Furthermore, new data on planned actions for 2022–2023 complement our findings by providing evidence on how firms are adapting after two years into the pandemic and in the context of increasing geopolitical tensions. We find that some firms might increase their reliance on domestic suppliers, but mass foreign plant closures and reshoring are not in sight. Other (planned) strategies to increase resilience, such as expanding the number of suppliers for a given input or inventories, are more frequent in the data. These strategies are more flexible and less costly than shutting down foreign plants and repatriate the offshored activities. Thus, some reconfiguration seems underway, but the long-run impact on globalization is uncertain and may take time to materialize. We rationalize these facts with a theoretical model highlighting that MNEs' internationalization strategies may display hysteresis due to the presence of sunk costs. Moreover, its multi-period setting shows how MNEs are sensitive to the type of shock and not just to its size. Specifically, temporary shocks may not induce MNEs to close or relocate their foreign production sites, while (perceived) long-lasting or permanent uncertainty usually does.

The rest of the paper is organized as follows: in Section 2 we briefly review the related literature; in Sections Section 3 we present the empirical evidence; in Section 4 we introduce the theoretical model and discuss simulations for different types of shocks; we also present a simple two-period version to give a graphical intuition of how the mechanisms work. The last section concludes discussing policy implications.

2. Related literature

For a long time the attention of scholars has mainly focused on the causes and consequences of the growing globalization that characterized the decades prior to the Great Financial Crisis (among others: Bernard and Jensen, 1999; Melitz, 2003; Helpman et al., 2004; Castellani and Zanfei, 2007; De Loecker, 2007; Topalova and Khandelwal, 2011; Halpern et al., 2015).

With the world entering into a phase of slowbalisation, concerns about the possible negative consequences of an excessive or not well-managed globalization, e.g. on income inequality and on the environment among many, became more pressing. Meanwhile, in the last few years, the study of globalization risks and of the factors behind the decision of MNEs to reduce or reorganize their international activities has gained importance.

The recent literature has investigated how MNEs transmit foreign shocks through their business network of foreign affiliates (Bena et al., 2021) and domestic partners (Huneeus, 2018; Dhyne et al., 2021; Fontagnè and Santoni, 2022), and, as a consequence, how globalization correlates countries' business cycles movements (Di Giovanni and Levchenko, 2010; Kleinert et al., 2015; Di Giovanni et al., 2018) and exposes to the effects of natural disasters occurring in some countries (Barrot and Sauvagnat, 2016; Boehm et al., 2019; Carvalho et al., 2021).

The Covid-19 pandemic has induced a surge in these studies.[9] Recent articles addressed the issue of the consequences of the Covid-19 (exogenous) shock, showing how pervasive lockdown measures, supply chains disruptions and the sudden fall in the demand have hurt firms worldwide, especially small and medium enterprises (Bartik et al., 2020; Fairlie, 2020). Moreover, the unprecedented nature of the shock has further increased the level of uncertainty that was already high because of the US–China trade war and a weak World Trade Organization (WTO) (Buchheim et al., 2020; Baker et al., 2020; Hassan et al., 2020).

A rapidly growing literature has focused on the role of internationalization for shock transmission, investigating to what extent more globally integrated countries have been impacted by the Covid-19 crisis (Sforza and Steininger, 2020; Bonadio et al., 2021; Eppinger et al., 2021; Giglioli et al., 2021) as well as whether internationalized firms have proven more or less resilient (Brancati and Brancati, 2020; Giovannetti et al., 2020; Borino et al., 2021).

Related studies analyze the possible impact on the future of globalization and discuss how factors, such as new economic and geopolitical equilibria, automation, trade policy uncertainty and excessive sectoral concentration might interact with the shock to change MNEs' internationalization strategies (Antràs, 2020; Javorcik, 2020; Miroudot, 2020; Di Stefano, 2021).

This literature constitutes an extremely valuable contribution to shed light on this complex topic, because it discusses several factors that contribute to shape the future of globalization. Nonetheless, uncertainty about future developments is still high, both because the theoretical approaches differ and because there is a lack of systematic evidence on the reaction of MNEs to the new context.

Moreover, the existing theoretical tools and empirical evidence hardly capture the complexity of the current situation, and offer only a limited description of the mechanisms at play. During the globalization decades, the main phenomenon of interest in the international economics literature was indeed the *expansion* of economic activity abroad. However, some authors highlighted the existence of crucial asymmetries between internationalization and de-internationalization emphasizing that the latter is not simply the reversal of the former. In a seminal contribution Dixit (1989) and Dixit and Pindyck (1994) highlight that the presence of sunk costs, in addition to the uncertainty that characterizes foreign markets, increases the stickiness of past decisions, making internationalization difficult to reverse. They find asymmetry between foreign market entry and exit. A firm starts exporting once it achieves a certain threshold of productivity, but it may keep exporting even after efficiency has fallen below the initial entry level. There is a region where "history matters" and results depend on the past history of the firm. It does not enter a market because the thresholds are too high, but if it is "in" it does not exit since it has paid the sunk costs. Impullitti et al. (2013) analyze

[9] At the time of writing, a simple search for the keyword 'Covid-19' in IDEAS/RePEc (one of the main bibliographic repository of Research Papers in Economics) produced more than 22,000 results. For a review see Brodeur et al. (2021), Baldwin and Evenett (2020), Baldwin and Di Mauro (2020), Gans (2020).

this issue focusing on exporters. More recently, Antràs (2020) discussed the hysteresis and the stickiness of offshoring decisions. When setting up production facilities abroad, firms need to invest in physical assets, gather information, define new contracts in a different legal environment, get used to bureaucratic procedures and incur in several other up-front set-up operations. Moreover, the relation-specific investments in product customization, needed to align the incentives and avoid contract enforcement issues when integrating a commercial partner, hardly have an outside value. Therefore plant closures and reshoring imply large additional costs.

With a different approach, more oriented towards understanding the multidimensional nature of firms' governance and strategies, international business scholars have also studied MNEs' reduction of internationalization[10] (for a review: Arte and Larimo, 2019; Schmid and Morschett, 2020). In this case the reference is the real option theory. Damaraju et al. (2015), in line with Dixit and Pindyck (1994) and Antràs (2020), maintain that, when uncertainty in the business environment is high and pervasive, as in the current pandemic, firms are reluctant to divest and prefer to *wait and see*. As pointed out by Conconi et al. (2016), when internationalization choices are only partially irreversible, uncertainty will increase the option value of waiting until more information is available. This is due to asymmetries between the real option of divestment and investment as well as to the fact that MNEs, beside incurring sunk costs from exiting a market, may also damage their reputation (Ozkan, 2020). Moreover, as pointed out by Chung et al. (2013), this effect is even more pronounced for large MNEs with dispersed international operations. These firms are less likely to divest their subsidiaries as they can adjust their activities across different subsidiary locations.

A specific strand of this literature has also investigated the exit from foreign markets when firms face unexpected exogenous shocks (Liu and Li, 2020; Oh and Oetzel, 2011, 2017; Dai et al., 2013, 2017). However, these studies mainly focus on country specific shocks such as conflicts, terrorist attacks or natural disasters. In terms of the firm's decision making process, this consists in deciding whether to exit an uncertain market to relocate in a *less* uncertain one, a situation different from to the current one, since the Covid-19 is a worldwide and not an idiosyncratic shock.

The insights from these different strands of the literature highlight some crucial mechanisms that can help explaining the complexity of the current crisis. This paper provides novel empirical evidence on MNEs reaction to the shock and builds on both the business and economic literature to provide a comprehensive theoretical framework to explain and rationalize the observed patterns.

3. New evidence from Italian firms

3.1. Data

In this section, we provide new evidence for Italian MNEs. Our primary data source is the Survey of Industrial and Service Firms. The survey provides original firm-level data, collected by the Bank of Italy in spring 2021, which gathers *quantitative* information on investments, gross sales, workforce and other economic variables from a representative sample of around 5,000 Italian industrial and service firms with 20 or more employees.[11] We combine this sample with *qualitative* information coming from the Business Outlook Survey of Industrial and Service Firms, covering approximately 3,000 industrial firms and 1,000 non-financial private service firms.[12]

Our data is representative of the Italian economy. The sample description reproduces the main findings from the literature on firms internationalization and MNEs. In line with what is usually observed in normal times, in 2020 (one year into the pandemic) MNEs recorded on average about twice the revenues of non-MNEs and employed more workers (around +80%). They were also more productive (about +20%) and more involved in exporting activities (49% vs. 18% of revenues from exports) compared to non-MNEs (see the summary statistics reported in Table A.1 in the Appendix).[13] This evidence is fully consistent with the existing literature (Castellani and Zanfei, 2007; Castellani et al., 2017; Borin and Mancini, 2016).

In what follows, in order to investigate different aspects and mechanisms, we match our dataset with information from other sources. More specifically, in the second part of Section 3.3, we merge the original data with information on MNEs' foreign plant location, which is available for a sub-sample of our surveyed firms (around 60% of the MNEs in our full sample)[14] to shed light on the possible mechanisms modulating the effect of Covid-19 on MNEs' economic performance, focusing on the geographical diversification of foreign plants. In the last part of Section 3.4, we exploit a Bank of Italy survey collected in spring 2022 to provide novel evidence on how firms' behavior adapts over time and to disentangle the most recent firm-level plans in terms of internationalization strategies for 2022 and 2023.

[10] Scholars have used different terms to describe exit from foreign markets: deinternationalization, divestment, withdrawal, failure, closure, disengagement, liquidation, total sales, and sell-off.

[11] See https://www.bancaditalia.it/pubblicazioni/indagine-imprese/index.html for further detail.

[12] See https://www.bancaditalia.it/pubblicazioni/sondaggio-imprese/index.html for further details.

[13] Based on the survey information, MNEs are defined as firms stably operating in foreign markets, not having closed foreign plants over the last three years. Results presented in the paper are robust to alternative definitions.

[14] The information on locations refer to 2014, and is taken from the Reprint database merged with the Bank of Italy Survey (see Borin and Mancini, 2016). The number of countries reached through foreign investments by each Italian MNE has been very stable across time. Our variable on the number of countries in which the MNEs have foreign plants ($\#of locations$) has a correlation of 93.5% between 2014 and 2010. Therefore we consider the 2014 data a good proxy of the foreign countries in which Italian MNEs have foreign plants.

3.2. How widespread is reshoring?

The debate on deglobalization and reshoring is still open. A crucial question that needs to be empirically answered is: *Did Covid-19 cause closures of foreign plants and did it induce MNEs to reshore production? Should we expect to see these phenomena in the near future?*

Let us concentrate on the effects of the Covid-19 outbreak on internationalization choices. The main stylized fact that we single out is that *among Italian MNEs foreign plant closures have been rare and firms are generally not considering closing plants abroad. Similarly, reshoring was only chosen by a minority of MNEs and not generally regarded as a viable option*.

As shown in Fig. 1, more than 85% of the Italian MNEs did not close any plant abroad between 2018 and 2020, and, even more importantly, are not considering to shut down in the near future, despite the pandemic.[15] Only 2.6% have reshored their production and less than 2% have moved production to other sites (not necessarily nearer). Therefore, survey data suggest that in the last three years the number of plant closures has been modest and that the pandemic has not dramatically changed MNEs' internationalization plans. New evidence on firms' *planned* actions for 2022–2023 from the Survey of Industrial and Service Firms conducted in spring 2022 by the Bank of Italy confirms that mass reshoring is not in sight.[16] The share of firms that is willing to close plants abroad is modest (around 2% of respondents). Other strategies to increase resilience are much more frequent. About 60% of firms plans to diversify their suppliers and around half of the total is considering to increase the optimal level of inventories for inputs and finished products.

To provide a perspective on reshoring trends and to further validate our data, we compared several sources. We are aware of the comparability and coverage limitations. Still, we are confident that the available evidence is largely aligned with ours, and that reshoring was not generally on the rise in the immediate aftermath of Covid-19. Looking at MNEs from seven European countries (excluding Italy), between 2013 and mid-2015, Dachs et al. (2019) find that pure reshoring (backshoring) from own subsidiaries regarded 2.6% of firms, while another 1.7% of firms switched from foreign to domestic suppliers. These numbers are aligned with what we observe for Italy in 2018–2020 (Fig. 1). Moreover, there seems to be no generalized upward trend in reshoring in the decade before the pandemic, at least from China; on the contrary, according to the European Union Chamber of Commerce and Business, the share of European firms that were considering shifting current and planned investments in China to other markets decreased from 22% in 2012, to 15% in 2015, and to 11% at the beginning of 2020; similarly, according to the US–China Business Council, in 2020, 87% percent of US multinationals did not relocate out of China recently nor were planning to do so, while only 4% planned to move operations back to the United States (Brenton et al., 2022). As for Italy, ISTAT (2022) reports that, both in 2020 and 2021, 84% of Italian MNEs did not change the location of foreign production facilities, confirming that even two years after the start of the pandemic, reshoring, while not negligible, is only chosen by a minority of MNEs. These figures are comparable to ours as we find that 85.3% of Italian MNEs did not close foreign production facilities. Lastly, it is worth noting that currently available data (including ours) only cover one or two years into the pandemic, thus capturing the short-to-medium term effects of the crisis. Fig. 1 also shows that a 7.8% of firms were in fact considering closing foreign production facilities in the next year. Therefore, we do not exclude that changes in the international strategies of firms may take more time to materialize, and we remain open to the possibility of future reshoring, also in response to the recent geopolitical shocks that hit the world economy. The theoretical framework we propose is consistent with this possibility.

All this evidence broadly supports the view that the "pandemic did not deliver the big permanent shock to global value chains that many had feared" (Financial Times, 29 July 2021), and is in line with recent international evidence discussed above. Overall, our results support the view that Covid-19 could accelerate already existing trends of supply chains rationalization (Antràs, 2020; Bacchetta et al., 2021; UNCTAD, 2020), but will not end globalization.[17]

The above stylized fact may come as a surprise to some, considering that the integration into foreign markets has been recently seen as linked to shock transmission and higher vulnerability. Why did Covid-19 not induce the mass foreign plant closures and reshoring that many observers had feared after the pandemic outbreak? We try to answer this question laying down a conceptual framework and some hypotheses, and checking whether the evidence is consistent with them.

A first explanation may be that MNEs have not swiftly changed their international exposure after the Covid-19 outbreak because they have coped better with the shock compared to other firms, and even better than their own expectations formulated right after the outbreak, in February and March 2020. In Section 3.3 we exploit the richness of our firm-level dataset and find supportive evidence for this hypothesis.

Another possibility, which complements the previous one, is that the pandemic was not a type of shock likely to trigger a deep reorganization of MNEs' international activity. The Covid-19 pandemic, despite causing dramatic disruptions, might indeed have been perceived as transitory. Since setting up plants abroad or closing them and reshoring are costly strategic decisions, they are more likely to respond to structural and medium-to-long-run shocks, rather than to transitory ones. This, of course, leads to another

[15] The question asked to companies in the Bank of Italy Business Outlook Survey of Industrial and Service Firms in fall 2020 was "Has your firm closed one or more production facilities abroad over the last three years?". The survey question refers to owned subsidiaries, and reshoring refers to pure reshoring, i.e. backshoring. A general definition of reshoring may encompass several forms of reorganization of international production including backshoring (moving production back home), nearshoring (moving it to closer locations) and farshoring (moving it to farer locations); moreover, reshoring may also be referred to owned subsidiaries or to contracting suppliers.

[16] Our baseline results in Section 3.4 will focus on actual plant closures instead of self-declared *planned* strategies, as the available evidence suggest that often latter strategies are not consistent with the former (see Lund et al. (2020)). Nevertheless, we extend the analysis also to planned future actions to increase resilience in Table 3.4.

[17] See also the McKinsey's report by Lund et al. (2020) on this point.

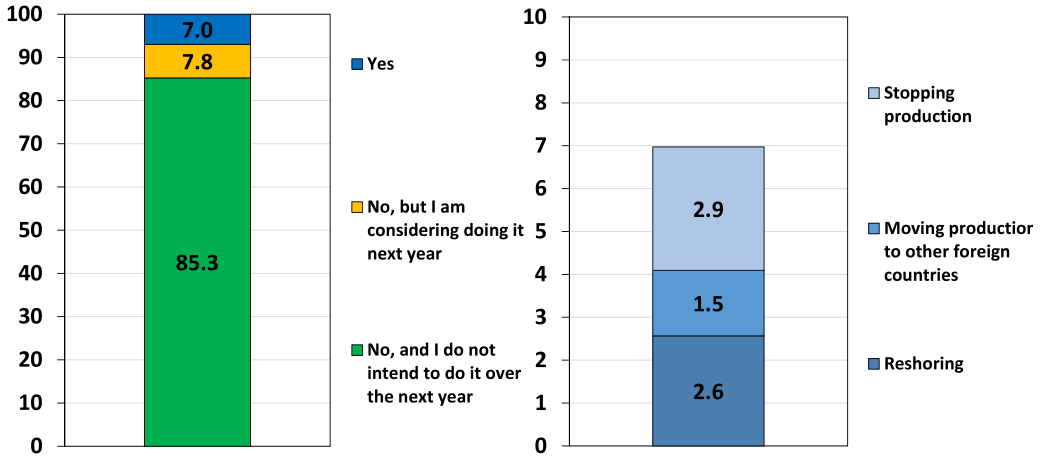


Fig. 1. MNEs and plant closures. *Has your company closed one or more production facilities abroad in the last three years?* *Source:* Own elaboration based on Bank of Italy survey data.

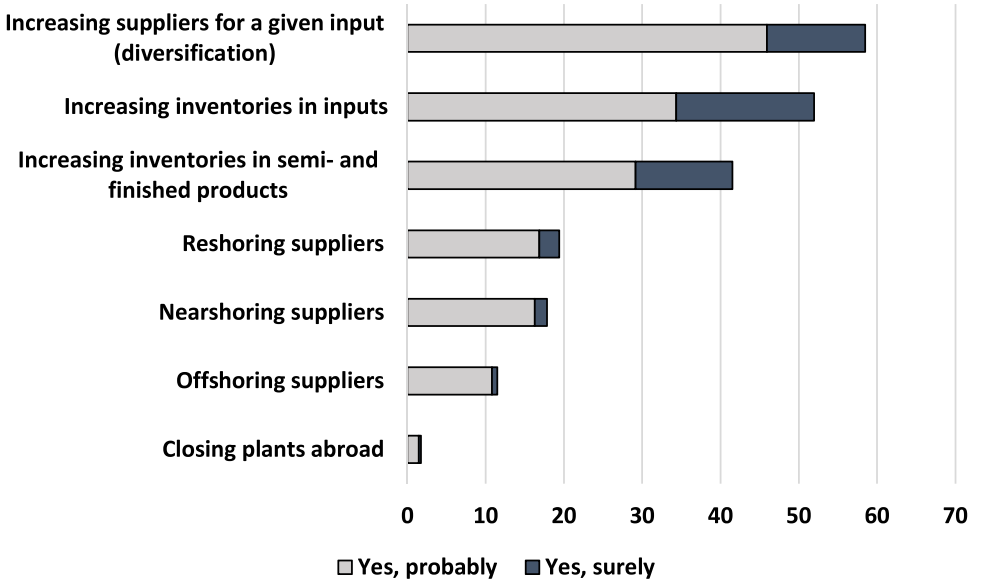


Fig. 2. Planned strategies to increase resilience. *Has your company planned to implement the following strategies over 2022–2023?* *Source:* Own elaboration based on Bank of Italy survey data.

question: *If Covid-19 did not cause reshoring, what are the other factors that induced some (few) MNEs to close plants or reshore?* In Section 3.4, we show that, while proxies of the Covid-19 shock did not significantly increase the firms' probability to close plants abroad, trade policy factors related to Brexit and the US–China trade war in 2018 and 2019 did.

In a nutshell, our empirical results suggest two things: first, MNEs managed to face Covid-19 relatively better than their domestic counterparts and, although they might adapt their internationalization patterns, they do not necessarily need to undo them; second, due to the presence of high (sunk) costs to open foreign plants, the actual or expected persistence of the shock is key to determine the pattern of internationalization strategies. The Covid-19 shock is likely not to have triggered mass foreign plant closures because it was (perceived as) largely transitory, while other shocks (e.g. Brexit and the US trade policy) were deemed as permanent or long-lasting.

3.3. Did MNEs manage to cope better with Covid-19?

We now check whether, during the Covid-19 pandemic, MNEs present systematically different performance with respect to other firms, after controlling for several characteristics. To this aim, we estimate the following linear regression model:

$$Y_i = \alpha + \beta MNE + \gamma ImpExp + Z_i'\Gamma + \varepsilon_i \quad (1)$$

where we regress different proxies of firm's performance on the firm's internationalization status – a dummy taking value 1 if the firm has plants abroad (MNE) or is a two way trader with no plants abroad ($ImpExp$). We use the following proxies for firm's performances (Y): the growth in revenues between 2020 and 2019 ($dRev2020$); a dummy taking value 1 if the firm has reported a drop in revenues higher than 30% over the entire 2020 ($DropRev2020$) or in the first three quarters of the year ($DropRevQ1Q3$); the growth in revenues coming from selling in foreign markets ($dRev2020_F$); the percentage change in the share of employees in remote working in 2020 with respect to 2019 ($dSmartWork$), the difference between the realized growth in revenues in 2020 and the expected growth formulated right after the Covid-19 outbreak ($dRev2020 - E(dRev2020)$); a dummy taking value 1 if the firm has faced supply shortages ($SupplyProbl$) and a dummy taking value 1 if the firm has faced severe supply shortages that led to plant shutdowns ($SupplyProdStop$).[18]

The coefficients β and γ measure the difference in performance in 2020 with respect to simple exporters and domestic firms, i.e. the reference category in the regression. To reduce confounding factors we add additional firms' characteristic as covariates (in matrix Z), namely: firms' age, employment and labor productivity in 2019, NUTS3 province and NACE 3-digit sector fixed effects. We also include a dummy taking value 1 if the firm stopped the production in 2020 due to shutdowns mandated by national or local decrees ($GovStop$). In this way the estimates of β and γ reflect the effect on performance of the degree of international involvement of the firm, for a given size, productivity, province, sector, and exogenous production halts.

In Table 3.1, we report regressions results. MNEs were able to cope better with the Covid-19 crisis with respect to two-way traders and non-MNEs of similar age, size, previous performance, exogenous shutdowns, sector and province. They experienced higher revenues growth in 2020 (column 1) and the share of these firms reporting sizeable (larger than 30%) contractions in revenues has been lower, both in the entire 2020 and in the first three quarters of 2020 (column 2 and 3). MNEs outperformed two way traders and exporters especially on sales in foreign markets, compared to exporting-only firms (column 4). MNEs and two-way traders increased remote working more than other firms (column 5). The difference between realized sales in 2020 and the expected sales for 2020 reported right after the Covid-19 outbreak was much higher for MNEs with respect to the rest of the firms (column 6). In other words, they over-performed their own expectations, compared to other firms. Finally, MNEs and two-way traders – which are likely to participate in GVCs – are more likely to have faced supply disruptions (column 7). This is not surprising as these firms are more directly exposed to supply chain disruptions, especially against systemic shocks, as in the case of Covid-19. The positive and significant coefficient for productivity is coherent with this interpretation. In column 8, we show that supply shortages that have stopped production were more frequent among MNEs and two-way traders, suggesting that they are indeed more exposed to foreign shocks. Moreover, larger firms have a lower probability to stop production due to these shortages. Overall, despite the fact that international interconnectedness and GVCs may transmit shocks (Brancati and Brancati, 2020; Borino et al., 2021), this evidence supports the hypothesis that MNEs have proven more resilient to the shock and could offer some insights on the modest entity of foreign plant closures. This is consistent with the evidence of larger losses for small and medium enterprises (Bartik et al., 2020; Fairlie, 2020).

A possible mechanism explaining this pattern may be related to the fact that MNEs with a more diversified presence in foreign countries could hedge against the Covid-19 disruptions. Diversification may have benefited MNEs by allowing them to mitigate risks through a network of suppliers and buyers located in different countries possibly not simultaneously hit by a shock. Thanks to the different timing and intensities of Covid-19 cases and of government restrictions, MNEs with a disperse network of locations may have had better opportunities to look for alternative suppliers and buyers, and to balance out specific idiosyncratic shocks. Moreover, a diversified ownership network may help MNEs to shift physical and financial resources between different entities within the group, thus providing an additional source of resilience.

We test this mechanism in Table 3.2. We run a separate regression on the sub-sample of firms for which we observe plant locations to test whether performance in 2020 has been affected by the cross-country diversification of the international portfolio and by the average exposure to Covid-19 in foreign locations. The former is proxied by the number of countries in which the MNE has foreign plants ($\#oflocations$); the latter by the average number of Covid-19 cases in the foreign locations in which the firm operates ($CovidCases$). We further control for the average real GDP across foreign locations ($log(GDP)$) and for firm-level characteristics in the domestic market (Z_i), i.e. productivity, age, change in domestic revenues in 2020 and production halts due to government decisions. We estimate:

$$dRev2020_i = \beta_0 + \beta_1 \#oflocations + \beta_2 log(GDP) + \beta_3 CovidCases + Z_i\Gamma + u_i \quad (2)$$

We find that diversification of international portfolio matters and is a relevant channel to predict the overall change in revenues in 2020 (column 1). In addition, we do not find any association between diversification and changes in domestic revenues (column 2), while revenues coming from foreign markets are positively affected (columns 3 and 4).[19] Not surprisingly, we also find that a higher exposure to Covid-19 in foreign markets reduces revenues. These results hold even when controlling not only for firm specific characteristics, but also for the growth in revenues coming from the domestic market (columns 4). Overall, this evidence is in line with the literature showing that through diversification of supply and demand sources the overall exposure to risks might be reduced (Bonadio et al., 2021; Borin et al., 2021; Caselli et al., 2020; Espitia et al., 2022; Todo et al., 2021).

[18] Data have been winsorized at the 5% and 95% level of the sectoral distribution. Results are consistent with the non-winsorized sample and are available upon request.

[19] This result is somehow expected as diversification may compensate shocks across multiple destination markets while it cannot prevent a demand shock in a given specific location, e.g. the domestic market. Moreover, in the case of domestic sales, part of the effect is likely absorbed by the other controls as firm's productivity and the fixed effects.

Table 3.1
MNEs performance in 2020.

	(1) dRev2020	(2) DropRev2020	(3) DropRevQ1Q3	(4) $dRev2020_F$
MNEs	2.050*	−0.063**	−0.105***	7.515***
	(1.80)	(−2.49)	(−2.64)	(3.24)
Two-way traders	−0.863	0.002	−0.009	1.672
	(−0.99)	(0.09)	(−0.29)	(0.98)
GovStop	−0.856	−0.002	0.045	−2.893
	(−0.82)	(−0.06)	(1.21)	(−1.45)
Age	−1.269**	0.016	0.009	−0.798
	(−2.00)	(1.02)	(0.41)	(−0.59)
$log(labprod)_{2019}$	0.566	−0.001	−0.047**	−2.817
	(0.75)	(−0.04)	(−2.00)	(−1.60)
$log(emp)_{2019}$	0.128	−0.005	0.008	−0.543
	(0.29)	(−0.56)	(0.51)	(−0.75)
Observations	2045	2045	2076	1666
NUTS3 FE	Y	Y	Y	Y
3-digit Sector FE	Y	Y	Y	Y
	(5) dSmartWork	(6) dRev2020-E(dRev2020)	(7) SupplyProbl	(8) SupplyProdStop
MNEs	3.937***	4.961**	0.106***	0.067**
	(3.15)	(2.14)	(2.90)	(2.01)
Two-way traders	2.489***	0.609	0.062*	0.047*
	(3.50)	(0.32)	(1.98)	(1.76)
GovStop	−1.343	0.882	−0.015	0.001
	(−1.27)	(0.36)	(−0.51)	(0.03)
Age	−0.324	−0.030	−0.032	−0.029
	(−0.41)	(−0.02)	(−1.14)	(−1.50)
$log(labprod)_{2019}$	4.167***	−0.608	0.046**	0.007
	(4.59)	(−0.40)	(2.03)	(0.37)
$log(emp)_{2019}$	3.518***	−0.628	−0.023	−0.024**
	(8.09)	(−0.74)	(−1.62)	(−2.19)
Observations	1973	941	1889	1889
NUTS3 FE	Y	Y	Y	Y
3-digit Sector FE	Y	Y	Y	Y

Note: Standard errors clustered at the 3-digit sector level. Sample weights are used in the regressions. *t*-statistics in parentheses. *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

3.4. Which factors contribute to closures and reshoring?

Given the evidence of MNEs' resilience during the pandemic, we investigate the role played by Covid-19 in determining the (few) cases of reshoring. We also scrutinize other possible factors playing a role. Indeed, despite its strength, Covid-19 is only one of several factors that are likely to affect globalization. Other relevant shocks, such as Brexit and the US–China trade war (not to mention the more recent war in Ukraine) were major challenges for the stability of the international production network. We now focus on the impact of different types of shock on firm's decision. Our analysis suggests that the distinction between temporary and permanent shocks (and their perception in the presence of uncertainty) plays a crucial role in determining firms' responses.[20] Trade policy changes typically have long-lasting effects as, once they occur, they are usually in place for several years. Crowley et al. (2018) find that anticipated permanent shocks (or perceived so), such as "tariff scares", reduce trade even if they never actually materialize. While trade policy shocks can often be regarded as permanent, the nature of the Covid-19 shock was initially unclear. The findings of Lafrogne-Joussier et al. (2022) suggests that the shock has been largely perceived as temporary by French firms, at least in the early months of the pandemic. Moreover. The perception of Covid-19 evolved during the pandemic. US and UK firms (Bunn et al., 2021) as well as Italian ones (Fiori and Scoccianti, 2021) perceived more downside risk in the early phases, but by 2021 the upside risk started to dominate with firms more concerned about demand spikes rather than sale reductions.

[20] Even before Covid-19, uncertainty was already historically high: the World Uncertainty Index (WUI) increased by 100% between 2008 and the 2012. It further increased by another 50 percentage points with Brexit and the US–China trade war (Ahir et al., 2022). A scenario of general increased uncertainty negatively impacts investments as firm may postpone them or revise their plans (Constantinescu et al., 2020). This also regards trade policy uncertainty as, according to Caldara et al. (2020), US investment reduced by about 1.5% in 2018. Similarly, Benguria et al. (2022) find that increased trade policy uncertainty due to the trade war led Chinese firms to reduce investment and R&D expenditures, and to make lower profits.

Table 3.2
MNEs diversification and performance.

	(1) dRev2020	(2) $dRev2020_D$	(3)	(4) $dRev2020_F$
# of locations	0.14*	−0.42	0.20*	0.22***
	(1.77)	(−1.08)	(1.87)	(2.83)
log(GDP)	0.99	−0.29	2.94**	1.17*
	(1.18)	(−0.14)	(2.07)	(1.66)
CovidCases	−1.43	1.54	−3.00*	−1.63**
	(−1.60)	(0.74)	(−1.85)	(−2.10)
GovStop	−2.17	1.91	1.17	−2.29
	(−0.83)	(0.33)	(0.27)	(−0.97)
$dRev2020_D$				0.19***
				(4.16)
Age	−3.89**	−2.82	−5.36**	−3.38**
	(−2.30)	(−0.74)	(−2.14)	(−2.25)
$log(labprod)_{2019}$	−0.15	9.49*	−1.17	−2.01
	(−0.10)	(1.97)	(−0.42)	(−1.44)
Observations	206	205	203	202
Sector	Y	Y	Y	Y
NUTS2 Region	Y	Y	Y	Y

Note: Robust standard errors. Sample weights are used in the regressions. *t*-statistics in parentheses. *: p < 0.1; **: p < 0.05; ***: p < 0.01.

To shed some light on the role of different types of shock, we explore to what extent the closure of foreign plants is associated with them. To this end, we estimate the probability that MNEs closed one or more plants abroad between 2018 and 2020 with the following Probit model:

$$Pr(Close_{i,18-20} = 1) = \Phi(\beta_0 + \beta_1 TradePolicy_i + \beta_2 CovidShock_i + Z_i\Gamma + u_i) \quad (3)$$

We include in the regression two variables for trade policy ($TradePolicy_i$). The first is $USTariffs$, a dummy taking value 1 if the MNE reports that the US 2018–2019 tariffs have negatively affected its sales, and the second is $Brexit$, a dummy taking value 1 if, before the deal with the EU, the MNE feared the introduction of tariffs after Brexit.[21] As proxies for the Covid-19 shock, $CovidShock_i$, we include a variable measuring whether production has been shut down (exogenously to the firm) by local or general government decrees ($GovStop$), or Covid-19 related supply disruptions ($SupplyProbl$). Finally, with Z_i, we include as additional controls the change in revenues in 2020 (with the variables defined in Section 3.3, i.e. $dRev_{2020}$ and $DropRev2020$) and lagged proxies of firm performance and size, i.e. average labor productivity ($log(labprod)_{15-17}$), employment ($log(emp)_{15-17}$) and percentage change in revenues ($dRev_{15-17}$), measured between 2015 and 2017, i.e. before the actual plant closure, as well as firms' age (Age). We also include regional and sectoral fixed effects controlling for possible omitted variables.

Table 3.3 reports the marginal effects on the probability of closing foreign plants. Despite the low number of observations – given by the specific nature of the phenomenon in analysis – results are stable across different specifications and significant. We find evidence that MNEs may react differently to different types of shocks.

In the baseline specification in column 1 we find that protectionist trade policies, here proxied by US tariffs that have directly or indirectly harmed Italian MNEs, are associated with a higher probability of having closed plants abroad (9.8 p.p.). Instead, plants shutdowns determined by the Covid-19 outbreak, *GovStop*, are not significantly associated with a higher propensity to close foreign plants. As expected, more productive firms are less likely to close foreign plants, as a 1% increase in labor productivity is associated with a reduction of −0.61 p.p. in the estimated probability. In addition, a 1 p.p. increase in revenues growth between 2015 and 2017 (in 2020) is associated with a drop of −0.6 p.p. (−0.3 p.p.) in the probability of plant closures.

In column 2 we check whether supply disruptions due to Covid-19 increased the propensity to close foreign plants, and find no statistically significant effects. In column 3 we find a very strong and positive association between having suffered severe revenues losses in 2020 and having closed foreign plants, while the effect of plant shutdowns imposed by the government or supply disruptions remains not statistically different from zero. This suggests that the shock on revenues, although temporary, led to plant closures when it was particularly large. In column 4 to 6 we include another proxy of trade protectionism, i.e. the potential negative effect of Brexit. The estimated marginal effect is significant and very close to the one obtained for US trade policy, between 8.6 and 8.4 p.p. across different specifications. This suggests that protectionist policies that have negatively affected firm performance ($USTariffs$) or are expected to have a negative impact ($Brexit$) might induce substantial changes in firms' location/exit choices. In addition,

[21] The question asked to companies was "How worried is your firm about the introduction of tariff and non-tariff barriers to trade in goods and services between the European Union and the United Kingdom due to Brexit?"

Table 3.3
Determinants of plant closure.

	(1)	(2)	(3)	(4)	(5)	(6)
			$Prob(Close_{i,18-20}=1)$			
UStariffs	0.098**	0.122***	0.116***	0.102***	0.076**	0.076**
	(2.35)	(3.06)	(2.90)	(2.74)	(2.12)	(2.12)
Brexit				0.086***	0.085**	0.084**
				(2.61)	(2.57)	(2.50)
GovStop	0.030	0.048	0.040	0.026	0.027	0.029
	(0.76)	(1.24)	(1.11)	(0.69)	(0.72)	(0.77)
SupplyProbl		−0.038	−0.047	−0.050	−0.043	
		(−1.11)	(−1.32)	(−1.48)	(−1.21)	
SupplyProdStop						−0.001
						(−0.22)
$dRev_{2020}$	−0.003**	−0.002*				
	(−2.41)	(−1.86)				
$DropRev_{2020}$			0.132***	0.145***	0.128***	0.126***
			(2.95)	(3.25)	(2.82)	(2.80)
$dRev_{15-17}$	−0.006**	−0.006**	−0.006**	−0.005***	−0.004*	−0.004*
	(−2.21)	(−2.41)	(−2.44)	(−2.62)	(−1.82)	(−1.79)
Age	−0.084***	−0.103***	−0.101***	−0.076***	−0.058**	−0.052*
	(−2.64)	(−3.23)	(−3.21)	(−2.67)	(−1.97)	(−1.69)
$log(labprod)_{15-17}$	−0.061**	−0.062**	−0.055**	−0.054**	−0.054**	−0.051**
	(−2.14)	(−2.35)	(−2.36)	(−2.31)	(−2.34)	(−2.11)
$log(emp)_{15-17}$	0.010	0.008	0.007	0.007	0.008	0.009
	(0.95)	(0.84)	(0.75)	(0.78)	(0.81)	(0.88)
Observations	265	244	244	244	234	234
Sector-NUTS1 Region	Y	Y	Y	Y		
Sector					Y	Y
NUTS2 Region					Y	Y

Notes: The table reports marginal effects. Robust standard errors. *t*-statistics in parentheses. *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

columns 5 and 6 show that our results are robust to the inclusion of different regional and sectoral fixed effects and by considering supply disruptions that resulted in production halts.[22]

In summary, trade policies and trade uncertainty have a significant impact on the decision to close foreign production facilities, while the Covid-19 shock, proxied by exogenous (government) plants shut down and supply disruptions, does not seem to have negatively affected internationalization strategies. However, sharp reductions in past and recent (2020) revenues, which is a standard channel of classic demand shocks, as highlighted in the model in the next section, played a role.

These results seem consistent with a *wait and see* behavior (Dixit and Pindyck, 1994; Chung et al., 2013; Damaraju et al., 2015; Conconi et al., 2016). Despite the magnitude of the pandemic shock, its persistence was not clear, therefore MNEs require more information before reshoring as a consequence of Covid-19 only; on the contrary, trade policies changes are likely to be (and to be perceived as) having long-lasting effects, and thus more likely to determine adjustments in the internationalization strategies.

Finally, we exploit a very recent Bank of Italy survey collected in spring 2022 to provide further evidence on whether firms have adapted their expectations and strategies as time into the pandemic has passed. More specifically, in Table 3.4, we consider three outcomes, i.e. the probable or certain closure of foreign plants in 2022 or 2023, $Prob(Close_{22-23})$, the probable or certain reshoring of suppliers in 2022 or 2023, $Prob(ReshSupply_{22-23})$, the probable or certain increase (diversification) of suppliers for the same input in 2022 or 2023, $Prob(DivSupply_{22-23})$.[23] We make use of *Brexit* and the exposure to the Russian war in Ukraine,[24] *UKR-RUS War*, as potential determinants of the change in internationalization strategies. We rely again on *GovStop* and *SupplyProb* as proxies for the Covid-19 shock. We also control for the change in revenues in both 2020 and 2021, *dRev2020* and *dRev2021*, as well as for the other variables included in Table 3.3.

We find that those firms that signaled Brexit as a major source of uncertainty are more likely to change their internationalization strategies, either by closing foreign plants abroad (column 1), reshoring suppliers (column 2), or by increasing the number of

[22] In Table A.2 in Appendix, we show very similar results also for another aspect related to the reduction of internationalization, i.e. the reduction of foreign suppliers. Despite a lower sunk cost with respect to closing plants abroad, the reduction of suppliers – achieved through self-production or by substituting foreign suppliers with domestic ones – is still associated with exposure to the Brexit shock, moreover, as for own subsidiaries, the effect of Covid-19 production halts due to governmental restrictions or supply disruptions are not statistically different from zero.

[23] Note that reshoring of suppliers includes contracting suppliers and thus is a softer, less sticky, form of internationalization, also easier to undo, relative to reshoring of foreign production facilities (see in Figs. 1 and 2).

[24] Firms are asked whether they expect that the Russian war will have a negative impact on their business in 2022.

Table 3.4
Internationalization strategies in the near future.

	(1) Prob($Close_{22-23}$)	(2) Prob($ReshSupply_{22-23}$)	(3) Prob($DivSupply_{22-23}$)
Brexit	0.031*	0.073**	0.107***
	(1.83)	(2.18)	(2.77)
UKR-RUS War	0.047*	0.176***	0.168***
	(1.91)	(5.42)	(5.40)
GovStop	0.027	−0.029	0.046
	(1.31)	(−0.78)	(1.12)
SupplyProbl	0.038*	0.172***	0.141***
	(1.94)	(5.61)	(3.65)
$dRev_{2021}$	−0.013	−0.043	0.220**
	(−0.32)	(−0.51)	(2.48)
$dRev_{2020}$	−0.007	0.034	0.132
	(−0.08)	(0.33)	(1.19)
Age	0.003	−0.000	0.040
	(0.17)	(−0.00)	(1.38)
$log(labprod)_{2020}$	0.003	−0.072***	−0.098***
	(0.26)	(−3.01)	(−4.18)
$log(emp)_{2020}$	0.002	0.032**	0.038***
	(0.26)	(2.45)	(2.76)
Observations	394	1257	1439
Sector	Y	Y	Y
NUTS2 Region	Y	Y	Y

Notes: The table reports marginal effects. Robust standard errors. *t*-statistics in parentheses. *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

suppliers for the same input (column 3); in addition, also the exposure to the war has analogous effects.[25] Moreover, in line with previous estimates, exogenous production halts due to government restrictions do not affect the probability to change the internationalization strategies. What seems particularly interesting in Table 3.4 is that, using the most recent survey, in contrast with our previous results, Covid-related supply disruptions (*SupplyProbl*) now seem to predict foreign plant closures and reshoring of suppliers (columns 1 and 2), as well as further diversification of suppliers of specific inputs (column 3). While the magnitude of the effect is not particularly large for closing foreign plants, it is quite large in the case of foreign suppliers (columns 2 and 3). This difference is possibly due to the higher sunk costs related to foreign plants relative to contracting suppliers. The new results add the previous ones, suggesting that although reshoring is, so far, not particularly widespread, after two years into the pandemic and with the new geopolitical tensions, some reconfiguration seems underway, and the long-run impact on the future of globalization is uncertain.

This last piece of evidence complements our findings as it offers insights on the short term evolution of firms' strategies and the underlying mechanisms. As firms' decisions depend on expectations, a change in planned strategies may reveal a change of the perception of the shocks. Expectations adapt as new information becomes available: after two years into the pandemic, firms might have revised their expectations on the length of the Covid shock thus starting to consider it as long lasting. This is consistent with the *wait and see* behavior discussed above. Under the new conditions, with revised expectations, some reshoring is probably going to take place even if it has largely not manifested yet in the data. However, some caution is due as it is worth recalling that this result is based on *planned* strategies, and firms often do not stick to their declarations. This is what emerges for instance from a two-step survey conducted in May 2020 and twelve months later by McKinsey among senior supply-chain executives from several industries. Contrary to what they had initially declared, by the time of the second round many companies indicated they had chosen to increase inventories and suppliers of raw materials, rather than to implement the nearshoring or regionalization strategies they had prospected in the previous survey.[26] For these reasons, we believe that our results on actual closures in the past years (Table 3.3) need to be complemented not only with further analysis on planned actions (as in Table 3.4), but also, and more importantly, with an assessment of the actual future reorganization of supply chains, as soon as the data will become available.

In the next section, we propose a theoretical framework that describes how different perceptions of shocks may affect MNEs internationalization strategies. We claim that these strategies may display hysteresis due to the presence of sunk costs. Once applied to a dynamic framework, this mechanism could induce different firms' reactions to different types of shocks. In particular, we show

[25] Note that these effects seem to push globalization in opposing directions, by reducing foreign exposure on the one side (foreign plant closures and reshoring of suppliers), while increasing the number of (foreign) suppliers of specific inputs on the other. The final outcome is thus ambiguous, even in the intentions of the surveyed firms, also considering that they might further revise their expectations and adapt their behavior. It is even possible that, at least for some firms, the recent shocks will lead towards more internationalization. Investigating which effect will prevail and why is a subject for future research. We thank an anonymous reviewer for this comment.

[26] Similarly, Italian firms plan to follow the same strategies to increase their resilience to supply chain shocks (see Fig. 2).

that it is not only the size of the shock that matters but also, and perhaps more importantly, its perceived persistence. Thus, severe but transitory shocks, as Covid-19, may not induce MNEs to close or relocate foreign production to the same extent that mild but permanent shocks do.

4. Theoretical framework

4.1. A multi-period model

Our aim is to show how the decision to offshore and reshore production are asymmetric in important ways. A crucial insight is that the offshoring decision can be sticky so that reshoring requires either very large or permanent shocks. As it is well known, firms that internationalize are self-selected among the most productive ones. They are better equipped to afford the internationalization costs and benefit from a larger scale of operations. However, once (highly productive) MNEs invested and paid the cost to set-up their international production network, further adjustments are also costly and only major permanent shocks provide incentives to change.

Our model fits into the international trade literature and builds on Melitz (2003) and Antràs (2015, 2020). The demand side of the model is rather standard. It is composed by a representative consumer who derives utility from consumption of a homogeneous numeraire good and a differentiated good which encompasses a continuum of varieties. Varieties are imperfect substitutes with a constant elasticity of substitution, and the consumer displays love for variety. Demand for each variety, thus, depends negatively on the price of the variety itself and positively on expenditure (or consumer's income) and on the price of substitutes (captured by a price index). Details on the demand side of the model are provided in Appendix A.2.

To investigate MNEs internationalization strategies, we mostly operate on the supply side of the model. We focus on two main elements: first, setting-up a plant at home or abroad implies sunk costs; second, firms maximize profits in a multi-period setting, i.e. they are forward looking. These two elements are not new per se, and readers familiar with the international trade literature will easily follow our results. Nonetheless, considering these two aspects together allows us to illustrate and rationalize our empirical results.

The differentiated sector is characterized by monopolistic competition. Each firm produces a unique variety $\omega \in \Omega$ using only labor with a technology encompassing increasing returns to scale stemming from a fix cost FC combined with a constant marginal cost MC. As in Melitz (2003), firms can be heterogeneous in terms of (time-invariant, firm-specific) productivity $\varphi(\omega)$.

The firm only sells in the domestic market, but can decide to manufacture the product abroad.[27] Since we are interested in the production location decision, we limit the firms choice to: (0) producing domestically; (1) producing abroad; (2) staying or going out of business. In a multi-period setting, we need to keep track of firm's current status in each period. We denote it with the letter S:

$$S = \begin{cases} 0, & \text{if producing domestically} \\ 1, & \text{if producing abroad} \\ 2, & \text{if not producing} \end{cases} \tag{4}$$

Entering the foreign market or offshoring at time t corresponds to a status change from $S_{t-1} \neq 1$ to $S_t = 1$. Similarly, reshoring is the change from $S_{t-1} = 1$ to $S_t = 0$. Of course, other status changes include entering the domestic market and going our of business. Therefore in each period t, the firm can take different status-change choices contingent on the previous state S_{t-1}. It is useful to denote status changes with the following indicator variables:[28]

$$I_0 = \begin{cases} 1, & \text{if } S_t = 0 \text{ and } S_{t-1} \neq 0 \text{ (starts domestic production)} \\ 0, & \text{otherwise} \end{cases} \tag{5}$$

$$I_1 = \begin{cases} 1, & \text{if } S_t = 1 \text{ and } S_{t-1} \neq 1 \text{ (starts foreign production)} \\ 0, & \text{otherwise} \end{cases} \tag{6}$$

Given the above internationalization choices, firm's profit depend on the variable production costs associated with each location and on the sunk costs related to setting up production facilities. Producing in the domestic market ($S = 0$) entails a one-time sunk cost F (if $I_0 = 1$), a fix cost $FC = f$ and a marginal cost $MC = aw\varphi(\omega)^{-1}$ determined by the unit labor requirement a, the domestic wage w and the time-invariant firm-specific productivity level $\varphi(\omega)$. Producing in the foreign market ($S = 1$) entails a one-time sunk

[27] We do not explicitly consider the extensive margin of sourcing, i.e. the number of countries or the number of suppliers, which is an important dimension in the actual data, and is relevant to study diversification. Adding the extensive margin would greatly complicate the model, but the main intuition regarding the role of sunk costs would be unchanged. Two recent papers seem particularly relevant on this point. Antràs et al. (2017) develop a multi-country sourcing model. The core mechanism of the model is essentially in line with ours, plus their multi-country model shows that the are complementarities across source markets. Grossman et al. (2021) analyze the trade-off between reshoring and diversification from a policy perspective. Their model also includes sourcing sunk costs. Diversified firms have a better chance of surviving against shocks and thus higher expected operating profits, but they also pay an added fixed cost. In the relevant case in which domestic suppliers are safer but more expensive than those abroad, policies promoting diversification are likely to be preferable since the market underprovides resilience.

[28] For simplicity, we omit the going-out-business I_2 indicator variable since, as long as there are not sunk costs associated with this decision, it plays no active role.

cost F^* (if $I_1 = 1$), a fix cost $FC = f^*$ and a marginal cost $MC = \tau z a w^* \varphi(\omega)^{-1}$ determined by the foreign wage w^* as well as by the lower productivity of foreign labor ($z \geq 1$ foreign workers correspond to one domestic worker) and the cross-border costs $\tau \geq 1$ from importing the manufactured product back to the home country. These include both the (iceberg) transport costs and any *ad valorem* domestic tariff. Profits in each status S can be compactly written as:

$$\pi(S) = \begin{cases} (aw)^{1-\sigma}\varphi(\omega)^{\sigma-1}B - f - I_0 F, & \text{if } S = 0 \\ (\tau z a w^*)^{1-\sigma}\varphi(\omega)^{\sigma-1}B - f^* - I_1 F^*, & \text{if } S = 1 \\ 0, & \text{if } S = 2 \end{cases} \tag{7}$$

with $\sigma > 1$ being the (constant) elasticity of substitution between any pair (ω, ω') in Ω and B is a term proportional to the demand faced by the firm.[29]

Because of sunk costs, the optimization problem of the firm must be solved dynamically as the profits in one period depend on the choice made in the previous period in terms of location and production and since it does not have an analytical solution, we solve it numerically. To this goal, define $\mathcal{V}(S_0)$ as

$$\mathcal{V}(S_0) = \max_{(S_t)_{t=1}^{\infty}} E\left[\sum_{t=1}^{\infty} \rho^t \pi(S_t) | \Sigma_t\right] \text{ such that (7) holds in every period,} \tag{8}$$

where Σ_t is the information set available in t and the sequence $(S_t)_{t=1}^{\infty}$ maximizes the expected present value of future profits, discounted at rate ρ, of a firm in state S_0 that produces the variety ω with productivity $\varphi(\omega)$. More generally, this function can be rearranged and we can define the equilibrium relation in a recursive form that must hold in every period:

$$\mathcal{V}(S_t) = \pi(S_t) + \rho E\left[\max\{\mathcal{V}(S_{t+1}) - I_{0,t+1}F - I_{1,t+1}F^*\} | \Sigma_{t+1}\right] \tag{9}$$

The state variable is the firm's location of production in the previous period, the choice variable is the location it chooses in the current period. The state variable affects the value of both the current-period profit and the expected continuation value. Notice that the expected continuation value of a firm producing domestically (abroad) that decides to offshore (reshore) will entail the payment of the sunk cost. Sunk costs are also paid by firms currently out of business that decide to restart the production either at home or abroad. In each period domestic firms can enter the market (either to produce domestically or abroad), change production location if they are already operating, or go out of business. Both fixed and sunk costs are set equal to zero when the firm is out of business. The scheme of the numerical algorithm is provided in Appendix A.3.

Let us now simulate the model in the multi-period framework. We assume that at time 0, before anything happens, all firms are inactive ($S = 2$) and they differ only in terms of productivity level (φ). We draw φ from a Pareto distribution with parameters chosen in order to mimic as close as possible the observed empirical distribution of labor productivity. For the purpose of simulation, the time horizon is set to 20 periods (quarters), which allows to focus on long-run investment and divestment decisions. The values chosen for the other parameters are listed in Appendix A.3.

As a first step, given the simulated distribution of productivity and assuming no other perturbations, we solve the model numerically by finding $\mathcal{V}(S_t)$ as the fixed point of the contraction mapping (9) for each level of φ. Although we do not attempt a proper calibration, this simple model is still able to generate a distribution of firms consistent with the observed one: only a small fraction (around 5%) of firms chooses to offshore.

In a second round of simulations, we focus our attention on internationalized firms to explore the impact of different types of shocks.[30] In particular, we consider changes to the demand (B) and to tariffs (τ).[31]

At the beginning of each period, firms observe the realization of shocks and decide whether to revise their location choices. If they do so, they must pay the associated sunk cost, while remaining in the current state does not involve additional sunk costs.

This setting, while very stylized, allows to check the effect of large vs. small and temporary vs. permanent shocks to one or more variables in combination. For illustrative purposes, in Fig. 3(a) we shock the demand parameter B and tariffs.[32] In this example, the shock to sales is temporary and that on tariffs is persistent. In Fig. 3(b) we see the impact of these shocks on firms' composition by location choice. The temporary demand shock alone has no effect on the share of offshoring firms, meaning that the initial shock was not large enough to justify paying the sunk cost of a change in production location. On the contrary, the increase in tariffs, despite being relatively small, triggers reshoring. This is because it is permanent.[33] Lastly, the combined effect of a temporary demand shock with a permanent tariff increase triggers even more reshoring. Note how the demand shock, which alone has no effect, acts now as a multiplier on the tariff shock effect.

The intuition behind these dynamics can be given through Eqs. (8) and (9). As a premise consider that, if no shock occurred, a firm that had chosen to offshore would continue to do so because there would exist a strictly positive margin between the present

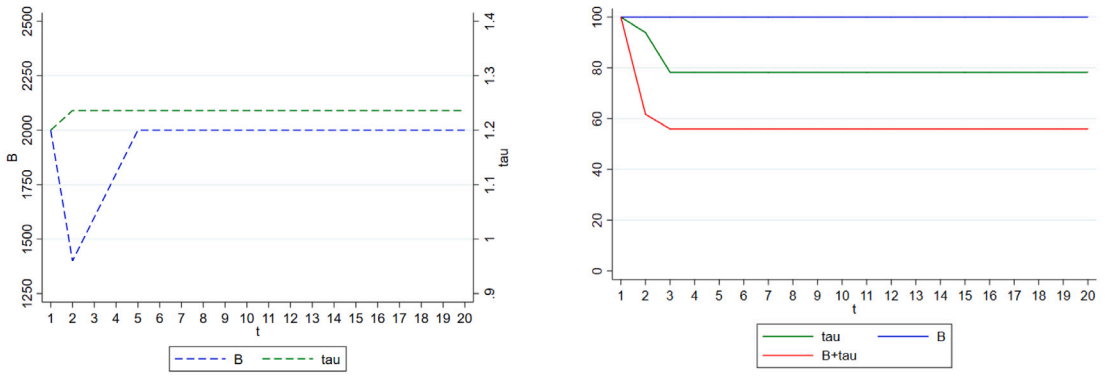
[29] See Appendix A.2 for details.

[30] We do this by imposing an appropriate minimum level for φ, say φ, over which we know all firms will invest abroad.

[31] In what follows we focus on these two for illustrative purposes, but other variables can be shocked as well, such trade costs, labor productivity, and firm productivity.

[32] As noted above, this is quite a simplification since B is in fact an endogenous combination of parameters which depend an preferences (which are assumed to be fixed) and on expenditure or income and the price index, which in turn declines with the number of firms. Yet B is exogenously taken as given by the individual firm so that from the firm's perspective a shock to B simply corresponds to a shock in sales.

[33] A discussion on the impact of temporary versus permanent shocks on both the demand B and the tariff τ is in Appendix.



(a) Shocks on demand and tariffs. (b) Share of offshored firms.

Fig. 3. Simulated shocks and reshoring. (a) Note: The x-axis indicates the time periods (quarters). Each line describes a different shock. The blue dashed line simulates a 80% drop of the demand level (B, left scale) in period 2, followed by a fast and full recover; the green line simulates a 5% permanent increase of the tariff level (tau, right scale) from period 2. (b) Note: Offshored firms in period 1 = 100. The x-axis indicates the time periods (quarters). The y-axis displays the percentage of off-shored firms, normalizing the level in period 1 (i.e. pre-shock) at 100. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

value of profits expected under offshore production compared to the alternative, this being true even for the least productive firms among those that offshore. A negative but temporary shock on the demand (B) would reduce the current period profit, $\pi(S_t)$, but would not alter the future stream of profits. Therefore, if the firm is either infinitely living or with a sufficiently large number of operating periods ahead, then the reduction of the current period profit may not be enough to erode the initial margin.[34] Instead, an increase of the tariff (τ) would reduce the entire stream of future profits and, therefore, have a much larger impact on the present value of expected profits under offshore production. In this case, it is very likely that a number of firms (namely those with a productivity level lower than a certain threshold $\underline{\varphi}$) would relocate. Namely, those for which the reduction is larger than the sum of the profit margin *and* the payment of the sunk cost from relocating. Finally, let us consider what happens if the increase in tariff is combined with a temporary reduction in demand. In this case, both the current and the future profits of offshored firms would be reduced. Hence, the productivity level below which firms relocate is higher than $\underline{\varphi}$ and some firms that were sufficiently productive to remain abroad under the previous scenario (tariff increase only) can no longer do so, now. A this point, even when the demand returns to its pre-shock level, some firms would no longer find it convenient to pay the sunk cost and offshore again and remain 'locked-in' the domestic production, therefore resulting into an amplification effect of the initial tariff increase.

4.2. Intuition in the two-period case

We rely on a simpler two-period version of the model to highlight the underlying intuition. Consider a firm that operates only two periods and has to choose whether to locate production domestically or abroad (no inactivity is allowed). To simplify notation, let us assume that there are no sunk costs associated with domestic production ($F = 0$).[35] This greatly simplifies notation, keeping the main mechanism intact.

Eq. (7) reduces to a binary choice, so that a firm wants to produce in the foreign market if $\pi(S = 1) > \pi(S = 0)$ either by offshoring its production abroad ($I_1 = 1$) or by remaining offshore ($I_1 = 0$).

Only firms whose productivity lies above a certain threshold find convenient to offshore:

$$\varphi \geq \left[\frac{I_1 F^* + f^* - f}{B[(\tau z a w^*)^{1-\sigma} - (a w)^{1-\sigma}]}\right]^{\frac{1}{\sigma-1}} \geq 0 \tag{10}$$

Notice how Eq. (10) implies that there are two different productivity cutoffs: a more stringent one for those who start offshore production ($I_1 = 1$) and a less stringent one for those already producing abroad ($I_1 = 0$). This is consistent with the empirical evidence provided in Section 3. First, it confirms that firms that offshore are more productive ex ante ($I_1 = 1$). Further, it suggests that ex post this productivity constraint becomes less binding for those who have offshored ($I_1 = 0$). Once offshoring has occurred, firms hit by a negative shock on productivity or by an increase in tariffs, wages or other costs, may decide to remain abroad, even though that choice would have not been made had the sunk cost not been already paid.

[34] Nevertheless, if the shock on the demand is temporary but sufficiently large, it could induce some firms to reshore. We present in the Appendix the simulation for such a case.

[35] With this assumption, in Eq. (7), the indicator variable I_0 plays no role.

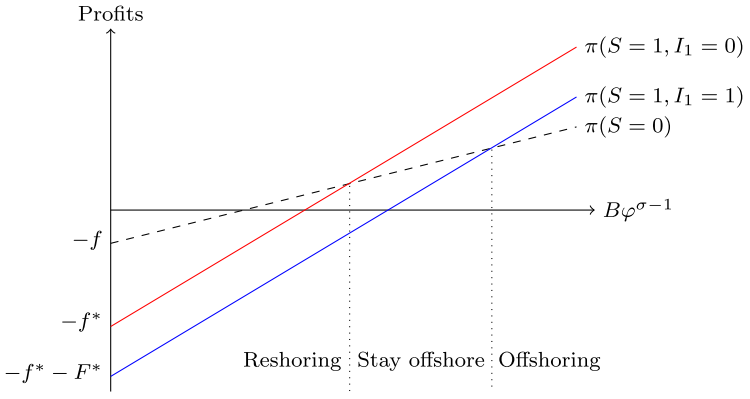


Fig. 4. The stickiness of offshoring: scale and productivity of the firm.

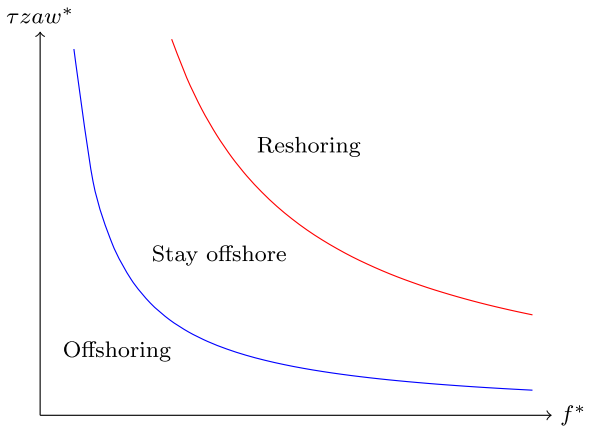


Fig. 5. The stickiness of offshoring: marginal vs. fix costs.

Sunk costs introduce an asymmetry between the ex-ante and ex-post optimal location decisions of the firms. The key mechanism stems from the fact that once sunk costs have been paid to locate the production somewhere, changing is costly. In other words, past decisions carry a weight and firms' internationalization strategies are not easily reverted or modified. On the contrary they are likely to display hysteresis effects and "history matters". To induce a firm to modify the location of its production the shock must be sufficiently large and/or persistent. It is therefore possible that certain shocks would greatly reduce the firm's profits but are not reflected on its location decisions.

Consider the case of a firm that offshored its production in the first period and is now considering reshoring. Ex-ante ($I_1 = 1$), the firm compares both fix and marginal costs of domestic production vs. offshoring, but then, after the choice is made, the sunk component of the fix cost of offshoring does not enter the problem since it was already paid ($I_1 = 0$). This tilts the decision by making offshoring sticky and creating a hysteresis effect. Even after an erosion of the marginal cost advantage of foreign production, the firm may keep production offshore; or equivalently, we need a large increase in the foreign marginal cost in order to make reshoring profitable. The larger the sunk cost of offshoring F^*, the larger the hysteresis effect. The presence of sunk costs creates an inactivity zone where the firm does not reshore even though it would have not offshored originally. This effect is represented in Figs. 4 and 5 for the firm's scale and productivity (B represents the scale, φ the productivity) and costs (marginal vs. fixed). Fig. 4 shows how firms producing at different scales or with different productivity take different decisions: larger and more productive firms are more likely to offshore. This is a standard result, in line with most of the theoretical and empirical literature. Once the firm has offshored, it will not reshore even after a negative shock to sales or productivity, unless the shock is large enough to bring the firm within the reshoring region on the left. Fig. 5 shows the combinations of costs of offshoring for which firms stay offshore (i.e., do not reshore) even though they would have not offshored at the new conditions. Given the scale of operations, the firm offshores if costs are low enough to lie in offshoring region (a standard result). Again, once a firm has offshored, it will remain offshore even after negative shocks to either fix cost, labor productivity, trade costs, tariffs, and communication costs, even if the new cost combination lies outside the original offshoring region, provided that the shocks are not too large.

5. Conclusion

The Covid-19 outbreak was sudden, large and unexpected. In many countries, GDP collapsed and firm losses have been massive and generalized, with the international production networks (at least partially) contributing to the transmission of the shock, due to supply chains disruptions and sudden production halts, especially in certain manufacturing and medical products. These developments triggered a discussion on the risks and instabilities associated with the international fragmentation of production. Observers and academics evaluated the possibility of reducing reliance on foreign markets and, with the belief that proximity reduced globalization risks, contemplated substituting uncertain foreign supplies with national or geographically closer sources. Along this line, some advocated also for a rethinking of MNEs' location choices and called for nearshoring and reshoring production plants abroad as means to lower uncertainty and secure supply. The most extreme scenarios were those predicting deglobalization and massive waves of reshoring. Against this backdrop, a policy debate followed, with several governments discussing or approving measures to incentivize the reshoring of strategic productions. Yet, despite these fears and measures, systematic evidence is still scant. While disruptions were severe and some firms decided to revise their location and/or sourcing choices, available anecdotal and survey evidence shows that no widespread reshoring is currently happening.

We contribute to the debate by providing novel empirical evidence on the impact of the Covid-19 shock on the internationalization strategies of Italian MNEs. Exploiting new firm-level data surveyed by the Bank of Italy, we find that among Italian MNEs foreign plant closures and reshoring are limited; only a small fraction of firms reshored (or nearshored) production or intend to do so in the near future.[36]

This is consistent with the idea that MNEs, despite being exposed to foreign shocks and severely hit, were also better equipped to face the crisis: they suffered less with respect to less internationalized or domestic firms in terms of sales reduction and other variables, and were faster to react to the shock.

Moreover, as also pointed out by Antràs (2020), theoretical reasons for the hysteresis of internationalization strategies exist. We provide a rationale for the observed evidence using a multi-period model of firm's location choice. Under the assumption that starting production abroad entails the payment of (large) fixed costs, part of which is sunk in nature, we show that international firms self-select among the larger and most productive ones, which makes them better equipped to afford the investment abroad. Once the offshoring choice has been taken and the sunk costs paid, further adjustments are costly and only sufficiently large and/or permanent shocks provide incentives to change behavior and choices. In a multi-period setting, temporary shocks might not trigger reshoring as current losses are compensated by future expected returns; furthermore, the already-paid sunk cost of offshoring does not enter the firm's optimization problem anymore, while relocating may involve additional costs, making the choice less viable.

The decisions to offshore and reshore production are therefore asymmetric in important ways and the presence of sunk costs makes the offshoring decision sticky, triggering hysteresis in firms' internationalization strategies. A shock like Covid-19, proxied by a large drop in sales, may have limited effects on the internationalization strategies of the firms if it is temporary in nature (or perceived so). Moreover, the model predicts that firm productivity and protectionist trade policies are, respectively, negatively and positively correlated with the probability to close plants abroad.

Our empirical evidence on Italian MNEs is consistent with the indications of the theoretical framework. Through the lenses of our model, we suggest that the Covid-19 shock has not been perceived as permanent and therefore impacted very little on firms' relocation decisions. This finding is also corroborated by similar evidence from other countries as well as by the rapid rebound of world trade, which, despite lockdowns and disruptions, has largely recovered to its pre-crisis level. On the contrary, the long-term uncertainty brought about by shocks like the Brexit and the US increase in tariffs were considered as long-lasting and had a significant impact on the decision to reshore (or close foreign branches).

These results offer valuable insights, however a note of caution is due. While all the regressions use survey weights that make the sample representative of the reference population and the results are stable across specifications and statistically significant, the sample is rather small. Furthermore, only a subset of our sample has information on the impact of both trade policies and Covid-19, coming from different waves of the survey. Moreover, our period of observation is limited, and the consequences of the shock may change according to the evolution of the pandemic and especially of the policy responses. Major changes in international exposure and patterns may have not yet manifested, simply because reorganization takes time. Some reconfiguration is likely to happen in the medium and long term, also considering other shocks that might add to Covid-19. Globalization will not end with Covid-19, while other policy and geopolitical factors are more likely to shape firms' decisions. After two years into the pandemic and with the new geopolitical tensions, firms may start revise their expectations and adapt their strategies. However, rather than closing foreign plants and moving their activity back home, MNEs seem to favor other, more flexible, strategies to increase resilience, such as diversifying suppliers for a given input, including new foreign as well as domestic ones, or expand their inventories of inputs and finished products. Our findings show that Covid-19 did not trigger (so far) large waves of reshoring, but the long-run impact on the future of globalization is uncertain. The recent evidence suggests that economic shocks can be both drivers of (planned) reshoring and of (planned) supply chains diversification; which of the two will prevail is still unclear. Because of this, different results may emerge as new and more comprehensive firm-level data will become progressively available.

Relevant policy considerations emerge from our findings. Our simulations suggest that individual shocks might have limited impacts due to sunk costs, but also that the combined effect of multiple shocks can have an amplifying effect and trigger large responses. Hence, while it seems unlikely that the Covid-19 shock will lead to significant reshoring by itself, its combined effect

[36] The question in the survey asks whether reshoring/nearshoring has occurred in the past three years and whether it is planned for the next year.

with policy uncertainty or with the adoption of protectionist measures is likely to impact relocation and future investment decisions by firms. To face the new conditions, countries and firms need to (re)balance global production efficiency and risk. Efficiency implies selecting only the "best" locations and suppliers, while diversification and some degree of redundancy, despite being costly, help to contain the risk of disruptions. Inward-oriented policies that reduce the diversification of suppliers and markets could be counterproductive precisely for the companies (and workers) they intend to protect. Reshoring may lower the country's overall exposure to foreign shocks but at the same time increases exposure to the domestic ones. These policies seem to sacrifice efficiency for nothing as the gains in terms of risk management are unclear. And firms seem aware of this. As highlighted by the European Round Table for Industry (2021) firms are largely able to adapt autonomously to the new global scenario. For instance, when shops were closed because of lockdown, many firms rapidly moved to target potential customers online through e-commerce.

However, there is one aspect that firms might not appropriately discount and leaves room for policy interventions. While firms are likely to know and manage very well their individual trade-off between efficiency and risk, they might not be well equipped to internalize systemic risk (Acemoglu, 2021). In a competitive market, to gain efficiency and get ahead of competitors, each firm might have an incentive to bear more risk than socially optimal. Country-level and multilateral policies might therefore be better suited to manage systemic risks.

Successful policy measures should operate on two fronts.

First, they should aim at helping firms internalize the social cost of their decisions in terms of systemic risk. In this case, multilateral outward-oriented diversification policies seem preferable. For instance, to improve the resilience of firms, policies might point towards supporting stockpiling and liquidity. To enhance efficiency, MNEs tend to optimize logistics and minimize storage costs. However, in a world of increasing uncertainty, a focus on the efficiency of transportation and production will leave firms vulnerable to shocks. International cooperation programs for the stockpiling of essential goods, especially intermediates, at the global level could ensure their availability in difficult times. This is particularly important for developing countries.

Second, policies need to consider the structural aspects that make locations attractive: the business environment, regulation, logistics, labor cost and productivity amongst others. Policies that directly aim at affecting firms' decisions are unlikely to be the best option. Subsidies or other immediate economic incentives are short-sighted as they are unlikely to be effective and are probably inefficient. Moreover, to contrast the negative effects of offshoring, rather than removing the gains, policies could aim at compensating the losers of the globalization process (Blanchard and Tirole, 2021; Antràs, 2020; Rodrik, 2018). This may involve redistribution as well as avoiding workers' displacement or providing workers with new skills through specific training programmes.

In conclusion, Covid-19 did not trigger large reshoring waves, at least among Italian firms. MNEs suffered, but also adapted better to the changing conditions and are not easily giving up on the long-term investment undertaken to build their international network. Reshoring has not been chosen by firms and policy makers can hardly know what is better for each firm. Policy uncertainty and protectionism, especially if combined with economic shocks, might force firms to revise their strategies in inefficient ways. In a post-Covid world, some reorganization of global production might take place and is probably desirable, but we must not sacrifice the gains to reduce the costs. This is where policy must play a role: managing systemic risks and alleviating economic and social costs.

Declaration of competing interest

Views and opinions expressed in this paper are those of the authors and do not necessarily represent those of the institutions with which they are affiliated.

Appendix

A.1. Tables and figures

See Tables A.1 and A.2.

A.2. Theoretical model

Consider a small open economy in which firms sell domestically whatever they produce but have, in each period, the possibility to choose whether to locate their production within the domestic borders or abroad. There is a differentiated sector characterized by a continuum of varieties and an homogeneous sector used as numeraire.

On the demand side, the economy is composed of a large number of individuals with CES preferences over a variety of goods indexed by $\omega \in \Omega$. The utility of the representative consumer is given by:

$$U = (1-\alpha)\, lnq_0 + \alpha lnQ \tag{11}$$

where α is parameter capturing the relative importance of the two goods for the representative consumer; q_0 denotes the quantity of the homogeneous good and Q is a Dixit–Stiglitz CES aggregator of the quantities of the differentiated varieties $q(\omega)$ taking the form:

$$Q = \left(\int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \tag{12}$$

Table A.1
Descriptive statistics.

	Non MNEs	MNEs
Age	40.74	43.57
	(23.04)	(23.01)
Revenues	28453.2	57495.9
	(181856.6)	(412257.6)
% of revenues from exports	0.179	0.395
	(0.274)	(0.323)
Employment	90.5	157.6
	(727.9)	(792.7)
Labor productivity (ln)	5.385	5.647
	(0.902)	(0.875)
N	2809	443

Table A.2
Determinants of the reduction in the number of suppliers.

	(1)	(2)	(3)	(4)	(5)	(6)
			$Prob(CutSupply_{i,18-20}=1)$			
UStariffs	0.001	−0.004	−0.003	−0.010	−0.001	−0.001
	(0.04)	(−0.25)	(−0.17)	(−0.60)	(−0.08)	(−0.07)
Brexit				0.041**	0.027**	0.028**
				(2.27)	(1.99)	(1.99)
GovStop	−0.007	0.002	0.008	0.008	0.008	0.008
	(−0.37)	(0.09)	(0.43)	(0.44)	(0.56)	(0.57)
SupplyProbl		0.011	0.011	0.006	0.005	
		(0.60)	(0.60)	(0.36)	(0.41)	
SupplyProdStop						−0.005
						(−0.26)
$dRev_{2020}$	−0.001**	−0.001**				
	(−2.21)	(−2.53)				
$DropRev_{2020}$			0.038**	0.040**	0.034**	0.036**
			(2.02)	(2.12)	(2.23)	(2.24)
$dRev_{15-17}$	0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.36)	(−0.23)	(−0.36)	(−0.38)	(−0.62)	(−0.63)
Age	−0.011	−0.005	−0.005	−0.002	−0.006	−0.007
	(−0.73)	(−0.34)	(−0.36)	(−0.17)	(−0.62)	(−0.65)
$log(labprod)_{15-17}$	−0.007	−0.000	−0.001	−0.002	−0.004	−0.004
	(−0.64)	(−0.04)	(−0.06)	(−0.28)	(−0.48)	(−0.56)
$log(emp)_{15-17}$	−0.012**	−0.015***	−0.015***	−0.017***	−0.013***	−0.013***
	(−2.51)	(−3.03)	(−3.03)	(−3.31)	(−3.73)	(−3.76)
Observations	1211	1100	1100	1100	1301	1301
Sector-NUTS1 Region	Y	Y	Y	Y		
Sector					Y	Y
NUTS2 Region					Y	Y

Notes: The table reports marginal effects. Robust standard errors. *t*-statistics in parentheses. *: $p < 0.1$; **: $p < 0.05$; ***: $p < 0.01$.

with $\sigma > 1$ being the (constant) elasticity of substitution between every pair of varieties and Ω being the set of all varieties available to consumers.

Note that the above utility, being a Cobb–Douglas, features a unit elasticity of substitution across sectors. This is a convenient simplifying assumption as it implies that industry expenditure shares are constant: consumers allocate a fraction α of their spending to the differentiated sector. Similarly the use of Dixit–Stiglitz CES preferences, although restrictive, greatly simplifies the analysis and is standard in the literature. These assumptions are consistent with Melitz (2003). In each period, consumers maximize their utility subject to a budget constraint.[37] They allocate spending across sectors according to α and across varieties to maximize Q. Demand for the numeraire can be obtained residually, while demand for the generic variety is given by:

$$q = \alpha Y P^{\sigma-1} p(\omega)^{-\sigma} \tag{13}$$

[37] We assume that consumers do not save, therefore, they solve the same optimization problem in every period. We drop the time index to simplify the notation.

where Y is expenditure, $p(\omega)$ is the price of the single variety and P is the ideal price index:

$$P = \left(\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}} \tag{14}$$

On the supply side, the homogeneous good is produced with labor only with a constant-returns-to-scale technology under perfect competition and is freely tradable. Factor endowments are large enough for the homogeneous good to be always produced. Workers are identical and mobile across sectors so that the wage rate is unique. The differentiated sector is characterized by monopolistic competition among infinitely living firms. Each variety is produced by a single firm whose technology features increasing returns to scale stemming from a fix cost combined with a constant marginal cost of producing. In each period, the variety ω producer takes prices as given and decides whether to manufacture it at home or abroad in order to maximize profits.[38] We also allow for the possibility of going out of business, i.e. not producing at all.

Firms employ only one input (labor) according to the technology

$$q(\omega) = \frac{\varphi(\omega)}{az(S)} l(\omega)$$

where $l(\omega)$ is the amount of labor employed, $\varphi(\omega)$ is the time-invariant firm-specific level of productivity, a is a unit labor requirement parameter and

$$z(S) = \begin{cases} z > 1, & \text{if } S = 1 \\ 1, & \text{otherwise} \end{cases}$$

is a parameter that allows for a generic loss of productivity whenever firms produce abroad. When firms do not produce, $q(\omega) = l(\omega) = 0$.

In addition to the variable cost paid to rent labor (w, w^*) and the trade costs to import the product back into the home market in case of offshoring $(\tau \geq 1)$, firms face two additional types of costs that do not depend on the scale of production: fixed costs (f, f^*) which are paid *every period* if and only if the amount produced is positive and may differ across locations; and sunk costs (F, F^*) which are paid *only once* when the firm starts producing in a location. Starred variables refer to the foreign market. Both fixed and sunk costs are set equal to zero while the firm remains out of business.

Under CES preferences the optimal price takes the form of a constant markup over the marginal cost,[39] $p_S(\omega) = \frac{\sigma}{\sigma-1} MC_S$, that can be used to compute the per-period profits from domestic sales in status S as in Eq. (7), and the parameter B is defined as:

$$B = \alpha Y P^{\sigma-1} \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} \tag{15}$$

and is a term proportional to the endogenous residual demand.[40]

A.3. Numerical algorithm

The parameters used in the simulations are listed in Table A.3. The first group includes the inter-temporal discount factor (ρ) and the constant elasticity of substitution in the CES function (σ), values are standard in existing literature. As quite standard in this literature, we assume that labor productivity (φ) is drawn from a Pareto distribution The parameters listed in the second group were chosen in order to generate a simulated distribution sufficiently close to the one observed in the data. Finally, the levels of parameters in the third group have been chosen with no connection to the data, but their relative levels are in line with some observed facts and in line with Antràs (2020). In particular, the domestic cost of labor is assumed to be higher than abroad ($w > w^*$) but producing abroad requires a larger unit requirement of labor ($z^* > z$). Similarly, sunk costs of offshoring and fixed costs for producing above are higher abroad ($F < F^*$ and $f < f^*$). Finally, the cross-border costs are assumed equivalent to a 20% *ad valorem* tariff.

Fig. 6 describes the simulating algorithm. At time 0 all firms start being inactive ($S = 2$). They observe the realization of the own productivity level (φ), the parameters and the realization of period shocks, if any. Then, each firm decides whether to remain inactive, produce domestically or offshore by comparing the discounted expected profits in the three cases. Notice that, whenever the firm decides to change its status in terms of location, a sunk cost must be paid, lowering the current-period level of profits. Nevertheless, firms may still decide to change status if such reduction is more than compensated by an increase in the expected discounted flow of future profits. After the choice is made, the firm status is updated and the algorithm moves to the following period.

[38] A slight generalization would include also headquarter services. In that case, the intermediate good, whether offshored or not, must be combined, in fixed proportions, with headquarter services in order to supply the final goods to the consumer. Supplying a unit of final good requires a_m units of the intermediate good and a_h units of headquarter services whose cost is p_h. Domestic marginal cost of production is, hence, $a_h p_h + a_m w$. Since headquarter services do not play an explicit role in our analysis, we omit them for simplicity.

[39] The firm that produces the quality ω chooses $p(\omega)$ to maximize the profit $p(\omega)q^D(\omega) - MC_S q^D(\omega)$, taking as given the demand level derived in (13).

[40] Although B is endogenously associated with the level of demand in the industry equilibrium, as Antràs (2020, p. 17) points out, "its determination would not undo the comparative statics".

Table A.3
Parameters used in the simulations.

Parameter	Value	Description
ρ	0.95	Inter-temporal discounted factor
σ	2.65	Constant elasticity of substitution (CES)
Generalized Pareto distribution of firm productivity (φ):		
Shape	0.25	
Scale	0.50	
Location	0.50	
F	1200	Sunk cost in case of reshoring
F^*	5500	Sunk cost in case of offshoring
f	100	Domestic fixed cost
f^*	300	Foreign fixed cost
w	60	Domestic labor cost
w^*	40	Foreign labor cost
a	1	Unit labor requirement
z	1.2	Foreign unit labor requirement
B	2000	Demand level
τ	1.2	Cross-border costs

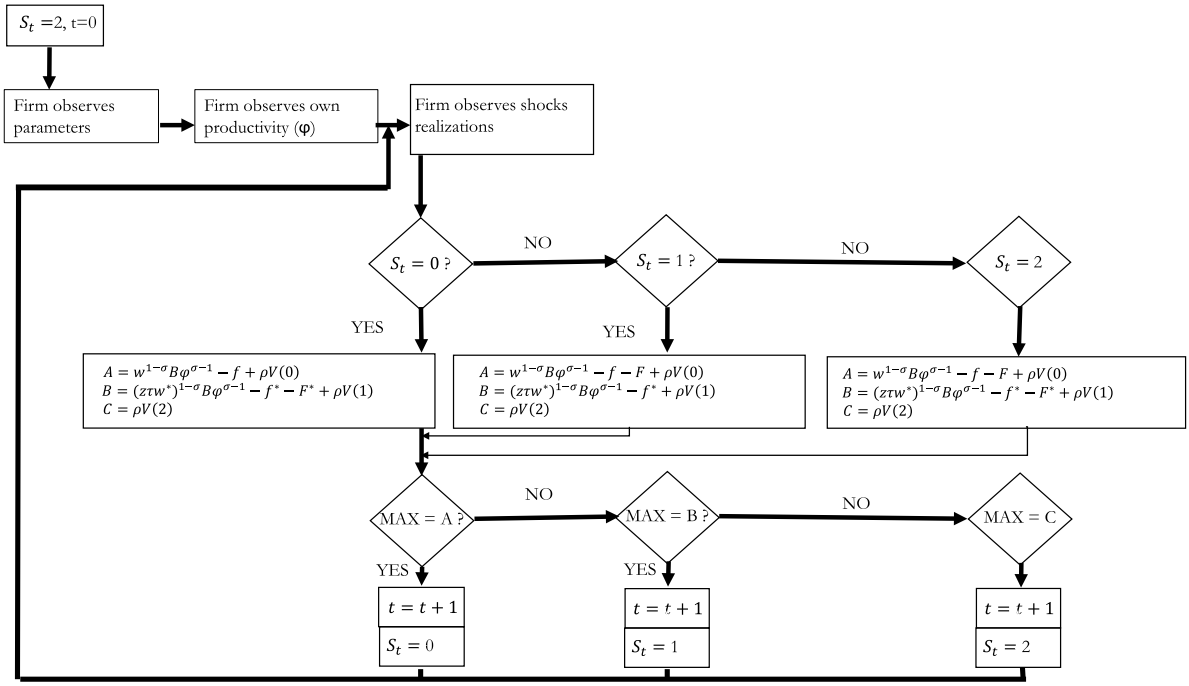
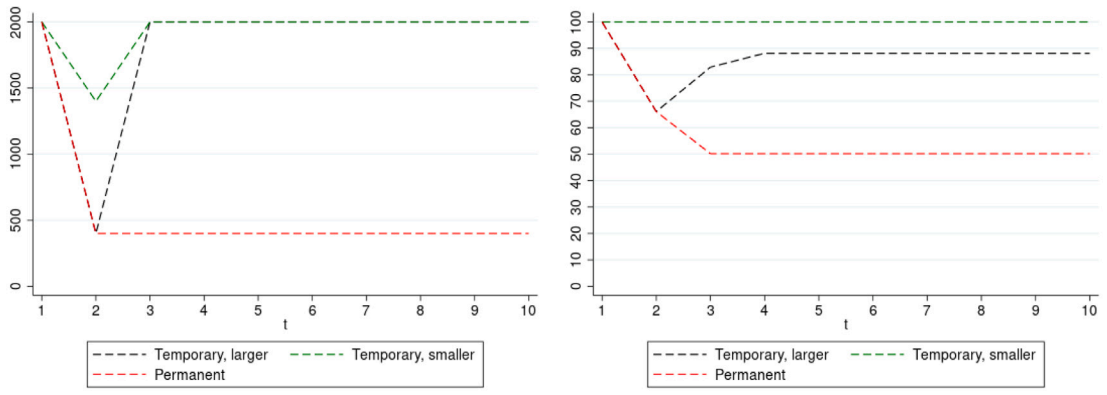


Fig. 6. Algorithm of the numerical simulation.

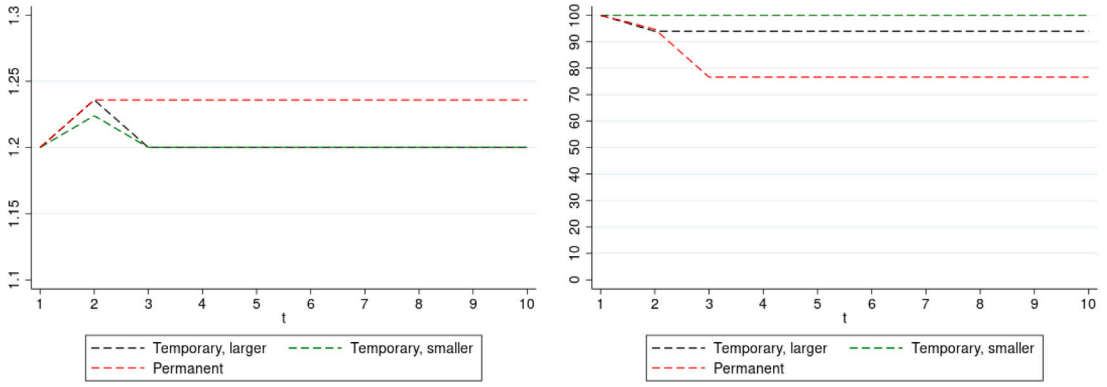
A.4. Temporary and permanent shocks

Firms react differently to shocks, depending on whether they are deemed as permanent or temporary. In particular, even though a temporary shock may imply a loss in the short run, this may be more than compensated by the discounted value of the expected future revenues and since firms maximize the discounted value of their entire stream of expected profits, it may happen that the impact is null if the shock is not large enough. This mechanism is depicted in Figs. 7 and 8. Three types of shock are considered on both the demand B and the tariff τ: permanent, short-lived and larger, short-lived and smaller. As expected, the largest impact on the percentage of firms reshored drops the largest when the shocks are permanent. On the contrary, a temporary shock may not induce any relocation of the production plants.



(a) Shocks on the demand (b) Percent of offshored firms

Fig. 7. Impact of different demand shocks.



(a) Shocks on tariffs (b) Percent of offshored firms

Fig. 8. Impact of different shocks on tariffs.

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