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Deliverable 2.5

Resource misallocation and external competitiveness

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Key word list

Globalization, Productivity, Networks, FDI

Definitions and acronyms

Acronyms	Definitions
BACI	CEPII database of bilateral trade (Base Analytique du Commerce International)
DDI	Domestic “direct investment” (domestic mergers and acquisitions)
EU	European Union
FDI	Foreign Direct Investment
ISTAT	Italian National Institute of Statistics
LP	Labour Productivity
MA	Market Access
MRT	Multilateral Resistance Term
NUTS3	Nomenclature of territorial units for statistics: small regions for specific diagnoses
NACE2	Statistical classification of economic activities in the European Community
OLS	Ordinary Least Squares
REV	Firm total revenue
SIRENE	French system of administrative identifier of firms and establishments (Système national d’Identification et du Répertoire des ENtreprises et de leurs Etablissements)
TFP	Total Factor Productivity
VA	Value added

1. Introduction

1.1. General context

This deliverable is part of the work package aiming to describe how globalisation in general and the rise of global value chains in particular interacts with knowledge flows, intangible assets and productivity. One important objective is analysing two main channels through which globalisation and global competition affect productivity. Within firm-productivity is firstly affected by external shocks and transmitted within the business networks via commercial relations (components, parts, professional services, etc.) and ownership relations (between parents and their affiliates and between affiliates of the same group domestic or abroad). The outcome of this transmission of shocks is the reallocation of factors and thus diverging total revenue across firms. To address these issues, it is necessary to focus on the firm level since growth and efficiency happens ultimately at the firm level; these are individual firms that trough their decisions generate (or not) value and jobs and ultimately absorb the shocks transmitted throughout the business network they belong to. Observing the firms accordingly help to better understand the ultimate micro-level mechanisms that generate the patterns we observe at more aggregate level. Knowing these mechanisms is crucial for policies concerned with the effects of trade liberalisation and consequences for the economy of shocks transmitted by the global economy. When considering individual firms, ownership structure and commercial relationships are indeed important elements to investigate. But another issue worth studying is the localization of the firm, as spillovers across firms belonging to different groups, industries or locations, may be prominent within countries between regions and within regions.

A recent literature is exploring these issues. Trade flows, input-output relations and within firms multinational transactions (through affiliates) have been shown to play a role in the transmission of shocks to, and among, firms (Di Giovanni & Levchenko 2010, Kleinert, Martin & Toubal 2015, Cravino & Levchenko 2017, Di Giovanni et al. 2018, Boehm, Flaaen & Pandalai-Nayar 2019, Bena, Dinc & Erel 2020). How firms adjust to foreign shocks remains to be further explored, especially when complex ownership structures establish international, and domestic, networks of firms. Firm-to-firm connections and business networks contribute to explain why domestic firms might be indirectly affected by foreign demand shocks through their business network (Dhyne, Kikkawa, Mogstad & Tintelnot 2020). It has also been shown that production networks are irresponsive to small shocks when firm-to-firm connections are costly to establish (Huneeus 2018). As of the strategy of identification of these mechanisms, natural disasters have been used as firm-specific idiosyncratic shocks propagating through the network of input-output relationships as output losses in presence of specific inputs (Barrot & Sauvagnat 2016).

1.2. Deliverable objectives

Against this background, we propose in this deliverable a different strategy of identification of the shocks (with a focus on demand shocks exogenous to the firms) and of measurement of their propagation. We quantify how foreign demand shocks affect directly and indirectly domestic firm revenues per employee and labor productivity, as the result of their trade and ownership networks, at a given competitiveness level of the industry region of the firm. The transmission channels we consider are from the global economy to the domestic firms, and

within the domestic economy across locations, sectors and firms, connected through business relationships (either Foreign Direct Investment or within country business groups.

2. Methodological approach

Instead of relying on firm-specific shocks, which is always problematic as shocks can be idiosyncratic (e.g. the decision of a manager or the low quality of an intermediate component from the suppliers network), we first compute an aggregated Market Access shock which is common to all firms in a given location (NUTS3) and industry (NACE2). Being computed as the variation in conditional import demand of foreign countries (from a structural gravity estimation), the resulting vector of external shocks can be considered plausibly exogenous to individual firm productivity. Moreover, external shocks are evaluated at a given level of competitiveness of the exporting industry-region the firm belongs to, as we consider the variation in import demand at destination excluding our countries of interest own exports. As a result, the usual export competitiveness channel (being the aggregate realization of individual firm's productivity shocks) is therefore silenced.

This exercise is performed on three countries (France, Italy and Spain) manufacturing firms for which we now their precise location and industry in each of the three countries. Starting from industry-location specific shocks we evaluate the role of ownership network on their diffusion within a country. In light of the relevance of indirect shocks on firm performances (Dhyne et al. 2020, Huneeus 2018) we investigate whether foreign shocks on a given location propagate to connected locations throughout domestic production networks. The contribution of this deliverable is therefore to estimate, for a given level of competitiveness of the exporting country, how exogenous external demand shocks impact firm performance (i.e. revenue per employee and productivity) while separating both their direct (location specific) and indirect impact. The latter impact is modelled as the spillover effect from other locations through domestic network of trade and investments. Importantly, demand shock is likely to be exogenous to changes in firm productivity, as computed from a theory consistent trade equation cleaning the variation from any confounding effect. The next step of the research agenda is to go beyond the labour productivity and quantify the impact of the mechanisms here described on factor misallocation.

3. Summary of activities and research findings

Our main source of firm data is the commercial dataset Orbis from which we extract the exhaustive panel of manufacturing firms in Italy, Spain and France over the period 2009-2017. Importantly, the estimation panel is built as the recollection of different vintages of the database as to ensure the greatest yearly coverage. Three types of information are retained: i) annual balance sheets of the firm; ii) its location and iii) its global ownership network (in year 2007). As we do not observe trade flows at the firm level, we opt for an exogenous external demand shock, constructed using aggregated trade data by sector and year, for each of the three countries in the sample.

Firm-level variables include: revenues, value-added (VA), total employment, labour productivity, headquarter location (NUTS 3) and main sector of activity (NACE 2). As for the global ownership network, we retain information on all ownership linkages in the 2007

Orbis vintage. We choose this year because it is prior the start of our panel, making the ownership decisions likely "pre-determined" to the demand shock and productivity changes tackled in our analysis. Based on this information, we can build both firm-specific and location-specific linkages with foreign countries as well as with other locations within a given country. Our outcome variable is the variation in either firm revenue per employee or firm productivity vis-`a-vis an external demand shock, conditional on the competitiveness of each firm location. We accordingly need information on the export structure of each of the three exporting countries (before the shock) by sector and destination as well as of each region within them. By matching firms and locations (NUTS 3) we obtain an exogenous structure of exports with the relevant dimension: region of the firm, exporting country-sector the region belongs to and country of destination of exports. "Italian National Institute of Statistics (ISTAT)" and "Ministero de Industria, Comercio y Turismo" provide trade data disaggregated at NACE 2 level for respectively Italy and Spain NUTS3 regions with the Rest of the World. As an example, we observe exports from the NUTS3 of Turin to Japan, in products grouped in the NACE sector number

10. This data is not readily available for France at the NUTS3 level thus we proceed differently. The “Douanes dataset" provides information on the destination of exports for each French manufacturing firm, by destination and year at the product level.2 The SIRENE database documents the location of the exporting firms, sharing the same administrative identifier. By merging the two databases and collapsing the data at the Département (which correspond to French NUTS3) - industry (NACE2) - foreign country level, we obtain the corresponding information for France.

On the demand side, we build shocks exogenous to the firm (and its country of location) by using aggregate trade data, at the country-year-NACE 2 level. Such data are sourced from BACI (Gaulier & Zignago 2010). We proceed as follow. First, we estimate a structural gravity equation at the country-by-industry level and recover the inward Multilateral Resistance terms (MRT thereafter) for each destination market. Then we derive the corresponding market access term for each exporter region, sector, destination and year by aggregating destination market inward MRTs using predetermined NUTS3-by-industry export weights (i.e. in year 2009). As a consequence, our foreign country-sector specific trade shocks is the conditional demand – multilateral resistance term of imports - of foreign countries from the Rest of the World, excluding shipments from Italy, France and Spain.

On the trade side, the last piece of information needed is trade between regions within countries, i.e. internal trade. Unfortunately, trade between NUTS3 regions is not directly observed in official statistics. In order to establish the strength of connections across France, Italy and Spain NUTS3 regions (in a given sector) we must rely on a gravity theoretical framework. For a given industry, we calibrate trade elasticity to physical distance from a structural gravity estimation using country-by-country trade flows between EU-28 State Members (from BACI dataset). Given that we consider trade flows within the single EU market, clear of tariffs and Non-Tariff Barriers, we can safely assume that such elasticities equally apply at the sub national level. We combine then the estimated (distance) elasticities with the actual distance between NUTS3 region as well as their economic shares to infer the “virtual" exchanges among them.

We firstly estimate the direct impact of the exogenous demand shock on the performance of each firm, conditional on its industry and region, and on the competitiveness of this

industry-region. The outcome variable is either the 5-year difference of firm labour productivity or the five-year change in the revenue per employee of the firm. Our baseline equation explains this outcome for each firm in each year with the five-years change in the demand addressed to any firm located in that industry-region at given competitiveness level of the exporting country, net of any confounding factor specific to the region and year considered (e.g. a supply shock in the region the firm belongs to, common to all industries in that region).

We then cut our sample into two bins according to the connection of the industry-region of the firm to ownership networks. For sake of a plausible identification strategy, this network is fixed in year 2007, prior to the shocks we are interested in. This ensure that successive firm level productivity changes do not feedback into the ownership network through mergers and acquisitions. We ask whether the industry-regions comprises firms internationally connected through a foreign parent or a foreign subsidiary. To wrap up, in this second approach, we estimate the impact of the external demand shock separately for firms operating within connected regions (even if these firms are not themselves connected) and the rest of our population. We control for any confounding factor specific to the region and year considered by sake of the region-year fixed effect.

Our third step is to consider the distance between this business network defined on the basis of trade relationships and another metric of the business networks that considers FDI weights for each region-industry, and we investigate the role played by the degree of synchronization between the trade and ownership foreign networks. To proceed, we compute the Euclidian distance between the pre-determined vectors of trade and ownership weights for each sector-region, with all foreign partners. The distribution of this distance across industry-region is informing us on the potential impact of trade and ownership links between firms and across borders.

We finally split the sub-population of firms operating in connected regions into two bins, according to the own connection of the observed firm, as not all firms in a connected region are indeed connected.

Let us now have a glance at the econometric results. The result of our baseline estimation of the impact of an exogenous demand shock on labour productivity of the firm, at given level of competitiveness of the industry-region, controlling for unobserved region-year shocks common to all firms tells us that the negative shock translates into a drop in labour productivity. Global shocks are thus transmitted to the firms through trade networks, as expected. But interestingly, this transmission is largely mediated by firms' ownership networks: if we split the industry-regions, those with no FDI connection are much less affected. Our quantification is that firms in FDI-connected industry-regions are three-time more affected by demand shocks. Hence, most of the trade impact is channelling through the combined network of international trade and ownership relationships.

Our results then demonstrate that firms operating in industry-regions where the two networks - trade and FDI - overlap the most are more severely affected, compared to the rest of firms operating in industry-regions with a lower proximity of the two networks. Our quantification is that firms operating in industry-regions with largely overlapping trade and ownership networks are affected twice as much, compared to firms in other regions with more limited overlap. And recall that even the latter firms are more impacted than firms in regions with no FDI involvement.

Lastly, even unconnected firms are much more affected in connected regions: the explanation is that global business networks transmit the demand shock to firms that are not themselves engaged in international ownership, as a consequence of business relationships between connected and unconnected firms in the considered industry-region (think of subcontractors for instance).

Another piece of evidence provided by our exercise is about the indirect impact of a trade shock. We already identified some indirect impact above, as non-FDI connected firms could well be more affected by the demand shock as a consequence of the presence in their industry-region of connected firms. The type of indirect link we are considering now is different. An example of the indirect effect corresponding to demand shocks' spillovers across industry-regions, is a firm located in Barcelona and operating in the mechanical industry will be affected indirectly by the demand shock faced by Bizkaia (by firms operating e.g. in Bilbao, as the result of the industry-destination orientation of the Basque autonomous community exports). We show that that above one-third of the total impact of the demand shock is channelling through indirect effects across regions and industries of a given country.

Our last result is that around 30% of the impact channels through domestic spillovers and that that domestic spillovers are more than three times larger in industry-regions connected with other regions of the same country, within the same industry: external demand shocks are largely transmitted within the boundaries of the firms across the different regions of a given country.

4. Conclusions and future steps

Our conclusions are clear-cut. Global shocks are transmitted through trade networks and this transmission is largely mediated by firms' ownership networks. Firms operating in FDI-connected industry-regions are three-time more affected by external demand shocks. Moreover, firms operating in industry-regions with largely overlapping trade and ownership networks are affected twice as much. Also, unconnected firms that are not themselves engaged in international ownership are also indirectly affected by external demand shocks, as a consequence of business relationships between connected and unconnected firms. Above one-third of the total impact of the demand shock is channelling through indirect effects across regions and industries of a given country. Lastly, domestic spillovers have been shown to play also a big role in the transmission of external demand shocks.

From a policy perspective, our findings stress that the impact of foreign shocks is not limited to firms engaged in international business through commercial or ownership connections. All firms operating in exposed industry-regions are affected as a result of their business relationships, and this result extends to firms operating in a different region and/or sector of the affected country. From the point of view of firms operating in the three EU Member states covered by our analysis, the economy has really become global. Shocks are transmitted across borders by trade and/or within the boundaries of the firms as a result of decisions made by headquarters. And international shock is even transmitted across regions of a given country, as a result of complex business relationship, commerce or ownership, between domestically located firms.

These findings do not exhaust the research agenda. The next step is to infer from the results in terms of labour productivity the consequences in terms of factor misallocation. Our estimation results can also be used to quantify how the Covid shock is propagating throughout the business networks of individual firms, across countries and across regions between countries.

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Resource misallocation and external competitiveness

MICROPROD Deliverable 2.5

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Abstract

International demand shocks are transmitted within the trade and ownership firms' networks and impact directly or indirectly domestic firm revenue per employee and productivity. Considering manufacturing firms for Italy, Spain and France over the period 2009-2017, we quantify these transmission channels from the global economy to the domestic firms, and within the domestic economy across locations, sectors and firms. We compute international demand shock as plausibly exogenous to individual firms, based on a theory consistent trade equation controlling for the impact of any confounding effect. Our results confirm that global shocks are transmitted through trade networks and that this transmission is largely mediated by firms' ownership networks both across and within the borders of the three countries.

Key Words: Globalization, Productivity, Networks, FDI.

JEL Codes: F14, F23, F61.

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Introduction

How globalization, global competition and foreign demand shock affect domestic firms' productivity and resources reallocation across firms has been extensively studied in the empirical literature and economic theory provides sound foundations for the underlying mechanisms. On one hand, import competition forces domestic firms to adjust and better combine their resources, while driving the least productive firms out of the market. On the other hand, the most productive firms benefit from foreign demand and thrive. Moreover, the effect of external shocks propagate through firms to the domestic economy with documented effect on the domestic labour market (Autor, Dorn & Hanson 2013, Acemoglu, Autor, Dorn, Hanson & Price 2016, Dix-Carneiro & Kovak 2017) and on the synchronization of business cycles with international partners (Di Giovanni, Levchenko & Mejean 2018). Firms' heterogeneity plays a key role in this synchronization as a result of the granularity of exports (Di Giovanni, Levchenko & Mejean 2020): large and more productive firms rely less on domestic inputs, leading to a dampening effect of firm heterogeneity on the international transmission of shocks. In presence of multi-product firms the within-firm product selection adds to the previous selection mechanisms when competition becomes tougher (Mayer, Melitz & Ottaviano 2014) or following a foreign shock (like the China shock identified through the phasing out of textile quotas (Fontagné, Secchi & Tomasi 2018)).

Another important dimension of globalization is increasingly attracting attention, namely *how shocks are transmitted within the trade and ownership firms' networks*, directly or indirectly, ultimately affecting the performances of the firms in terms of revenue per employee and productivity. Trade flows, input-output relations and within firms multinational transactions (through affiliates) have been shown to play a role in the transmission of shocks to, and among, firms (Di Giovanni & Levchenko 2010, Kleinert, Martin & Toubal 2015, Cravino & Levchenko 2017, Di Giovanni et al. 2018, Boehm, Flaaen & Pandalai-Nayar 2019, Bena, Dinc & Erel 2020). How firms adjust to foreign shocks remains to be further explored, especially when complex ownership structures establish international, and domestic, networks of firms. Firm-to-firm connections and business networks contribute to explain why domestic firms might be *indirectly* affected by foreign demand shocks through their business network (Dhyne, Kikkawa, Mogstad & Tintelnot 2020). The quality

of the business environment also plays a role in presence of vertical business relationships: the variance in the strength of contract enforcement across India determines how firms source inputs and organize production and the network structure of firms leads to misallocation in the market for inputs with a toll on aggregate productivity (Boehm & Oberfield 2020). Natural disasters have been used as firm-specific idiosyncratic shocks propagating through the network of input-output relationships as output losses in presence of specific inputs (Barrot & Sauvagnat 2016). Lastly, production networks are irresponsive to small shocks when firm-to-firm connections are costly to establish (Huneeus 2018).

Against this background, the objective of this paper is to quantify how foreign demand shocks affect directly and indirectly domestic firm revenues per employee and labor productivity, as the result of their trade and ownership networks, at a given competitiveness level of the industry-region of the firm. The transmission channels we consider are from the global economy to the domestic firms, and within the domestic economy across locations, sectors and firms, connected through business relationships (either Foreign Direct Investment – FDI thereafter – or within country business groups).

Instead of relying on firm-specific shocks, which is always problematic as shocks can be idiosyncratic (e.g. the decision of a manager or the low quality of an intermediate component from the suppliers network), we first compute an aggregated Market Access shock which is common to all firms in a given location (NUTS3) and industry (NACE2). Being computed as the variation in conditional import demand of foreign countries (from a structural gravity estimation), the resulting vector of external shocks can be considered plausibly exogenous to individual firm productivity. Moreover, external shocks are evaluated at a given level of competitiveness of the exporting industry-region the firm belongs to, as we consider the variation in import demand at destination excluding our countries of interest own exports. As a result, the usual export competitiveness channel (being the aggregate realization of individual firms productivity shocks) is therefore silenced.

This exercise is performed on three countries – France, Italy and Spain – manufacturing firms

for which we now their precise location and industry in each of the three countries. Starting from industry-location specific shocks we evaluate the role of ownership network on their diffusion within a country. In light of the relevance of indirect shocks on firm performances (Dhyne et al. 2020, Huneeus 2018) we investigate whether foreign shocks on a given location propagate to connected locations throughout domestic production networks.

To wrap up, the contribution of this paper is to estimate, for a given level of competitiveness of the exporting country, how exogenous external demand shocks impact firm performance – i.e. revenue per employee and productivity – while separating both their direct (location specific) and indirect impact. The latter impact is modelled as the spillover effect from other locations through domestic network of trade and investments. Importantly, demand shock is likely to be exogenous to changes in firm productivity, as computed from a theory consistent trade equation cleaning the variation from any confounding effect. The next step of the research agenda is to go beyond the labour productivity and quantify the impact of the mechanisms here described on factor misallocation.

The rest of the paper is organized as follows. Data is described in the Section 1. Section 2 details the identification strategy, while Section 3 discusses the results. Section 4 offers some concluding remarks.

1 Data description

We describe in the following section the firm level data, the selected countries and the time period considered. The main source of firm data data is the commercial dataset Orbis[1] from which we extract the exhaustive panel of manufacturing firms in Italy, Spain and France over the period 2009-2017. Importantly, the estimation panel is built as the recollection of different vintages of the database as to ensure the greatest yearly coverage. Three types of information are retained: i) annual balance sheets of the firm; ii) its location and iii) its global ownership network (in year 2007). As we do not observe trade flows at the firm level, we opt for an exogenous external

[1] `http://www.bvdep.com`

demand shock, constructed using aggregated trade data by sector and year, for each of the three countries in the sample.

Firm-level variables include: revenues, value-added (VA), total employment, labour productivity, headquarter location (NUTS 3) and main sector of activity (NACE 2). As for the global ownership network, we retain information on all ownership linkages in the 2007 Orbis vintage. We choose this year because it is prior the start of our panel, making the ownership decisions likely "pre-determined" to the demand shock and productivity changes tackled in our analysis. Based on this information, we can built both firm-specific and location-specific linkages with foreign countries as well as with other locations within a given country. Our outcome variable is the variation in either firm revenue per employee or firm productivity *vis-à-vis* an external demand shock, conditional on the competitiveness of each firm location.

We accordingly need information on the export structure of each of the three exporting countries (*before the shock*) by sector and destination as well as of each region within them. By matching firms and locations (NUTS 3) we obtain an exogenous structure of exports with the relevant dimension: region of the firm, exporting country-sector the region belongs to and country of destination of exports. *"Italian National Institute of Statistics (ISTAT)"* and *"Ministero de Industria, Comercio y Turismo"* provide trade data disaggregated at NACE 2 level for respectively Italy and Spain NUTS3 regions with the Rest of the World. As an example, we observe exports from the NUTS3 of Turin to Japan, in products grouped in the NACE sector number 10. This data is not ready available for France at the NUTS3 level thus we proceed differently. The *"Douanes dataset"* provides information on the destination of exports for each French manufacturing firm, by destination and year at the product level.[2] The SIRENE database documents the location of the exporting firms, sharing the same administrative identifier. By merging the two databases and collapsing the data at the *Département* (which correspond to French NUTS3) - industry (NACE2) - foreign country level, we obtain the corresponding information for France.

[2]Lionel Fontagné thanks the *Direction Générale des Douanes et Droits Indirects* for granting access to the Statistics of External Trade.

On the demand side, we build shocks exogenous to the firm (and its country of location) by using aggregate trade data, at the country-year-NACE 2 level. Such data are sourced from BACI (Gaulier & Zignago 2010). We proceed as follow. First, we estimate a structural gravity equation at the country-by-industry level and recover the inward Multilateral Resistance terms (MRT thereafter) for each destination market. Then we derive the corresponding market access term for each exporter region, sector, destination and year by aggregating destination market inward MRTs using predetermined NUTS3-by-industry export weights (i.e. in year 2009). As a consequence, our foreign country-sector specific trade shocks is the conditional demand - multilateral resistance term of imports - of foreign countries from the Rest of the World, excluding shipments from Italy, France and Spain.

On the trade side, the last piece of information needed is trade between regions within countries, i.e. *internal* trade. Unfortunately, trade between NUTS3 regions is not directly observed in official statistics. In order to establish the strength of connections across France, Italy and Spain NUTS3 regions (in a given sector) we must rely on a gravity theoretical framework. For a given industry, we calibrate trade elasticity to physical distance from a structural gravity estimation using country-by-country trade flows between EU-28 State Members (from BACI dataset). Given that we consider trade flows within the single EU market, clear of tariffs and Non-Tariff Barriers, we can safely assume that such elasticities equally apply at the sub national level. We combine then the estimated (distance) elasticities with the actual distance between NUTS3 region as well as their economic shares to infer the "virtual" exchanges among them.

2 Identification strategy

Importantly for our identification strategy, we observe for each firm i its location j (NUTS3) and its main sector of activity k (NACE2). All firms i in a given location j operating in sector k in year $t$face the same external demand shock, i.e. *market access*, MA_{jkt}. Such shocks are specific to location industry and year, and they are computed as the conditional import demand of foreign countries (d). The set of destinations d considered in the calculation includes the full array of destination markets in the world (approx 180 countries in BACI). Such shocks are most likely

exogenous to individual firm i productivity developments as they are defined as a change in the market access faced by a firm located in a NUTS3, operating in a certain NACE2 and calculated as the 5-year change of MA_{jkt}.

As afore mentioned, the demand is not directly taken from the trade statistics, but computed controlling for all unobserved characteristics of destination and origin country and sector: origin-sector-time, destination-sector-time, and origin-destination-sector unobserved characteristics are controlled for. By virtue of the structural gravity principles, the destination-sector-time fixed effects map to the inward MRT of each destination, thus capturing the theory consistent determinants of demand for each destination-sector-year triplet. The last step before moving to estimation is to weight the *market access* terms for all firms located in a certain origin (NUTS3) and operating in a certain sector (NACE2). Weights are taken from the pre-determined (2009) export structure of the different NUTS3 afore defined.

The different variables are constructed as follows:

$$MA_{jkt} = \sum_{d=1}^{D} w_{jdk,2009} * exp(\hat{\delta}_{dkt}) \tag{1}$$

where

$$w_{jdk,2009} = \frac{X_{jdk,2009}}{\sum_{d=1}^{D} X_{jdk,2009}} \tag{2}$$

and δ_{dkt} is the inward MRT estimated through the (OLS) structural gravity equation below:

$$ln(X_{odkt}) = \beta_0 + \gamma_{okt} + \delta_{dkt} + \nu_{odk} + \varepsilon_{odkt} \tag{3}$$

where γ_{okt}, δ_{dkt} , ν_{odk} are respectively origin-sector-time, destination-sector-time, and origin-destination-sector fixed effects. To ensure that the estimation country competitiveness does not affect the *market access* identification, France, Italy and Spain are excluded (as exporters) from the sample when estimating Equation 3.

So far we have considered a weighting matrix based on the export structure of the different NUTS3. An alternative way of weighting is to consider the ownership structures in combination to the commercial structures. By using information on ownership linkages, we can partition MA_{jkt} according to the extent of location-industry (jk) "FDI exposure". This will help in assessing how an external shock differently affects firms within an FDI exposed NUTS3-sector jk.

So far we have modelled the *direct* transmission channels corresponding to the trade and ownership network of the region-industry the firm belongs to. The last step is to drill into the *indirect* transmission channel, defined as the internal transmission of the direct external shocks to the three countries considered (i.e. the spillover flowing across regions and industries whiting each country). We will loosely call this channel the "spillover" effect.

The indirect shock is constructed as a domestic spillover from domestically connected locations-industry MA_{jkt}. The construction is similar to that of the foreign shock: instead of import demand from third countries we use as external shock the change itself of MA_{jkt} received by each connected location. Since we do not observe trade between NUTS3, we estimate it using a structural gravity equation and calculate sectorial weights between NUTS3 (in year 2009). Thus, the indirect shock, $Spill_{jkt}$ is calculated as follows:

$$Spill_{jkt} = \sum_{j'=1, j' \neq j}^{J} \tilde{w}_{jj'kt=2009} * MA_{j'kt} \tag{4}$$

where

$$\tilde{w}_{jj'kt=2009} = \frac{\tilde{X}_{jj'kt=2009}}{\sum_{j'=1, j' \neq j}^{J} \tilde{X}_{jj'kt=2009}} \tag{5}$$

and $\tilde{X}_{jj'kt=2009}$ is within countries predicted trade between different NUTS 3 estimated from Equation 6

$$ln(\tilde{X}_{jj'kt=2009}) = ln\left(\frac{GDP_{jkt=2009} * E_{j'kt=2009}}{\sum_{j=1}^{J} GDP_{jkt=2009}}\right) + \beta_k ln(Distance_{jj'}) \tag{6}$$

where $GDP_{jkt=2009}$ is exporter sector GDP in $jkt = 2009$; $E_{j'kt=2009}$ is importer sector expenditure in $jkt = 2009$; $\sum_{j=1}^{J} GDP_{kt=2009}$ is the sum of sectorial GDP on the three countries considered; β_k is trade elasticity of industry k, and $Distance_{jj'}$ is the distance in km between the centroids of NUTS 3 j and j'[3]. As for the direct effect, also for the indirect effect we can disentangle the spillover through the use of the domestic ownership linkages network, i.e. discriminating between domestic locations also connected by ownership linkages .

As firm level outcome we first focus on log(Revenues/Total Employment) and Labour Productivity –log(VA/Total Employment) – as a proxy for firm-level productivity. We will consider also TFP and labor misallocation as additional firm outcomes in an extension of the paper. We present the results for labour productivity in the core of the text as the various dimensions of response of the performance of the firm to a given shock are eventually subsumed in it.

We estimate a set of 15 equations on our panel of French, Italian and Spanish firms. We now expose the rationale of each equation – labelled from (a) to (o) in the text and in the tables of results of the next section. Notations are as follows: i, j, k, t, o identify respectively firm, NUTS3, NACE2, year and origin country (namely France, Italy or Spain).

We firstly estimate the *direct* impact of the exogenous demand shock on the performance of each firm, conditional on its industry and region, and on the competitiveness of this industry-region. $\Delta_5 LP_{it}$ is the 5-year difference of firm labour productivity. In Appendix we provide the results for $\Delta_5 REV_{it}$ which is the five-year change in the revenue per employee of the firm. Equation (a) explains the five-year change in the outcome for firm i at year t with the five-years change in the demand addressed to any firm located in that industry-region at given competitiveness level of the exporting country o, net of any confounding factor specific to the region and year considered (e.g. a supply shock in the region the firm belongs to, common to all industries in that region). $\Delta_5 MA_{jkt}$ is this foreign shock defined above.

Equation (b) cuts our sample into two bins according to the connection of the industry-region

[3]Estimated trade linkages $\tilde{X}_{jj'kt=2009}$ are censored to 1000 €; sectorial trade elasticity β_k is calculated using an ancillary structural OLS gravity model for EU-28 over the period 2009-2017

of the firm to ownership networks. As said, for sake of a plausible identification strategy, this network is fixed in year 2007, prior to the shocks we are interested in. This ensure that successive firm level productivity changes do not feedback into the ownership network through mergers and acquisitions. We ask whether the industry-regions comprises firms internationally connected through a foreign parent or a foreign subsidiary. This defines the dummy $FDI_{jk} = 1$, which has no t subscript for the reason just mentioned. Accordingly, equation (b) is estimating the impact of the external demand shock separately for firms operating within connected regions – even if these firms are not themselves connected – and the rest of our population. We control for any confounding factor specific to the region and year considered by sake of the region-year fixed effect.

Recall that in equation (a) and (b), the weighting matrix describing the *direct* impact of business network at the initial period was based on observed trade weights at the region-industry level. This matrix was directly observed in the Italian and Spanish trade data, and reconstructed from the micro-data for the universe of French exporters as afore mentioned. We now consider the distance between this business network defined on the basis of trade relationships and another metric of the business networks that considers FDI weights for each region-industry, and we investigate the role played by the degree of synchronization between the trade and ownership foreign networks. To proceed, we compute the Euclidian distance between the pre-determined vectors of trade and ownership weights for each sector-region, with all foreign partners. The distribution of this distance across industry-region is informing us on the potential impact of trade and ownership links between firms and across borders: ρ is a dummy equal to 1 if the distance between the two networks is in the lowest decile.

We finally split in equation (d) the sub-population of firms operating in connected regions into two bins, according to the own connection of the observed firm, as not all firms in a connected region are indeed connected. We define the dummy $FDI_i = 1$ if the firm i *had* a foreign parent or subsidiary at the initial period (for sake of exogeneity). Equations (e) and (f) keep the rationale of equation (d), but with a different set of fixed effects. Equation (e) is introducing sector-time fixed effects on the top of the region-time fixed effect to control for any confounding sector-specific shock. Equation (f) is also controlling for any origin country-sector-specific shock.

Concerning the fixed effects, γ_{jt}, φ_{kt} and ψ_{okt} are respectively NUTS3-year, NACE2-year, Country-NACE2-year fixed effects.

In equations (a) to (f) errors are clustered at the region-industry-year and firm level. Results for this first set of equations are shown in Table 1.

$$(a) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt} + \gamma_{jt} + \varepsilon_{it}$$

$$(b) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1} + \gamma_{jt} + \varepsilon_{it}$$

$$(c) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=0} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=1} + \gamma_{jt} + \varepsilon_{it}$$

$$(d) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{i}=1} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{i}=0} + \gamma_{jt} + \varepsilon_{it}$$

$$(e) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{i}=1} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{i}=0} + \gamma_{jt} + \varphi_{kt} + \varepsilon_{it}$$

$$(f) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{i}=1} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{i}=0} + \gamma_{jt} + \psi_{okt} + \varepsilon_{it}$$

We now want to further investigate the role of ownership connection in the direct transmission of shocks by taking into account not only the presence of an international network but also its intensity. This leads to the five next equations, (g) to (k). Notice that Table 2 reproduces in the first column the results of equation (b) in order to shed light on the impact of having the firm operating in an industry-region highly connected through international FDI networks. As before, trade weights are used to specify the demand shock faced by the firm.

Equation(g) splits our population of firms in three bins: firms with no FDI connection (indifferently firms in industry-region with no FDI connection: $FDI_{jk} = 0$), firms operating in region with low FDI connection ($FDI_{jk} = 0$ & $1^{st}D = 0$), versus in region with high FDI connection ($FDI_{jk} = 1$ & $1^{st}D = 1$). The dummy $1^{st}D$ is defined based on the distribution of intensity of FDI connections: it is equal to 1 if the number of FDI involved firms is in the first decile of the distribution.

Equation (h) reproduces equation (b), using a different set of fixed effects, controlling for unobserved sector-time shocks on the top of region-time shocks.

Equation (i) reproduces equation (g), controlling for unobserved sector-time shocks on the top of region-time shocks.

Equation (j) reproduces equation (h), controlling for unobserved origin country-sector-time shocks on the top of region-time shocks.

Equation (k) reproduces equation (i), controlling for unobserved origin country-sector-time shocks on the top of region-time shocks.

In equations (g) to (k) errors are clustered at the region-industry-year and firm level. Results for this first set of equations are shown in Table 2.

$$(g) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=0} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=1} + \gamma_{jt} + \varepsilon_{it}$$

$$(h) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1} + \gamma_{jt} + \varphi_{kt} + \varepsilon_{it}$$

$$(i) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=0} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=1} + \gamma_{jt} + \varphi_{kt} + \varepsilon_{it}$$

$$(j) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1} + \gamma_{jt} + \psi_{okt} + \varepsilon_{it}$$

$$(k) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=0} + \beta_3 \Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=1} + \gamma_{jt} + \psi_{okt} + \varepsilon_{it}$$

Our last set of equations aims to quantify the magnitude of indirect impacts of a foreign shock

on the performance of the firms in a a given industry-region. The weighting matrix of the demand shock is as before the trade weights observed at the initial period.

Equation (l) is adding to the direct effect of Δ_{MA} already presented an indirect effect, channeling through the trade networks of the region considered with the other regions of the *same* country. We note $Spill_{jkt}$ this indirect effect, which is measured using the inter-regional intra-national trade at the industry level, projected with a gravity equation embarking production at origin and income destination, geodesic distance between regions centroids and an elasticity of trade to distance recovered from international intra-European Union trade flows.

Equation (m) is splitting the industry-region of the firms with and without international ownership connections and with or without internal ownership connections respectively. DDI_{jk}, the mirroring variable of FDI_{jk}, indicates whether the region-industry jk is involved in "domestic direct investments", meaning ownership connections with other regions of the same country.

Equation (n) is reproducing equation (l) with a different set of fixed effects, adding the control for unobserved sector-year shocks.

Equation (o) is reproducing equation (m) with a different set of fixed effects, adding the control for unobserved sector-year shocks.

In equations (m) to (o) errors are clustered at the firm and origin country-industry-year and firm level to control for the within country spatial dependence induced by the spillover measure. Results for this first set of equations are shown in Table 3.

$$(l) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt} + \beta_2 \Delta_5 Spill_{jkt} + \gamma_{jt} + \varepsilon_{it}$$

$$(m) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1} + \beta_3 \Delta_5 Spill_{jkt}^{DDI_{jk}=0} + \beta_4 \Delta_5 Spill_{jkt}^{DDI_{jk}=1} + \gamma_{jt} + \varepsilon_{it}$$

$$(n) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt} + \beta_2 \Delta_5 Spill_{jkt} + \gamma_{jt} + \varphi_{kt} + \varepsilon_{it}$$

$$(o) \quad \Delta_5 LP_{it} = \beta_0 + \beta_1 \Delta_5 MA_{jkt}^{FDI_{jk}=0} + \beta_2 \Delta_5 MA_{jkt}^{FDI_{jk}=1} + \beta_3 \Delta_5 Spill_{jkt}^{DDI_{jk}=0} + \beta_4 \Delta_5 Spill_{jkt}^{DDI_{jk}=1} + \gamma_{jt} + \varphi_{kt} + \varepsilon_{it}$$

3 Results

Let us first consider the impact of a demand shock as reported. We start in column (a) of Table 1 by showing the results of an exogenous demand shock on labour productivity of the firm, at given level of competitiveness of the industry-region, controlling for unobserved region-year shocks common to all firms. The parameter is positive and significant at the 1% level, meaning that a negative shock translates into a drop in labour productivity. Global shocks are thus transmitted to the firms through trade networks, as expected. But interestingly, this transmission is largely mediated by firms' ownership networks: we show in column (b), that if we split the industry-regions, those with no FDI connection are much less affected. Our quantification is that firms in FDI-connected industry-regions are three-time more affected by demand shocks. Hence, most of the trade impact is channelling through the combined network of international trade and ownership relationships.

We further decompose in column (c) of Table 1 the effect of a demand shock by considering the intensity of overlap between trade and ownership networks in which industry-regions are involved. The parameter for region-industry with no FDI involvement is indeed unaffected. The interaction with the dummy ρ tells us how firms operating in industry-regions where the two networks –

trade and FDI – overlap the most (the regions where the Euclidian distance between the two is the lowest) are affected, compared to the rest of firms operating in industry-regions with a lower proximity of the two networks. Our quantification is that firms operating in industry-regions with largely overlapping trade and ownership networks are affected twice as much, compared to firms in other regions with more limited overlap. And recall that even the latter firms are more impacted than firms in regions with no FDI involvement.

Lastly, we focus on the sub-population of firms operating in FDI-connected regions, and split them according to their own connection (or not) with the dummy FDI_i in columns (d) to (f). In column (d), we keep the same structure of fixed effects as in columns (a) to (c), while column (e) additionally controls for unobserved industry-time shocks, and column (f) for country-industry time unobserved shocks respectively. Column (d) is telling us that the impact of the demand shock is 50% higher for connected firms, compared to unconnected firms in connected regions. Columns (e) and (f) even provide difference larger from an order of magnitude, but the main message remains. And the bottom line is that even unconnected firms are much more affected in connected regions, as shown by the comparison of column (d) last raw and first raw: the explanation is that global business networks transmit the demand shock to firms that are not themselves engaged in international ownership, as a consequence of business relationships between connected and unconnected firms in the considered industry-region (think of subcontractors for instance).

We reproduce in the first column of Table 2 column (b) of Table 1 for sake of comparison. We now compare with column (g) splitting industry-regions according to the intensity of their FDI connectedness. The parameter for unconnected industry-regions is indeed not statistically significant between the two columns. This comparison shows that firms belonging to the top decile in terms of intensity of FDI connections are 2.4 times more affected by the demand shock. Columns (i) and (k) confirm this result with different set of fixed effects and give an order of magnitude of the impact for firms of the two types ranging from 2 to 3.

The last piece of evidence provided by our exercise is about the *indirect* impact of a trade shock. We already identified some indirect impact above, as non-FDI connected firms could well

Table 1: Trade direct impact - I

VARIABLES	$\Delta_5 LP_{it}^{VA}$					
	(a)	(b)	(c)	(d)	(e)	(f)
$\Delta_5 MA_{jkt}$	0.0886***					
	(0.0143)					
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$		0.0503***	0.0502***	0.0503***	0.0016	-0.0107
		(0.0184)	(0.0184)	(0.0184)	(0.0200)	(0.0207)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$		0.1411***				
		(0.0221)				
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=0}$			0.1344***			
			(0.0224)			
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=1}$			0.2692***			
			(0.0900)			
$\Delta_5 MA_{jkt}^{FDI_{i}=0}$				0.1380***	0.1049***	0.0692***
				(0.0226)	(0.0245)	(0.0253)
$\Delta_5 MA_{jkt}^{FDI_{i}=1}$				0.2027***	0.1859***	0.1506**
				(0.0669)	(0.0669)	(0.0670)
Observations	378,951	378,951	378,951	378,951	378,951	378,950
R-squared	0.0105	0.0106	0.0106	0.0106	0.0136	0.0149
FEs	jt	jt	jt	jt	jt kt	jt okt
Cluster	i jkt	i jkt	i jkt	i jkt	i jkt	i jkt
Country	all	all	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.

Table 2: Trade direct impact – II

VARIABLES	$\Delta_5 LP_{it}^{VA}$					
	(b)	(g)	(h)	(i)	(j)	(k)
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$	0.0503***	0.0499***	0.0017	0.0018	-0.0107	-0.0107
	(0.0184)	(0.0184)	(0.0201)	(0.0201)	(0.0207)	(0.0207)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$	0.1411***		0.1090***		0.0734***	
	(0.0221)		(0.0240)		(0.0248)	
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=0}$		0.1326***		0.1063***		0.0696***
		(0.0223)		(0.0241)		(0.0249)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=1}$		0.3271***		0.2009**		0.2002**
		(0.1001)		(0.0965)		(0.0983)
Observations	378,951	378,951	378,951	378,951	378,950	378,950
R-squared	0.0106	0.0106	0.0136	0.0136	0.0149	0.0149
FEs	jt	jt	jt kt	jt kt	jt Ckt	jt Ckt
Cluster	i jkt	i jkt	i jkt	i jkt	i jkt	i jkt
Country	all	all	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.

be more affected by the demand shock as a consequence of the presence in their industry-region of connected firms. The type of indirect link we are considering now is different. We start with the indirect effect corresponding to demand shocks' spillovers across industry-regions. To give an example, a firm located in Barcelona and operating in the mechanical industry will be affected indirectly by the demand shock faced by Bizkaia (by firms operating e.g. in Bilbao, as the result of the industry-destination orientation of the Basque autonomous community exports). Column (l) in Table 3 is to be compared with column (a) in Table 1. The overall effect of the demand shock captured in the latter column is reduced when one controls for spillovers in the former column. And the variation in the intensity of the spillover is now partially explaining the variation in the outcome – labour productivity. The bottom line is that above one-third of the total impact of the demand shock is channelling through indirect effects *across regions and industries of a given country*.

We can now compare column (b) in Table 1 with column (n) in Table 3. This is informing us on how controlling for *domestic* spillovers affects the channel of FDI-connectedness of the industry-region the firm is operating in. We find that around 30% of the impact channels through domestic spillovers. The coefficients estimated for the local spillover variable in the two types of regions (local ownership connectedness or not) in column (n) in Table 3 confirm that domestic spillovers are more than three times larger in industry-regions connected with other regions of the same country, within the same industry. This result shows that external demand shocks are largely transmitted within the boundaries of the firms across the different regions of a given country.

Table 3: Trade indirect impact

VARIABLES	$\Delta_5 LP_{it}^{VA}$			
	(m)	(n)	(o)	(p)
$\Delta_5 MA_{jkt}$	0.0583***		0.0379**	
	(0.0181)		(0.0176)	
$\Delta_5 Spill_{jkt}$	0.0927***		0.0442	
	(0.0362)		(0.0391)	
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$		0.0358*		0.0038
		(0.0209)		(0.0210)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$		0.0941***		0.0993***
		(0.0266)		(0.0252)
$\Delta_5 Spill_{jkt}^{DDI_{jk}=0}$		0.0584*		0.0154
		(0.0345)		(0.0378)
$\Delta_5 Spill_{jkt}^{DDI_{jk}=1}$		0.1970***		0.1532***
		(0.0589)		(0.0563)
Observations	378,951	378,951	378,951	378,951
R-squared	0.0106	0.0107	0.0136	0.0137
FEs	jt	jt	jt kt	jt kt
Cluster	i okt	i okt	i okt	i okt
Country	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.

4 Conclusion

This paper asked how globalization, global competition and foreign demand shock affect domestic firms' productivity, with a focus on how shocks are transmitted within the trade and ownership firms' networks. To answer this question, we quantified how foreign demand shocks affect, directly and indirectly, domestic firm revenue per employee and productivity, as the result of their trade and ownership networks, at a given competitiveness level of the industry-region of the firm. The transmission channels we considered are from the global economy to the domestic firms, and within the domestic economy across locations, sectors and firms, accounting for business relationships and the prevalence of Foreign Direct Investment relationships and of relations between firms belonging to the same group within a country. An important element of our identification strategy worth stressing is that the demand shock i) is constructed such as to make sure it is exogenous to the firm, and ii) is computed based on a theory consistent trade equation controlling for the impact of any confounding effect.

We considered the panel of all manufacturing firms in Italy, Spain and France over the period 2009-2017. Each firm has been identified according to the region and industry of operation. We addressed transmission channels through the export structure of these industry-regions, through the international network of ownership connections between firms, and through the domestic business networks characterised by *internal* (i.e. domestic) trade and internal ownership structures.

Our conclusions are clear-cut. Global shocks are transmitted through trade networks and this transmission is largely mediated by firms' ownership networks. Firms operating in FDI-connected industry-regions are three-time more affected by external demand shocks. Moreover, firms operating in industry-regions with largely overlapping trade and ownership networks are affected twice as much. Also, unconnected firms that are not themselves engaged in international ownership are also indirectly affected by external demand shocks, as a consequence of business relationships between connected and unconnected firms. Above one-third of the total impact of the demand shock is channelling through indirect effects across regions and industries of a given country. Lastly, domestic spillovers have been shown to play also a big role in the transmission of external demand

shocks.

From a policy perspective, our findings stress that the impact of foreign shocks is not limited to firms engaged in international business through commercial or ownership connections. All firms operating in exposed industry-regions are affected as a result of their business relationships, and this result extends to firms operating in a different region and/or sector of the affected country. From the point of view of firms operating in the three EU Member states covered by our analysis, the economy has really become global. Shocks are transmitted across borders by trade and/or within the boundaries of the firms as a result of decisions made by headquarters. And international shock are even transmitted across regions of a given country, as a result of complex business relationship, commerce or ownership, between domestically located firms.

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Appendix

A1: Trade direct impact - I

VARIABLES	$\Delta_5 REV_{it}$					
	(a)	(b)	(c)	(d)	(e)	(f)
$\Delta_5 MA_{jkt}$	0.0843***					
	(0.0158)					
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$		0.0558***	0.0557***	0.0558***	0.0076	0.0050
		(0.0193)	(0.0193)	(0.0193)	(0.0207)	(0.0208)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$		0.1233***				
		(0.0261)				
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=0}$			0.1174***			
			(0.0268)			
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,\rho=1}$			0.2378**			
			(0.0973)			
$\Delta_5 MA_{jkt}^{FDI_{i}=0}$				0.1224***	0.1073***	0.0803***
				(0.0266)	(0.0266)	(0.0271)
$\Delta_5 MA_{jkt}^{FDI_{i}=1}$				0.1413*	0.1374*	0.1194*
				(0.0722)	(0.0710)	(0.0709)
Observations	378,903	378,903	378,903	378,903	378,903	378,902
R-squared	0.0117	0.0118	0.0118	0.0118	0.0160	0.0174
FEs	jt	jt	jt	jt	jt kt	jt okt
Cluster	i jkt	i jkt	i jkt	i jkt	i jkt	i jkt
Country	all	all	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.

A2: Trade direct impact - II

VARIABLES	$\Delta_5 REV_{it}$					
	(b)	(g)	(h)	(i)	(j)	(k)
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$	0.0558***	0.0553***	0.0076	0.0078	0.0050	0.0050
	(0.0193)	(0.0193)	(0.0207)	(0.0207)	(0.0208)	(0.0208)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$	0.1233***		0.1089***		0.0823***	
	(0.0261)		(0.0261)		(0.0265)	
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=0}$		0.1125***		0.1050***		0.0781***
		(0.0265)		(0.0261)		(0.0266)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1,1^{st}D=1}$		0.3613***		0.2413**		0.2196**
		(0.1018)		(0.1025)		(0.1047)
Observations	378,903	378,903	378,903	378,903	378,902	378,902
R-squared	0.0118	0.0118	0.0160	0.0160	0.0174	0.0175
FEs	jt	jt	jt kt	jt kt	jt okt	jt okt
Cluster	i jkt	i jkt	i jkt	i jkt	i jkt	i jkt
Country	all	all	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.

A3: Trade indirect impact

VARIABLES	$\Delta_5 REV_{it}$			
	(l)	(m)	(n)	(o)
$\Delta_5 MA_{jkt}$	0.0690***		0.0440**	
	(0.0198)		(0.0195)	
$\Delta_5 Spill_{jkt}$	0.0466		0.0067	
	(0.0445)		(0.0444)	
$\Delta_5 MA_{jkt}^{FDI_{jk}=0}$		0.0505**		0.0110
		(0.0229)		(0.0226)
$\Delta_5 MA_{jkt}^{FDI_{jk}=1}$		0.0986***		0.1037***
		(0.0295)		(0.0288)
$\Delta_5 Spill_{jkt}^{DDI_{jk}=0}$		0.0185		-0.0222
		(0.0414)		(0.0432)
$\Delta_5 Spill_{jkt}^{DDI_{jk}=1}$		0.1315*		0.1189*
		(0.0744)		(0.0610)
Observations	378,903	378,903	378,903	378,903
R-squared	0.0118	0.0118	0.0160	0.0161
FEs	jt	jt	jt kt	jt kt
Cluster	i okt	i okt	i okt	i okt
Country	all	all	all	all

Notes: Clustered standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. "Country all" means France, Italy and Spain pooled.