Networked Shocks and Regional Resilience: Implications from Brexit and the Corona Pandemic

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Abstract

This paper argues that for regional policies to be effective for resilience and economic diversification, a larger understanding of both the complexity of interregional networks and the absorptive capacities of firms in regions is needed. Using Brexit and the corona pandemic as examples of shocks, the heterogeneity of regional and sectoral impacts on firms is shown. Although exposures to and potentials of shocks can be identified for regions (speculatively, as both shocks have not materialized fully yet), translation of these into policy measures that address firms' selective competitive needs is challenging. Many impacts are generated and distributed along market and competition relations, which are not always sensitive to (the same) place-based policies. A discussion on policies that link to a broader interpretation of resilience (of both repair and renewal) is presented, and a research agenda is adhered that more extensively explores how local policies can be implemented in the multilevel network-region-firm structure of impacts.

1. Introduction

Large external shocks impose economic threats to regions, but may also offer opportunities for structural change, allowing for new varieties of production to enter or flourish in regions, and less viable ones to diminish or exit. Economic shocks transmit through complex networks of economic interaction between (actors in) regions and affect the competitive positions of industries and firms. Recent economic geographical literature suggests that opportunities for new regional varieties may be stimulated locally from specific specialized industries, crossovers from technological knowledge and complementary labour skills (Neffke et al. 2011, Balland et al. 2019). The degree of technological or cognitive relatedness of the local economy then is crucial for understanding the potentials of structural change (Frenken et al. 2007). Although such a localized character of economic development is little disputed, two aspects in this endogenous development conceptualization are in need for more attention. The first concerns the degree to which mechanisms leading to innovation, renewal and growth in regions originate from exogenous, unpredictable, interregional networked relations (and shocks therein). The second concerns the fact that firms within industries are in the end making up regional resilience, competitiveness (competition), and regional structural change but are

heterogeneously addressed by general policies. Both the network and firm-sectoral level details connected to the regional relational economy are complex in character. As data on both network and firm-sector level is increasingly available, economic analysis and policy should use insights from this data. This paper uses the shocks of Brexit and the corona pandemic to show how a multilevel complexity determines new opportunities and threats for firms and industries in regions, and that policies on regional resilience ideally should focus both on mitigation of impacts ('repair') as well as the stimulation of structural changes ('renew'). Examples of these are given using networked trade data and its potential impacts on European regions (particularly Italian regions) in case of a hypothetical hard Brexit, and the potential value of regional and sectoral economic mitigation strategies of corona health measures. As both shocks have not fully materialized yet, the reasoning will be partly speculative. It does show however that a better understanding of complex networked structures underlying the impacts on firms and industries competitiveness may serve better identification of effective regional economic policies.

To do this, section 2 presents conceptual notions on regional variety and networked proximities. The region is part of larger networks, of trade, investments and knowledge, and positions in these networks may be determining for the occurrence of economic potentials and threats, especially when shocks occur in these networks. How this may work out for regions in the UK and the EU (particularly Italian regions) after a hard-deal Brexit, is sketched in section 3. This section suggests that what is good for the goose (competitive positions of firms in EU regions), may not be good for the gander (competitive positions of firms in UK regions). Value chain relations may impose threats to European regional economies that are not directly importing from or exporting to the UK. Materialization of effects are argued to be strongly dependent on absorptive and adaptive capacities of (firms in) regional industries. Section 4 explores policy initiatives that may suite both regional repair and renewal agendas during and after the corona pandemic, applying a broad definition of resilience (Boschma 2013). As also suggested in the discussed Brexit research, challenges before the corona crisis turn out to be even larger challenges afterwards. Section 5 discusses that reinforced emphasis on the identification of threats and potentials in a multilevel setting is needed, with policies aligning to this.

2. Regional variety and networked proximities

Economic growth opportunities and associated knowledge is neither equally accessible nor equally relevant for economic actors (Cortinovis & Van Oort 2020). But ideas, capabilities and knowledge are easier profitably exchanged and applied when the knowledge base of different actors are more related. In contrast, when the cognitive distance is large and actors do not 'speak the same language', knowledge and growth spillovers are less likely to take place. There is an emerging body of literature that focuses on the implications of relatedness for the process of regional diversification and economic growth. Incumbent firms are more likely to enter industries that are relatively close to the one they are already operating in. Similarly, new firms are more likely to start off and be successful in a sector that is closely related to other sectors in the region, as they can benefit from relevant local capabilities (like related knowledge and skills), or what has been referred to as 'local related externalities' (Neffke et al. 2015). Diversifying into a completely unrelated sector, though still possible, would increase fundamental uncertainty and make firms face higher costs and higher risks of failure, due to the lack of required capabilities both at the firm and the regional level. The consequences of these dynamics are that regions tend to diversify into new industries that are closely related to their existing industrial base. This implies that regional diversification can be considered a path-dependent process, in which the industrial history of regions provides opportunities but also sets limits to diversification. This process of relatedness-driven diversification has been referred to as regional branching, since new activities draw upon and combine capabilities from existing local activities. Empirical studies have confirmed the predominance of this process of related diversification both at the national and regional scale (Neffke et al. 2011; Boschma et al. 2013). Important ingredients needed for regional anchoring of these trajectories are argued to be the skills of employees that are available in cities and regions (Neffke 2019), product and service markets (for matching), indivisible assets and infrastructures (for sharing) and universities and competitors (for learning opportunities) and reduced transport and transaction costs in each of these (Duranton & Puga 2014). From these theories and findings, a picture emerges of a region profiting from geographical proximity and agglomeration (with specialization and diversification externalities), where the right local circumstances enable industry specific endogenous growth and innovative recombination opportunities.

Boschma (2005) suggests though that various forms of proximity may play a role simultaneously. Organizational, institutional, cognitive or technological proximities may arise in collaboration, investment or value chain relations crossing region's boundaries, dependent on local concentrations of productive assets linking to production and innovation networks

(Boschma & Iammarino 2009, Cortinovis & Van Oort 2018). Despite its appealing conceptualization, in empirical research on proximities it is hard to distinguish between the different types of intra- and interregional proximity, because all have an outcome in common; namely that physical proximity is important in all of them (Caragliu et al. 2016). The increasing use of microdata on transfer mechanisms of knowledge spillovers allows for more identification of effects as proximities are not by definition substitutes for one another, yet the 'proximity equivalence' remains problematic when geographical co-location may be both a cause and an outcome of other proximities. As Crescenzi et al. (2020, p.9) state, "if various kinds of proximity are needed for successful innovation, the problem is that we know little about the causal sequences by which such different proximities come about". Notwithstanding this, there have been interesting contributions on how extra-local linkages (however defined) may facilitate local growth opportunities (Bathelt et al. 2004, Morrison et al. 2013), how trade linkages contribute to knowledge diffusion and growth (Mendoza 2016, Ernst & Kim 2002), how receiving foreign direct investments from multinationals may induce employment or productivity in host regions (Lo Turco & Maggioni 2019, Elekens et al. 2019, Crescenzi et al. 2017), and how membership of international knowledge networks may stimulate local innovation and economic growth (Miguelez et al. 2017, Crescenzi et al. 2016).

Insight in such interregional relations is crucial, for instance for the future competitiveness and cohesion of European regions. With the objective of offering prosperity and quality-of-life opportunities for citizens in all EU regions, comes the notion that while inequalities between countries are declining, inequalities between regions within countries seem to increase (Dijkstra et al. 2019). Regional policies that intend to reduce this regional inequality or to induce stronger economic growth can take various forms, and can be employed at several levels of governance, making them essentially multi-level and multi-actor in character. The European Commission recently embraced the concept of smart specialization, in which both the endogenous growth potential of regions due to entrepreneurial opportunities ('smart specializing or diversifying'), and external networks of economic interaction are hypothesized important (Foray 2015, p.76-77). While the local development potentials of regions are put central in many place-based development strategies (Barca et al. 2012, Neumark & Simpson 2016), it is the network dimension and how this impacts on firm competitiveness that remains little understood. Because of a lack of interregional economic network information, applied knowledge for local decision making in for instance trade, infrastructure and knowledge networks is scarce, while these aspects form a significant part of the cohesion policy budget

(Thissen et al. 2013). Many EU-policies relate to interregional relations, even though relatively little is known about these. Policies on trade, knowledge (the European Research Area), foreign investments, competitiveness of regions, smart specialization and cohesion policies all relate to intra- and interregional relations. Thissen et al. (2013) and Van Oort & Thissen (2017) showed empirically that regional economic positions in European networks to a large extent determine *local* opportunities for development and place-based policy strategies. In line with these arguments, concerns have been raised on the extent to which regions economically or socially gain or lose from globalization, and whether recent changes in globalization perception - like Brexit and the impacts of the corona crisis, but also other changing trade deals, social movements, changing attitudes towards sustainability, inequality and digitization - can be explained by uneven endowments for interregional relations. Interregional relations are by definition very complex, with many independent and interrelated aspects relevant for regional development prospects, sometimes co-evolving in character and sometimes hampering each other.

All these interregional network relationships arguably embody relevant networked proximity dimensions, but how well firms function in these is found to be dependent on their absorptive capacity – the ability to internalize external trends and developments (like in times of shocks) from the network and use it for own profit (Fu 2008, Cortinovis & Van Oort 2018). This absorptive and adaptive capacity is crucial for regional resilience and sector-level competitiveness in case of economic shocks. In line with the noticed 'proximity equivalence', geographical proximity is often claimed to be beneficial for absorptive capacity, as it facilitates collaboration and knowledge exchange. Most often this is explained by the importance of face-to-face contacts for the exchange of tacit knowledge (McCann 2013). In many studies this localized interaction is however only assumed implicitly rather than examined in an explicit manner (Carlino & Kerr 2015), although increasing availability and use of micro-data in network flows and econometric methodologies brings identification of place-based and cluster effects closer (Battke et al. 2016). Yet, due to interregional network relations, the impacts of extra-regional shocks are very complex in nature and difficult to identify. A recent paper of Berkowitz et al. (2019) for instance, makes a plea for identification of the exact impacts of restructuring cohesions policy funds, stressing the disturbing effects of "bad controls", doubted exogeneity of shocks and developments, and the recognition of indirect transmission channels that are correlated to the direct ones. Shocks in trade networks are therefore rather limited researched for regional structural change, as they are regarded too macro-economic for steering

specific, locally effective policies. Instead, policy focuses much on short term mitigation (Boschma 2013). But it is exactly the competitive position of firms that is affected by such shocks. The need for integration of firm-in-sectors level and regional level policies in the light of structural change opportunities and threats will be illustrated in this paper using Brexit and corona as examples of shocks in the next sections.

3. Competitiveness implications of a hard Brexit scenario

The exact nature of the post-Brexit UK-EU trade relationship is not known and may be uncertain for quite a while. However, given the very short time-period for negotiating a new agreement between the UK and EU governments in 2020, it is strongly suggested that the final UK-EU trading arrangement may be akin to a so-called 'hard Brexit' which involves the UK reverting to World Trade Organisation (WTO) trade rules. A recent paper by Thissen et al. (2020) therefore explored how Brexit will impact on the competitive vulnerability or opportunity of (firms in) industries in different regions at the level of NUTS2 regions in Europe, putting emphasis on how robust these implications are with respect to different types of Brexit agreements. This relationship between firm competitiveness and changes in locational and trade network characteristics turns out to be complex, illustrating exactly the points of network and firm-sector dependence made in the previous section. The methodology used allows to calculate the different relative orders of magnitude of restructuring which are eventually required for different industries in different regions in order to adjust to the tariff and non-tariff cost increases associated with Brexit (Thissen et al. 2020). The analysis is undertaken by building a novel Leontief price model which not only includes regional sectoral structure and value-chain effects, but also incorporates the revealed spatial competition relationships underpinned by these value-chain structures across all UK and EU regions. It then analyses the change in the ability of firms in region/sector contexts to compete due to changes in the production costs or tariffs that must be paid on sales markets due to Brexit.

In order to understand the nature and importance of the issue, Thissen et al. (2020) use an illustrative example of the possible Brexit-related effects on the competitiveness of beer producers in different countries. In this example, "steel produced in the UK and The Netherlands is used in the UK production of beer cans, which are then used by British, Dutch and German beer producers located in the UK and in The Netherlands and Germany. Thus, a Brexit-related tariff on steel being traded from The Netherlands to UK firms may not only result in higher direct UK steel prices but also may result in an increase in the production costs

of many beer cans in the UK, and consequently in the final price of a can of beer. The costs effects of Brexit on the UK, Dutch and German companies producing beer will depend in part on their ability to shift steel sourcing into or away from the UK, and also on the extent to which they directly compete with each other in the British, Dutch and German consumer markets. Moreover, beer producers do not only use beer cans but also other inputs such as grains, insurance, ICT and financial services etc., and each of these sectors will also be affected differently by Brexit due to their position within global value-chains, and in turn these sectors will affect beer producers' costs in different ways. As such, Brexit induces direct costs increases associated with the tariff and non-tariff related costs and indirect costs which are transmitted via the input-output and global value-chain networks. The overall costs increase facing beer producers from the three different countries will depend on their own specific positioning within these complex configurations of cross-border input-output and global value-chain relationships also involving all other sectors and regions. Although the costs of all beer producers will stay either equal or will increase, this does not, however, mean that the competitiveness of all beer producers falls. The reason is that it also depends on their spatial presence in different markets. The Dutch, British and German beer producing industries will have a different market presence in different regions. In regions where the three beer producers all have a major market presence, the differential tariff and non-tariff costs effects of Brexit on each of the countries will imply that the competitiveness implications will be different for the three beer producers, with the producer whose costs increase the most facing the greatest loss of competitiveness in that particular market. In contrast, in regions where a beer producer has a very dominant position with little or no competition, then the costs increases associated with Brexit will be mainly passed on to customers".

This example demonstrates that the spatial distributional competition (competitiveness) effects of Brexit are not clear cut, with some individual firms or sectors in specific regions potentially gaining competitive positions and associated market shares, while others will likely be losing out on all competitiveness dimensions. This is a characteristic of the industry-specific and regional-specific heterogeneity of revealed competition (Thissen et al. 2013). A cost increase for a specific sector in a specific region may be offset in terms of competitiveness when competing regions face similar or even higher cost increases. Regional changes in these competitive opportunities and vulnerabilities are calculated as cost increases for regions vis-à-vis all their sector and sales market specific competitors. Products traded within the UK or

within mainland EU will not be affected by Brexit tariffs, and hence may become relatively cheaper compared to products that cross the UK-EU boundary.

Focussing on international competitiveness of firms embedded in industries, Thissen et al. (2020) conclude that the overall national and regional losses for the UK regions are much higher than for other EU regions (in line with earlier research by Chen et al. 2018). Regions in the Low Countries, Ireland, Germany and Italy also experience competitive vulnerabilities in niche markets, like agricultural products exports being affected due to a price effects in international value chains for this sector. At the same time, many other regions of Europe face competitive opportunities at the UK's expense. See table 1 for the impacts on competitiveness of Italian region-sector combinations. All shaded cells in the table show above-average sector size (specialization) with divergent average certainty effect in the region. In dark grey, all impacts are shown that have above average certainty of impact of Brexit (so are insensitive to the exact Brexit (non)tariff scenario). In light grey, all impacts are shown that have below average certainty of impact of Brexit (so are sensitive to the exact Brexit (non)tariff scenario). The numbers refer to the effect on competitiveness - a negative number is an improvement in competitiveness. The cost increase numbers are between brackets in the cells. The selected sectors have at least one element in the row that is grey (above/below divergence in certainty of impact). Due to value-chain relations, the developments signalled in the table may even occur in regions that do not overwhelmingly trade with the UK directly, but are dependent on value chain relations that do cross the EU-UK border (several times).

From the table it becomes clear that manufacturers in the automotive industry in Italy gain market share on the expense of that of the UK firms, especially in Piemonte, Veneto, Emilia-Romagna and Lazio. Similarly, ICT and even business services may relatively shift their market power to mainland regions that have specialized production, in Italy being favourable in terms of competitiveness for specializations in Veneto, Lombardia, Emilia-Romagna and Toscana. Other positive competitiveness effects are notably in wholesale trade, warehousing and creative industry servicing, especially in the northern and central regions of the country. Specialized regions in Italy may also loose competitive advantage over other regions in Europe[1]. This is clearly the case for agricultural products (Liguria, Abruzzo), food production

[1] It should be noted that potential UK or EU behavioural and policy changes in sectors are not included in our analyses, such as changes in agricultural policy eventually replacing the EU-policy in this sector in the UK, or protectionists measures on both sides of the Channel. See for a full discussion of this, Thissen et al. (2020).

(also Puglia and Sicilia), and metal products and machinery & equipment industries (in many regions) in table 1.

Table 1: Total competitiveness, cost changes and sensitivity to Brexit scenario in Italian regions for selected industries

	Piemonte	Liguria	Lombardia	Veneto	Emilia-Romagna	Toscana	Lazio	Abruzzo	Puglia	Sicilia
Average over all sectors	0.03 (0.3)	0.06 (0.35)	0.02 (0.23)	-0.03 (0.16)	-0.03 (0.16)	-0.01 (0.21)	-0.03 (0.17)	0.07 (0.3)	0.04 (0.26)	0.07 (0.32)
Crop and animal production, hunting and related service activities	0.1 (0.3)	0.5 (0.9)	0.0 (0.1)	0.1 (0.2)	0.0 (0.1)	0.0 (0.0)	0.2 (0.4)	0.5 (1.0)	0.0 (0.1)	0.2 (0.4)
Fishing and aquaculture	0.0 (0.1)	-0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)
Mining and quarrying	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	-0.1 (0.0)	-0.1 (0.0)	-0.1 (0.1)	0.0 (0.3)	-0.1 (0.2)
Manufacture of food products; beverages and tobacco products	0.2 (0.4)	0.8 (1.3)	0.0 (0.2)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.0 (0.1)	0.7 (1.2)	0.4 (0.8)	0.5 (0.8)
Manufacture of textiles, wearing apparel, leather and related products	0.1 (0.2)	0.1 (0.2)	0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.1 (0.2)	0.1 (0.2)
Manufacture of coke and refined petroleum products	1.2 (1.8)	1.5 (2.1)	1.0 (1.5)	0.0 (0.0)	0.2 (0.3)	0.2 (0.3)	0.2 (0.4)	1.1 (1.6)	1.2 (1.7)	2.0 (2.7)
Manufacture of chemicals and chemical products	0.4 (1.0)	0.7 (1.5)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	-0.1 (0.1)	0.5 (1.1)	0.8 (1.8)	1.5 (3.0)
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.0 (0.2)	0.1 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.2 (0.4)	0.2 (0.4)	1.0 (1.3)
Manufacture of rubber and plastic products	0.5 (1.9)	0.8 (2.4)	0.4 (1.5)	-0.3 (0.3)	-0.3 (0.3)	0.4 (1.4)	-0.1 (0.7)	0.5 (1.9)	0.8 (2.7)	0.7 (2.2)
Manufacture of basic metals	0.5 (1.3)	0.9 (1.8)	0.7 (1.4)	0.0 (0.3)	0.1 (0.4)	0.1 (0.4)	0.0 (0.3)	0.9 (1.6)	1.0 (1.8)	1.2 (2.0)
Manufacture of fabricated metal products, except machinery and equipment	0.4 (0.6)	0.9 (1.2)	0.3 (0.4)	0.1 (0.3)	0.0 (0.1)	0.1 (0.2)	0.0 (0.1)	0.6 (0.9)	0.9 (1.3)	0.7 (0.9)
Manufacture of computer, electronic and optical products	0.4 (1.0)	0.6 (1.3)	0.2 (0.7)	-0.2 (0.2)	-0.1 (0.4)	-0.1 (0.3)	-0.1 (0.3)	0.4 (1.1)	0.8 (1.7)	0.5 (1.2)
Manufacture of machinery and equipment n.e.c.	0.3 (1.2)	1.0 (2.8)	0.4 (1.0)	0.1 (0.3)	0.2 (0.5)	0.2 (0.6)	0.1 (0.5)	0.5 (1.6)	0.9 (2.8)	0.8 (2.3)
Manufacture of motor vehicles, trailers and semi-trailers	-0.3 (2.4)	-0.1 (3.7)	0.0 (3.0)	-0.4 (1.1)	-0.4 (1.1)	-0.1 (1.9)	-0.6 (1.3)	-0.7 (2.2)	-1.0 (2.1)	-0.9 (2.8)
Manufacture of other transport equipment	1.2 (3.0)	1.3 (3.0)	1.0 (2.6)		0.1 (1.3)	0.3 (1.3)	0.2 (1.3)	0.7 (2.2)	1.2 (2.9)	1.0 (2.7)
Manufacture of furniture; other manufacturing	0.8 (1.6)	1.4 (2.2)	0.8 (1.6)	0.3 (0.7)	0.2 (0.7)	0.4 (0.9)	0.4 (0.8)	0.7 (1.3)	2.1 (3.2)	1.7 (2.7)
Sewerage, waste management, remediation activities	0.1 (1.2)	0.3 (0.8)	-0.1 (1.4)		-0.4 (0.1)	-0.2 (0.2)	0.0 (0.5)	0.1 (0.5)	0.0 (0.7)	0.0 (1.3)
Wholesale trade, except of motor vehicles and motorcycles	-0.1 (0.3)	0.0 (0.5)	0.0 (0.2)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.0 (0.2)	0.1 (0.6)	0.2 (0.7)
Retail trade, except of motor vehicles and motorcycles	0.2 (0.4)	0.4 (0.6)	0.0 (0.3)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.3 (0.4)	0.4 (0.7)	0.4 (0.7)
Land transport and transport via pipelines	0.1 (0.2)	0.5 (0.7)	0.3 (0.5)	0.3 (0.3)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.7 (0.9)	0.0 (0.1)	0.1 (0.2)
Water transport	1.9 (2.5)	0.1 (0.2)	0.7 (1.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.5 (0.7)	0.1 (0.2)
Warehousing and support activities for transportation	0.0 (0.2)	0.1 (0.2)	0.0 (0.2)	-0.1 (0.1)	-0.1 (0.0)	-0.1 (0.0)	-0.1 (0.0)	0.1 (0.2)	0.0 (0.2)	0.1 (0.4)
Accommodation and food service activities	0.0 (0.1)	0.0 (0.1)	-0.1 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.1 (0.1)
Publishing activities	0.2 (0.9)	0.4 (0.7)	-0.2 (0.7)	-0.2 (0.1)	-0.2 (0.1)	-0.2 (0.2)	0.0 (0.4)	0.1 (0.4)	0.3 (0.6)	-0.1 (0.9)
Motion picture, video, television programme production; programming and broadcasting ac	-0.7 (0.8)	0.1 (0.5)	-0.5 (0.8)	-0.3 (0.1)	-0.3 (0.0)	-0.3 (0.1)	-0.1 (0.3)	0.0 (0.3)	-1.0 (0.5)	-1.4 (0.9)
Telecommunications	-0.3 (1.0)	-0.2 (0.7)	0.0 (1.0)	-0.3 (0.3)	-0.4 (0.2)	-0.2 (0.3)	0.0 (0.5)	0.1 (0.5)	-0.7 (0.8)	-0.8 (1.1)
Financial service activities, except insurance and pension funding	-0.1 (0.1)	0.0 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.0 (0.2)	0.0 (0.2)
Insurance, reinsurance and pension funding, except compulsory social security	0.0 (0.3)	0.3 (0.6)	0.0 (0.2)	0.0 (0.3)	0.0 (0.3)	0.0 (0.4)	-0.1 (0.2)	0.0 (0.3)	0.3 (0.7)	0.6 (0.9)
Activities auxiliary to financial services and insurance activities	-0.5 (0.2)	-1.1 (0.2)	-0.1 (0.1)	-0.9 (0.2)	-0.8 (0.1)	-1.0 (0.2)	-0.6 (0.1)	-0.8 (0.1)	-1.4 (0.3)	-1.6 (0.4)
Imputed rents of owner-occupied dwellings	-0.1 (0.0)	0.0 (0.0)	-0.5 (0.0)	-0.1 (0.0)	-0.1 (0.0)	-0.1 (0.0)	-0.1 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)
Scientific research and development	0.9 (0.1)	0.4 (0.1)	0.4 (0.1)		-0.2 (0.0)	-0.2 (0.0)	-0.1 (0.0)	0.1 (0.1)	0.9 (0.2)	1.3 (0.5)
Advertising and market research	-1.3 (1.1)	0.1 (0.6)	-0.4 (0.7)	-0.5 (0.1)	-0.5 (0.1)	-0.5 (0.1)	-0.5 (0.0)	0.0 (0.2)	-1.9 (1.1)	-2.2 (1.6)
Other professional, scientific and technical activities; veterinary activities	0.2 (0.9)	0.3 (0.6)	0.2 (0.8)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.1 (0.4)	0.2 (0.5)	0.4 (0.9)
Travel agency, tour operator reservation service and related activities	-0.1 (1.1)	0.2 (0.9)	-0.5 (0.9)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.1 (0.4)	0.2 (0.8)	0.2 (1.1)
Residential care activities and social work activities without accommodation	0.0 (0.1)	0.2 (0.1)	-0.1 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.0)	0.1 (0.2)	0.2 (0.2)

Any grey in table: above average size sector (specialization) with divergent average certainty effect in the region. Dark grey: above average certainty of impact of Brexit (insensitive to the exact Brexit (non)tariff scenario). Light grey: below average certainty of impact of Brexit (sensitive to the exact Brexit (non)tariff scenario). Numbers: effect on competitiveness - a negative number is an improvement in competitiveness. The cost increase numbers are between brackets. Selection of sectors: at least one element/cell in the row should be grey.

A striking result of the analyses of the impact of Brexit on the competitiveness in Italian regions is the limited sensitivity to the details of the agreement, i.e. the variation in tariffs over different product categories – the suggested impacts are mostly relatively certain (darker grey in the table). This underlines the importance of networks of international value chains in Italian production where cost increases in the use of a multiple of goods in production that are (indirectly) affected by Brexit related tariffs may have a comparable effect on competitiveness as the specific tariffs on final export products.

Thissen et al. (2020, p.23-24) show that the largest impacted industry in the UK is the motor-vehicle industry, but other detailed impacts are in computer and optical manufacturing and the machinery and equipment manufacturing. It is concluded that the UK's existing interregional inequalities are likely to increase as a result of a hard Brexit scenario. In marked contrast, across the rest of the EU it is generally the weaker and more geographically peripheral regions in the southern and eastern fringes of the EU (like Italian regions) which benefit in terms of competitive opportunities due to the cost increases, although these effects are much more sensitive to the nature of the final deal (compared to the for granted threats in UK regions).

The advantage of the revealed competition indicator presented in table 1 (and earlier introduced in Thissen et al. 2013), is that the regional and industry detail used in the modelling pins opportunities and threats down to a relatively detailed level. But a possible limitation of the analysis is that fairly clear-cut conclusions are derived using the best available EU-wide interregional data, while not discussing the possible behavioural responses to the post-Brexit context, including the restructuring of input-output and supply-chain relations, corporate internal restructuring, changes in sub-contracting or marketing strategies, or monetary, trade and sectoral policies, as these are extremely complex to model. These responses can be made by UK or EU (individual or EU-wide) governments. Although the anticipated cost increases along value chain lines will act like an 'invisible hand' in guiding competitive positions in case of a hard Brexit scenario, whether the fruits of such opportunities will be reaped by specific firms is not certain. This depends on the adaptive and absorptive capacity of firms in their respective industry networks, and the possibilities for substitution of value chain connections to alternative regions (which mainland EU firms have many, while UK firms have virtually none as long as new trade agreements are not put in place). This clearly illustrates the need for more detailed research on the exact connection between network-based international economic shocks, regional industry-level opportunities and threats, and firm-sector level gains in competitiveness.

4. Complexity in identifying economic impacts of the corona pandemic

When Brexit (one country leaving a common market) already seems complicated in terms of trade and competitiveness impacts, leading to threats and opportunities in regions all over Europe, the implications of corona measures are even more severe as supply, demand and intermediate deliveries are affected simultaneously on a global interregional scale. Let us take the beer producing example again, focusing on the Dutch beer producer Heineken. Suppose

that the demand for beer drops strongly in Berlin because restaurants and pubs there are closed because of corona measures. This causes beer selling firms in Berlin, like Heineken, to have less turnover. But in principle, this does not deteriorate the competitiveness position of Heineken, as competitors (Grolsch, Paulaner, Budweiser and Guinness) experience the same downscaling of demand, and all firms keep their respective market share. But when the production of Heineken is reduced because of corona measures in the Netherlands, causing production to be insufficient for exporting for the (even reduced) demand in Berlin, then Heineken loses market share in Berlin. The competitiveness of Heineken then deteriorates. But when additionally, because of corona measures, the demand for beer in the Netherlands drops, more beer is available for exporting to Berlin, and Heineken may eventually not be affected too much again in its competitive position. The example shows that the complexity of product markets is increasing rapidly in case of a pandemic with varying demand and supply restrictions, with input output and direct and indirect value chain effects in various international regions and industries occurring simultaneously, with varying resulting competitiveness effects. An analysis for 'corona impacts' as encompassing as the analysis of the Brexit impacts (discussed in the previous section) is therefore at this moment less feasible, as too many interregional and inter-industry relations and parameters are uncertain and changing constantly (compare Okuyama & Santos 2014, Koks & Thissen 2016). An analysis on individual region- and industry-specific measures introduced by national or regional policy may be more useful to explore, although the combination of possible different interacting regional policies seems close to infinite and these have therefore to be inventoried collectively for regions (as impacts may be reciprocal in character, stemming from measures elsewhere) (Conte et al. 2020, Guan et al. 2020).

Recovering from the corona shock in the (near) future seems to be advantaged by a varied, flexible and diversified regional economic structure, with multiple specializations and value chain positions (in products and subcontracting relations). Dependency on only a few specializations that internationally are vulnerable to demand and supply shocks, may weaken the resilience of regions. Recent recovery plans from corona also show the broader restructuring impacts of resilience as advocated by Boschma (2013), with short term recovery measures being complemented by long term economic restructuring goals aiming for structural change. This complies with Martin's (2012) concept of ecological resilience: the role of shocks or disturbances in pushing a system beyond its 'elasticity threshold' to a new domain. If the outcomes of the shock are above this threshold, then this might change complete labor markets,

and brings the economy into a new state. On the other hand, if this threshold is not reached, then the economy will be able to return to pre-recession growth levels. Ecological resilience is also called ‘adaptive resilience’, being the capacity of a regional economy to reconfigure, which means that it can adapt after a recession and create jobs in a new sector (Martin, 2012). Regions which are considered to have the adaptive resilience capacity are generally more innovative. Moreover, if many firms in a region can terminate less productive activities and modify these into more productive activities in another sector, then this will make a regional economy more adaptively resilient – accompanying structural change, with more new jobs being created in new industries.

Some policy initiatives clearly sort themselves into the evolutionary or adaptive type of restructuring. Guiding policy documents by the Dutch national government, the European Commission (2020) and the OECD (2020) for instance, suggest focusing on a mixture of anticyclical investment, innovative renewal, sustained transitions, reorganizing the labor market, and stimulation of talent, diversification and multiplier industries. The German recovery plan is at the same time also a renewal plan. Many European regional economies are interrelated with German industries. The preliminary German recovery plan for corona of 130 billion euros is the largest national plan ever (Financial Times 2020), but the focus is on making the country structurally more climate change proof, sustainable, resilient and inclusive. The plan is initiated by the Ministries of Finance and Economic Affairs and is backed by the IMF and OECD. An important element in it is that the traditional, fossil energy-based car manufacturing industry does not receive aid, but subsidies for electric cars are more than doubled. Taxes on Co2 rise, other value added taxes are generally reduced by 3%. The German government pre-finances social housing and covers losses of municipalities in their incomes. This indeed is simultaneously a recovery and renewal plan, where recovery is selectively aiming for renewal. The societal challenges that prevailed before the corona crisis, are judged important and combined with the perceived need for additional investment during and after the present corona crisis. As with Brexit, more insight in interregional relations and their impact in firm-sector level competitiveness is a key to understanding the exact resilience and competitive threats and opportunities.

Combining short-term repair challenges for resilience (battling unemployment, income loss and demand shortages) with long-term structural renewal opportunities takes courage and preferably a critical mass of diversified (‘smartly specialized’) industries in the economy. The

most eligible actor to take this up in the short run are, indeed, governments (Mazzucato 2013). Investments of governments that consider future renewal and restructuring in the end facilitate long-term resilience, and place-based and network-based policies must be considered simultaneously. A long term (post)corona action perspective therefore seems to incorporate the following elements.

First, the enlargement of incentives for economic renewal and innovation. During the crises large firms and multinationals use their reserves, and many small and medium-sized firms fight for their survival. Since both do not immediately focus on renewal, and in some regions this situation is more prevalent than others, there may be a role for the government to guide incentives towards renewal and innovation. Second, labor market policy may become crucial in the short *and* long run. Flexibility and job automation may have caused a deterioration of innovative and learning effects of skilled employees (Neffke 2019) and reconsidering the limits to flexibility in the context of resilience is recommendable. Matching on (proximate) labor markets in case of regional or industry level disruption due to corona measures is an important resilience topic for research. At the same time, more inclusive labor participatory development on the regional level may be aimed for, while the short-term unemployment caused by the corona measures and value chain disruptions may obviously harm this. At the same time government's and society objectives may shift such as, for example, an increased appreciation of the 'foundational economy' jobs in health, education and law in some regions (Foundational Economy Collective 2018). Third, talent development in regions remains of utmost importance – also after the corona crisis. Attraction, education and matching of international talent contributes to adaptation and innovation and is a long-term challenge for future growth and resilience. Fourth, behavioral changes of employees in terms of commuting and workplaces may result in lasting opportunities for a more sustainable reform. People work more from home, order more online, and adapt their commuting behavior (such as an increased usage of electric bicycles in the Netherlands). Fifth, the growth capacity of cities may be fastest restored by a long-term vision on the development of (and investments in) added value industries. Next to business services, industrial production resources are interesting multiplier industries, with skill-opportunities in many cities and regions (Neffke et al. 2011, Van Oort et al. 2020), driving new employment from diversified and related industries that are primal to resilience (Frenken et al. 2007) and may generate high value added. The examples of Brexit and the corona pandemic measures show that regional development and resilience are also to a large degree dependent on international value chain positions. Stabilizing demand and supply shocks, or

even having close-by substitution possibilities in terms of production and labor specialization across (neighboring) regions may facilitate continuing economic functioning with local lockdowns or value chain disruptions. Sixth, and related to this, is the embeddedness of production in local and international value chains. Apart from protectionism arguments, the dependency on global value chains in combination with extreme specialization is recently argued as increasing the vulnerability in the production of essential products. A more local (European) scale may mitigate such risks. Seventh, the restoring of meeting and face-to-face contact function of cities is high on economic repair agendas. The consumer city was a driver of much urban economic development before the corona pandemic and will most likely be again after the pandemic. Finally, and closely related to the broader resilience interpretation suggested before, it seems to make sense to match the increased investment needed in the short run to the long run objectives of governments and societies and the associated transitions that these societies face. Investments in sustainable energy industries and circular economy initiatives may not maximize value added, but may pay off in term of regional resilience in the long run (Burger et al. 2018), conditioned to the existing skill-base, diversification portfolio and agglomeration circumstances in regions and are more in line with long run government objectives.

All elements raised are susceptible to a high degree of uncertainty and seem to set a large research agenda for the years to come. Not every region can diversify into new (or renewed) production, given the earlier argued cognitive skills present (or absent) in the labor force. Research into what constitutes realistic regionalized production within regional, European and global networks is recommended. E.g., the Netherlands could rely more on German production and less in American or Chinese – yet, this will lead to rising costs (compare the Brexit example), but perhaps this is worth the mitigation of risks.

5. Conclusions and discussion

In this paper, some important conceptual notions on regional variety and networked proximities are presented and linked to the impact of economic shocks to firm competitiveness positions. The region is part of larger networks, of trade, investments and knowledge, and positions in these networks may be determining for the occurrence of economic potentials and threats, especially when shock occur in these networks. How this may work out for regions in Europe, in particular Italy, is discussed in two examples. The first focuses on potential changing trade relations between regions in Europe and the UK because of Brexit, and its resulting

implications for firm competitiveness. It is suggested that what is good for the goose (competitive positions of firms in EU/Italian regions), may not be good for the gander (competitive positions of firms in UK regions). Materialization of effects though is argued to be strongly dependent on absorptive and adaptive capacities of (firms in) regional industries. The now wide spreading analyses by various scholars that focus on the implications of Brexit – an unprecedented leaving of a country from the integrated market of the European Union – shows how many issues actually touch upon competitiveness and cohesion in European regions that are to a large degree related to 'interregional associations', as Foray (2015) labelled them. Impacts on trade, foreign investments, migration and knowledge relations become relevant, and value-chain and multiplier effects of each of these make that the shock can resonate throughout integrated regional markets of Europe (Baldwin et al. 2009).

Further resilience policy initiatives that may suite both regional repair and renewal agendas during and after the corona pandemic are explored in a second example. Challenges before the corona crisis (inequality, sustainability, transitions and structural change, competitiveness) are suggested to be even larger challenges after such a crisis, and again the interplay of international networked developments (regional lockdowns with disrupted consumption, production and value chain implications) with regional competitiveness of firms and industries is discussed. Further examples of potential shocks can be analyzed similarly, e.g. the potential impacts of the development of the Road & Belt Initiative from China, providing an alternative transport link with Europe (Brakman et al. 2019), the impact of natural disasters on infrastructure networks, with global value chain linkages and regional impacts due to the Sendai Framework for disaster risk reduction and the Warsaw International Mechanism for Loss and Damage (Koks & Thissen 2016, Koks et al. 2019), or the regional implications of the Paris agreements on climate change measures (Wadhwa 2018).

The reasoning of this paper links to a growing literature on regional economic resilience and how industries and regions may adapt their organization towards innovative new or expanding markets (Boschma 2013, Martin 2012). This literature attributes a large responsibility to regional policy and governance for competitiveness and cohesion. An intriguing issue is that regional economies to a large extent seem self-organizing in character (Bertaud 2018), while the individual firms making up this spatial economy have control over their organization, investments, production functions and location strategies. On a regional level, successful place-based policies that ignore either the networked economic circumstances or the firm or

entrepreneurial level link are therefore rare (Neumark & Simpson 2015, Bartik 2020). This does not mean that the regional level is not needed in identification of opportunities or policies. But opportunities for diversification and development that are identified on the regional level (e.g. in Neffke et al. 2011) may not be applied by all firms in a region-industry combination equally successfully (Knoben et al. 2016), and interregional network relations may facilitate shocks that threaten or speed up existing challenges for regional structural change (Thissen et al. 2013). This paper argued that the link between on the one hand the identification of regional level opportunities and potentials (due to crises) and on the other hand industry- and firm-level dynamics of structural change, needs more refined policy attention. If policies are to reap opportunities or mitigate negative effects of shocks, it ideally should work on the absorptive and adaptive capacities of firms and industries, either directly by investing in human and knowledge capital, or indirectly by facilitating local markets that contribute to these (knowledge transfer, labor market, institutions, multipliers, consumption and legislation). Both place-based and network-based policies need to be considered simultaneously, and this also leads to complexity and translation difficulties for policies and governance. The research agenda on such multilevel interplays and regional governance models (Thissen et al. 2020, Van Oort et al. 2012) is to be embraced. The importance of consistent and properly linked trade, transport and knowledge network data goes beyond spatial equilibrium modelling as it also opens many possibilities of research in different fields such as Input-Output value chain analysis, research on relatedness and firms' absorptive capacities, and spatial econometric research.

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