Does industry resilience matter for postshock industrial policy? A focus on tourism-related industries

Does Industry Resilience Matter for Postshock Industrial Policy?

A Focus on Tourism-Related Industries

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Abstract

Selective industrial policies have been increasingly used by governments to achieve desired normative goals. However, they have been revealed to be complex and vulnerable interventions, demanding robust tools able to justify choices and mitigate potential 'government failures'. In light of the emerging challenges and potential disruptions that might threaten our economies and societies, we contend that postshock industry resilience can be a valuable analytical framework to understand how different sectors react to unforeseen shocks. Accordingly, we present a methodology that measures postshock industry resilience and apply it to the Italian case in the aftermath of the 2008 shock. Particular attention is devoted to tourism-related industries. Main findings show that the industries reacted heterogeneously to the 2008 shock. For tourism-related industries, the results suggest following an ad hoc approach to the analysis of each tourism-focused industry to avoid generalizations that might lead to incorrect policy interpretations.

Keywords: industry resilience, tourism, industrial policies, composite indicators.

Jel Classification: L52, O14, C43, L16

Introduction

This paper focuses on selective industrial policies. Specifically, we are interested in those governments interventions that, by choosing and targeting specific industries, aim at governing the complex process of structural change affecting our economies and societies towards relevant societal goals, while ensuring, in parallel, that such transformations are economically, socially and environmentally sustainable (Chang 1994, Chang et al. 2013; Cimoli et al. 2009; Stiglitz and Lin 2013; Bianchi et al. 2011; Di Tommaso and Schweitzer 2013; Lall and Teubal 1998; Barbieri et al. 2019; Tassinari 2019; Di Tommaso et al., 2020a; Di Tommaso et al. 2020b; Ferrannini et al. 2021). A typical and traditional example are those policies investing in the national construction industry to contrast recession and unemployment (as it happened in the New-deal Times or more recently after the 2008 crisis). Another example, thinking about contemporary challenges, is represented by those policies designed to support the growth of the national renewable-energy industry to fight climate change or to ensure energy independence from abroad in strategic sectors (Hirschman 1958; Polenske et al. 1990; Nivola 2008; Bag 2010; Mazzuccato 2013; Di Tommaso and Schweitzer 2013; Cardinale 2019; Jewell et al. 2016). However, everywhere, in the past and in our present, selective industrial policy have showed to be complex and vulnerable interventions, hence attracting criticisms from a body of scholars pointing out typical circumstances and misconducts that could compromise the selection process of the policy targets and ultimately undermine government interventions (Krueger, 1990; Le Grand, 1991; Chang, 1994, 2011; Buigues and Sekkat, 2009; Di Tommaso and Schweitzer, 2013; Schuck, 2014).

Against this backdrop, few recent studies have argued that rigorous tools guiding public action in choosing the appropriate targets to promote desired societal goals are needed to make government interventions more effective, efficient, and oriented towards a sustainable structural change (The Economist, 2010; Di Tommaso et al. 2017, 2020a, 2022; Ngo et al. 2021). Indeed, while it is true that selective industrial policy, by definition, favours some industries or societal groups over others, government decision of prioritizing some groups over others should be a conscious and coherent one,

linked to the specific pursue of some normatively defined societal goals in the public interest (Di Tommaso et al. 2020b). In this view, innovative framework and methodologies should be considered as crucial to support the process of industry selection: in particular, they could guide policymakers to better link policy targets to specific societal goals, also in a perspective of policy accountability and social watch.

In this paper, we draw from this emergent research programme on the role that rigorous tools might play to guide policymakers in identifying how different targets express different capacities to achieve certain desired policy goals (Di Tommaso et al. 2017, 2020a, 2022; Ngo et al. 2021; Ferrannini et al., 2021**).** Specifically, we will build upon early studies on *postshock industry resilience,* which represents an analytical tool that measure sectoral resilience capacity in the aftermath of a shock (Di Tommaso et al., 2022). We focus on *postshock industry resilience* since international organizations and scholars have started to warn governments that they should get used to tackle unexpected shocks of different nature in the upcoming years (Beck 1986; OECD 2011; Tiraboschi 2020, Hynes et al. 2020; World Economic Forum 2022). Indeed, the Covid-19 pandemic cannot be considered an isolated event: other similar challenges or potential disruptions might threat our economies and societies in the near future, due to the global interconnection of political, economic and commercial relations (OECD 2011; Hynes et al. 2020). In view of this, *postshock industry resilience* can be a valuable analytical framework that provide decision-makers with solid evidence on how different sectors react to unforeseen shocks. It can therefore represent an informative base on which policymakers – during the complex process of policy design and implementation where a plurality of actors and stakeholder are involved – ground the rationales of the intervention and select targeted industries, with the ultimate aim of promoting a sustainable structural change in the post shock.

In the following paragraphs, we present a methodology that measure *industry resilience* (Di Tommaso et al. 2022) and apply it to the Italian case, in order to assess the resilience capacity of sectors in the aftermath of the 2008 shock. Particular attention will be devoted to tourism-related

industries. Indeed, while sectors such as manufacturing and construction have received great attention from scholars in the aftermath of the crisis due their vital role in the Italian economy (Girardi 2012; Lagravinese 2015; Terkaj, W., & Tolio, T. (2019), the service sectors has been mostly treated as a homogeneous aggregate. However, the service sector encompasses few sub-sectors, so called tourism-related industries, that deserve particular attention in a country like Italy given the relevance of tourism on the national economy (Bank of Italy, 2019). Such tourism-related industries are mainly embodied, according to the literature (Leiper 1979) by the following sectors: 1) transportation, 2) accommodation and food service activities, 3) recreation and other service activities, and 4) retail trade. Since Italy represents one of the leading countries in the world in terms of tourist arrivals (ISTAT, 2021), it is therefore interesting to see how such segments of the tourism industry have reacted to the recessionary crisis, considered the pivotal role that tourism plays in the Italian economy also in comparison to the European average data (Cellini and Cuccia 2015): indeed, tourism represents a share above 10% of the Italian GDP. Overall, the tourism total contribution to the GDP in Italy amounted to roughly 163 billion euros in 2021.

This original contribution of this paper is threefold:

1) It refines both the definition of the concept and the methodological application of *industry resilience*;

2) It contributes to the literature on the effectiveness and efficiency of industrial policy interventions, addressing the more general need of better linking the capacity of achieving societal goals to selective government actions, also in a perspective of policy accountability and social watch;

3) It enriches the debate on selective industrial policy by exploring their role, effectiveness and efficiency in the field of services and particularly with regards to the tourism-related sectors.

The rest of the paper is organized as follows. The next section develops the theoretical background, after that we introduce the methodological design, the data used and elaborated. The following section shows the empirical application to the Italian case and presents main results. Finally, the last section

offers a discussion and some conclusive remarks, including policy implications and some future research lines.

Theoretical background

Selective industrial policy and societal goals

Everywhere, in the past and in our present, selective industrial policies have been used by national and local governments to achieve what have been defined - in that country and in that historical moment - national societal goals (Lall and Teubal 1998; Barbieri et al. 2019; Tassinari 2019; Di Tommaso et al 2020a; Di Tommaso et al. 2020b; Ferrannini et al. 2021; Silvestri et al. 2022; Prodi 2022; Landini and Ferrannini 2022; Bellandi et al. 2022). However, selective industrial policies have historically attracted criticisms because their "potential failures" (Krueger, 1990; Le Grand, 1991; Chang, 1994, 2011; Buigues and Sekkat, 2009; Di Tommaso and Schweitzer, 2013; Schuck, 2014). Indeed, selective industrial policy have showed to be complex and vulnerable interventions demanding robust tools able to justify government choices. Hence, public investment and preferences towards one specific sector over another need to be carefully analysed, discussed and evaluated (ex-ante and ex-post) in terms of their supposed capacity of achieving specific societal goals (Di Tommaso et al. 2017, 2020, 2022; Ngo et al. 2021).

In this framework, as a wide and established literature has highlighted (see, e.g., Krueger, 1990; Le Grand, 1991; Chang, 1994; Di Tommaso and Schweitzer, 2013; Di Tommaso et al 2017), important "failures" might arise during the process of industry/sector selection. Indeed, before and during the implementation of the policy, a multitude of actors and stakeholders are in the position of influencing the process of target selection (Hirschman, 1970; Cardinale, 2017; Scazzieri et al., 2015). First, we might expect traditional "internal failures" given that governments are not "black boxes". They are complex organization where lack of competence, scarce and asymmetric information, self-serving bureaucrats, internal competition and overlapping of competences might easily push policies

away from the expected desired outcomes. This complexity might have an impact on how sectors are actually selected by governments, defining priorities and preferential policies that have limited justification if confronted with those goals declared as the real rationale of the intervention.

Second, along with governments' "internal failures", great challenges are related to the fragility of the government-industry-society relationships. Governments might be captured by some partial interests who know how to organize themselves, demand and obtain special policy attention with the further risk of encouraging rent-seeking behaviour, clientelism, corruption, exchange of political consensus with policy intervention. Once again, these dynamics might have an impact on how sectors are chosen, making (since the very beginning), the policy process inefficient and ineffective. Hence, external or internal pressures could favour "particular" interests over more general ones during the process of industry/sector selection.

In this complex and realistic setting, government selective interventions have to be justified according to their capacity of achieving specific normatively-defined societal goals. In principle, an ideal process would be the discussion and the comparative evaluation of how different sectors might contribute to the promotion of well-defined societal goals. For example, to what extent government support to manufacturing versus service sector might represent a solution to wide objectives, such as: fostering economic growth, innovation or competitiveness; reducing national dependency from foreign strategic technology; fighting unemployment, economic, social and territorial disparities; contrasting environmental crisis and climate change. Or, to enter in a more desirable specificity: would investing in construction industry to create new public works (roads, trains, bridges, dams, etcetera) effectively counteract the economic and social risks connected to job losses? Or again, would the support to electric engine production or renewables (solar or wind power) promote a greener economy and society?

In this context, robust frameworks and methodologies should be considered as crucial for mitigating the potential rise of the abovementioned "internal and external government failures" in a perspective of policy accountability and social watch. Such tools would represent clear points of reference during

the process of industry selection that might regulate the interactions in this delicate stage between bureaucrats, policy makers, stakeholders and citizens.

Industry resilience

Resilience is a multifaceted term that has been used in several disciplines. It broadly defines the capacity of a system to withstand a shock or recover from it, also undergoing adaptive changes to its socio-economic structures and institutional arrangements under new emerging circumstances (Adger 2006; Folke 2006; Martin and Sunley 2015, Cardinale 2019). Recently, it has become a relevant concept also in the field of industrial policy. The intuitive idea - elaborated during the Covid-19 pandemic - is that making our economies and societies more resilient to unexpected shock could be considered a desirable national societal goal and thus an equally desirable policy goal (Di Tommaso et al. 2022). Covid-19 is the most recent evidence of the vulnerability of our economies and societies. However, a long list of other possible upcoming "expected and unexpected-shocks" (such as those related to climate change, energy prices or global food insecurity, future financial crises and so on) seems to urge the need of policy interventions that should be able to work along two directions: first, making postshock economic and social drop less sudden and severe, hence irreparable; second, fostering recovery capacity and velocity. In other words, as shown reference to in figure 1, policy efforts could/should aim at minimizing the "*drop"* of the economy and social welfare (the red area) and maximizing the "*recovery"* (the green part). Clearly, the reactions of the economy and society to shocks may vary, following trajectories of partial or full recovery, or even what we might define an "*ultra-recovery*". In addition, it exists in principle the possibility that shocks may also result in a definitive collapse with no recovery at all (figure 2).

[Figure 1 here]

[Figure 2 here]

It is also clear that the postshock resilience capacity of our economies and societies is the result of a variety of interrelated economic, social and institutional dimensions. And this is what we observe and understand for example when we realize how heterogenous has been the impacts of Covid-19 across different actors and territories (Cortes and Forsythe 2020; Bailey et al. 2020; Emmerling et al. 2021). However, in this paper we are particularly interested in the value of *postshock industry resilience*, where industry here is meant as synonymous of sector (Marshall 1961; Moss 1984; Di Tommaso et al., 2022). Building-up a growing debate in social, economic and management studies (Earvolino-Ramirez, 2007; Longstaff, 2009; Raid and Botterill, 2013; Martin, 2012; Reggiani, 2013; Crescenzi et al., 2016, Cardinale, 2019) - *industry resilience* is here defined as follow: *the way, the extent and the speed at which industries return to the previous state trend or trajectory after a shock, thus achieving a partial or a full recovery (or even what we might define an "ultra-recovery")* (Di Tommaso 2020a; Di Tommaso et.al 2022; OECD, 2021; Canova et al., 2012).

As mentioned above, the intuition and the assumption underpinning this paper is that the more resilient are our industries, the better would be for the economy and the society as a whole. Indeed, as many observers and scholars animating an international and interdisciplinary debate suggest (Beck 1986; OECD 2011; Tiraboschi 2020, Hynes et al. 2020; World Economic Forum 2022), governments should get prepared to further upcoming unexpected shocks of different nature in the near future. Unexpected disruptions can both accelerate desirable structural changes or be so severe as to make any type of change unsustainable: in this context, *industry resilience* can represent a valuable analytical framework for policymakers, since it would contribute to orient the process of structural change towards a trajectory that is sustainable for the socio-economic system.

In principle, *postshock industry resilience* could assess several dimensions, such as changes in industry value added, trade, employment dynamics, or output. However, in a policy perspective of promoting the social sustainability[1] of structural change and making our societies more resilient, it

[1] Social sustainability has been broadly defined as a set of conditions that allow for improvements to the living conditions of current and future generations (Böstrom, 2012; Barbieri et al., 2020)

has been pointed out that *industry resilience* should primarily address postshock employment dynamics occurring within sectors (Di Tommaso et al. 2022). Indeed, *shocks affect workers differently depending on their industry* (OECD, 2021). Further exacerbation of traditional dualisms in labour markets and social conflicts ensuing from unforeseen shocks might deteriorate the social fabric, threatening the economic prosperity of a country in the long run.

By recognizing the economic and social value of *industry resilience*, novel rationales for industrial policy interventions in favour of specific sectors/industries would arise: for example, supporting the most resilient sectors because of their potential capacity of fostering wider dimensions of economic and social resilience; or, on the contrary, investing in sectors that have proved to be scarcely resilient to shocks to make the society more resilient as a whole. In our perspective, such targeting would aim not solely at the recovery of jobs in those sectors, but it could encompass also other aspects encouraging the adaptation of the workforce to the postshock emerging conditions, for instance through skills conversion or workers requalification in order to be able to govern the future shift of jobs from declining sectors to more promising ones. In this stream, Fasone and Pedrini (2022) paid attention also on the gender equality issues.

Resilience and tourism industry

The literature on the tourism sector has investigated resilience to shocks as well. A first discussion on resilience in the tourism sector was introduced by Farrell and Twining-Ward (2004 and 2005), stimulating a debate on resilience and the adaptive capacity of complex systems. Calgaro and Cochrane (2009) applied the concept of resilience to identify which actions could mitigate system vulnerability and building a response after a shock; McDonald (2009) used it to identify relationships between stakeholders in a tourism destination, thus emphasizing the role and usefulness of complexity science for achieving societal goals such as sustainable development.

However, in tourism studies, the concept of resilience has mainly focused on economic aspects without accounting for other dimensions, for instance social or institutional features. Indeed,

according to Faulkner (2000), the main perspective of resilience adopted in tourism studies relates to "the recovery of tourism industries and tourist arrival numbers following fast variable changes – that is, disaster and crisis preparation and recover" (Faulkner, 2000 - cited in Lew, 2014, p.3). In line with this, by focusing on a country-level (or regional) analysis, some studies show heterogeneity of resilience capacities based on specific economic conditions. In Italy, for example, Cellini and Cuccia (2015) show how the tourism industry was more resilient to the 2008 financial crisis than other industries by analyzing which characteristics are connected to the resilience capacity of regions. Specifically, they emphasize how the differences in the regional-level economic resilience of the tourism sector could explain the degree of success in response to the crisis.

More recently, tourism scholars have included "slow change variables" in their analyses on resilience (Lew, 2014), such as: economic migration and social change (Lew, 2013), global climate change (Becken and Hay, 2007; Kajan and Saarinen, 2013), tourist behavior (Becken and Wilson, 2013), and specific tourism industries (Steiger and Stotter, 2013; Biggs, 2011).

Overall, these studies have tried to emphasize theoretical and practical implications for the tourism sector (Brown et al., 2018; Calgaro et al., 2014; Cochrane, 2010; Lew, 2014). However, studies have been carried out mainly using a qualitative approach and focusing on single case-studies; in contrast, quantitative analysis on resilience is still limited (Okafor et al., 2021). Moreover, other limitations concern the fact that most of the studies on resilience, shock and tourism conducted over the period 1960-2018 address primarily tourism firms or organizations (Orchiston et al., 2016; Ritchie and Jiang 2019), with particular focus on the accommodation sector and on "community resilience" within tourist destinations. In this literature, scant are the studies exploring resilience over the different stages of the economic cycle of tourism-related industries.

Based on these gaps in the literature and in the light of the challenges posed by Covid-19, it seems necessary to propose a resilience-based framework for the tourism industries; this seems particularly relevant in a context in which, according to Sharma et al. (2021), technological innovations like artificial intelligence (AI), the Internet of things (IoT), are becoming increasingly diffused and, along

with other potential disruptions, can trigger a process of structural change in the sector that need to be addressed in a sustainable way.

Data and Methodology

Measuring industry resilience through the composite indicators

In order to assess postshock *industry resilience* in Italy in the aftermath of 2008, we build upon a previous study that has developed this concept and a methodology based on composite indicators (CIs) to measure it (Di Tommaso et al. 2022) ([2]). Such CIs allow to rank sectors based on their performance during and in the aftermath of an unexpected shock. Specifically, by grasping the amplitude, duration and velocity of the changes affecting sectoral employment, the CIs can support policy-makers in visualizing sectoral performances dynamically and multidimensionally; they also allow the comparison of each sector with other sectors and with their own counterfactual trend.

Accordingly, we proceed by following three main steps: first, we illustrate the six indicators used to model *industry resilience*. Second, we select the variables that allow us to measure *industry resilience*. Considering the framework of this paper, and specifically the idea that ensuring the social sustainability of structural change and making our societies and economies more resilient to shocks should be considered a relevant societal goal in current times, the main variable observed for each sector is employment. In particular, and in line with Di Tommaso et al. (2022), we use employment levels to assess changes in employment quantity, but also the ratio between temporary employment and total employment to assess changes in employment quality. Third, we detail how we build our CIs after observing the variables' behavior across all of the six indicators.

First, *industry resilience* has been modelled by six indicators - eventually synthetized into two composite indicators - capturing different aspects of postshock sectors' behaviors. Specifically, the

[2] Composite indicators have been often to aggregate multiple information on complex phenomena and synthetize them into simple and easily understandable pieces of information. On the increasing use and diffusion of composite indicators among decision-makers, international organizations and other bodies for policy-making informing purposes see UNDP, 2021, and previous years; Pichon *et al.*, 2020; and Alkire and Santos, 2014.

indicators capturing different aspects of postshock sectors' behaviors have been identified starting from the local points (i.e., the peak t_0 and the trough t_{min}) that shape sectors' business cycles (Han and Goetz, 2015; Hall et al. 2003). Further, a third crucial point used to create the indicators is the *rebound* point, t_{end}. It signals where the timespan considered for measuring the recovery of each sector ends: we follow Di Tommaso et al. (2022) and set t_{end} 24 months after the trough, *"thus allowing the sector to clearly reveal an observable trajectory while at the same time smoothing short-term volatility effects as well as avoiding excessively long timespans, which might be influenced by other factors independent of the shock"* (Di Tommaso et al., 2022, 5). Figure 3 shows how *industry resilience* is modelled.

[Figure 3 here]

These three points allows to retrieve the following information on sectors:

1) The actual behavior of the postshock curve, proxied by **Industry Rebound** (IR_j), **Industry Drop Velocity** (IDV_j), **Industry Recovery Velocity (**IRV_j)
2) The counterfactual behavior of the curve, captured by **Rebound-Counterfactual Difference Ratio (**RCD_j**), Trough–Counterfactual Difference Ratio (**TCD_j**)**
3) Sectors' size, which is captured by **Industrial Average Employment** ($\bar{X}_j$)

For details on the indicators' construction, see Di Tommaso et al. (2022).

Overall, *industry resilience* accounts for multiple dimensions characterizing postshock sectors' behavior, namely drops, rebounds, velocity, and counterfactual elements related to both employment quantity and employment quality.

Data, variables and indicators

We now present the data used for this exercise on the Italian case[3]. Data are from the European Union Labour Force Survey (EU-LFS), which includes employment quantity quarterly data for 10 one-digit NACE sectors. Table 1 reports the peaks, the troughs and the rebound points for the 10 sectors ([4]): these points identify the overall time frame under analysis (Di Tommaso et al., 2022). Overall, the time frame considered goes from the third quarter in 2007 (where the first peak occurs in Manufacturing and Arts, entertainment, recreation) to the fourth quarter in 2016 (where the last rebound point occurs in Financial and insurance activities).

[Table 1 here]

We have excluded from the analysis sectors for which no peak was clearly identified, as well as sectors for which data on counterfactual trends were not possible to be emphasized. We are thus left with 10 sectors, for which we are able to calculate the value of each one of the six abovementioned indicators.

As for employment quality, Di Tommaso et al. (2022) build a *Good Jobs Index*, using information on stability of employment contracts and earnings. We partly depart from this approach. Indeed, given the lack of appropriate data on salary, we use data on stability of contracts, which we proxy as the percentage of temporary employment ([5]) over total employment. The highest the percentage, the lowest the stability of contracts within the sector, and hence the lowest the quality of employment, we assume ([6]).

[3] For the design of this research, we used a *maximum variation sampling* method. According to Patton (2002), this kind of non-probabilistic sampling enables to collect data, to describe and explain the key elements related to the phenomenon under analysis by encompassing the maximum variation of its features. In line with this approach, Italy is a representative case in which we can find the most part of the different characteristics of the sector in terms of: motivation for traveling, destination, accommodation, seasonality, quality and price, and so on.

[4] Appendix A (see online supplementary materials) contains further details on sectors selection.

[5] According to the Eurostat glossary, data on temporary employment include types of work under a fixed-term contract, as against permanent work where there is no end-date. Typical cases are: people in seasonal employment; people engaged first by an agency or employment exchange and then hired to a third party to do a specific task (unless there is a written work contract of unlimited life); people with specific training contracts.

[6] Such an assumption is in line with bot theoretical and empirical studies contending that firms using temporary contracts pursue low-road employment strategies, characterized by the creation of cheap and low-quality jobs. In other words, and generalizing to the sectoral level, the number of temporary contracts used within a given sector signals the presence of low quality of jobs in it (Kalleberg 2011; ILO 2015; Alpert *et al.*, 2019).

In what follows, we build the two CIs ranking the *J* sectors on the basis of the *K*=6 indicators.

I) For each sector, we calculate the value of each one of the six indicator, both for employment quantity (i.e., the number of people employed in the sector) and employment quality (the share of temporary employment on total employment); in order to compare sectors, the minimum and the rebound values for each sector are computed as the percentage deviation from their respective peak value (=100).

II) We then rank normalized each indicator value to make the variables comparable across indicators and sectors (Becker, 2021; Di Tommaso et al., 2022), as follows:

$$I_{kj} = Rank(x_{kj}) \quad (1)$$

where I_{kj} represents the normalized value of individual indicator *k* for sector *j*.

Ranks are defined so that the best performing indicator's value ranks 10, the second-best ranks 9 and so on (Becker, 2021) until 1 (the worst performing indicator's value).

For employment quantity, lowest values generally correspond to worst quantitative performance (i.e., a contraction of overall jobs). For employment quality, the opposite holds: lowest values (i.e., lower percentage of temporary employment) generally correspond to better quality performance of the sectors and to a contraction of the percentage of temporary jobs.

Exception is made for the two counterfactual indicators for employment quality. The RCD and TCD indicators as originally framed by Di Tommaso et al. (2022), once used with our measure of employment quality, generate values that, when ordered, do not reflect sector counterfactual performance. We are therefore impeded from creating the partial rankings for the counterfactual indicators. In order to overcome this issue, we have directly ranked sectoral counterfactual performances on the basis of the identification of four groups of sectors' behaviors:

1) *Good trends being maintained:* Sectors where the share of low-quality employment was decreasing before the shock and continued to decline in the aftermath of it. Sectors belonging

to this group have the highest rank.

2) *Bad trends being reversed:* Sectors where the share of low-quality employment was increasing before the shock but declined in the aftermath of it. Sectors belonging to this group have the medium-high rank.

3) *Bad trends being maintained:* Sectors where the share of low-quality employment was increasing before the shock and continued to increase in the aftermath of it. Sectors belonging to this group have the medium-low rank.

4) *Good trends being reversed:* Sectors where the share of low-quality employment was declining before the shock but increased in the aftermath of it. Sectors belonging to this group have the lowest rank.

Hence, in terms of relationship between their counterfactual and actual trend, sectors belonging to the first group are the best performers, while the fourth group include the worst performer sectors. Sectoral performances within groups are ordered based on the amount of low-quality employment reduced, thus in descendent order (see online supplementary materials - Appendix B).

III) We weight indicators by attaching the same weight to each one of the six indicators, as the literature suggests in similar cases (Saisana *et al.*, 2005; Marozzi, 2015; JRC-EC, 2008);

IV) We follow Di Tommaso et al. (2022) and use as aggregation method the equally weighted geometric mean, which uses the product of the indicators as follows. For each sector j:

$$gM_j = (\prod_{i=1}^{k} I_j^{w_k})^{1/\sum_{i=1}^{k} w_k}, \quad (2)$$

where I_j is the rank-normalized indicator and w_k is the corresponding weight.

The geometric mean is more robust to outliers and allows for no substitutability of the information provided by each indicator (Becker, 2021; JRC-EC, 2008).

The final CIs were obtained from ordering in descending order the geometric mean values and assigning higher rankings to higher values, which correspond to an overall better performance. The results consist of two rank-based CIs, one for quantity (*CI_QUANT*) and the other for quality **(***CI_QUAL).*

Empirical Analysis and Results

In this section, we apply the two composite indicators (CIs) - measuring *industry resilience* in terms of changes in jobs quantity and quality across sectors in the aftermath of the 2008 shock - to the Italian case. The emerging results related to the postshock quantitative and qualitative profiles of sectoral employment are then analysed in order to draw useful insights for industrial policy design and implementation. In particular, we offer a specific focus on the tourism-related industries, which, as anticipated in the introductory paragraph, deserve particular attention in a country like Italy given their relevance on the national economy (see also: Bank of Italy, 2019). Indeed, we want to understand how the different tourism' sectors perform in terms of postshock resilience within the Italian economy.

As already recalled, according to Leiper (1979), four aspects compose the tourism product: 1) transport, 2) hospitality, 3) recreation, and 4) shopping. In our study, these components are

encompassed by the following sectors ([7]): 1) "Transportation and storage", 2) "Accommodation and food service activities", 3) "Arts, entertainment and recreation and other service activities" ([8]).

Before proceeding with the calculations of the indices, we begin our empirical analysis by emphasizing industry trends in terms of dynamics of total employment. Accordingly, we report in Figure 4 the trends of employment quantity by sector in Italy over the years 1998-2021. We observe these series to depict the behavior of each industry over time.

[Figure 4 here]

As first evidence, we observe a heterogeneous cross-sectors performance and a different response to the diverse *stimuli* coming from the environment, including financial or economic shocks. Primarily, it can be noticed that sectors' behaviors can be classified in three major groups.

A first group maintains almost the same trend, if we compare the starting point of the observation (i.e., the year 1998) and its end, although some fluctuations over the time appears. Within this group, even though the final numbers of workers in the sector remain similar to the initial stage, we can emphasize some sector with a more evident instability and others with a certain stability.

A second and a third cluster of sectors show a constant increasing and a decreasing trend, respectively, and consequently a different level of employment at the end of the period considered. Specifically, the sectors "Financial and insurance activities", "Transportation and storage", and "Wholesale and retail trade: repair of motor vehicles and motorcycles", belong to the first group. In particular, "Transportation and storage" is the sector with the higher instability, instead "Wholesale and retail trade: repair of motor vehicles and motorcycles" reports the lower.

[7] See online supplementary materials - Appendix A for the related NACE classification.

[8] As already stated in the literature by Leiper and more in general in practice in the national accounts, the tourism industry includes also the retail sector (i.e., shopping activities). Unfortunately, in this study we are not able to account for the "Retail sector" because of availability of data. In fact, this last information, in the Eurostat database of which we make use, is included in the macro sector "Wholesale and retail trade: repair of motor vehicles and motorcycles" making data processing hard. Nevertheless, the analysis maintains a good level of reliability in the light of the relative weight of retail trade within such an industry. The Bank of Italy (Banca d'Italia, 2019), in the last report before the diffusion of the pandemic, by determining the value added by branch of tourism industries attributes to the retail sector a percentage of 6.1 in the general account of tourism industry. Obviously, the core branch of the sector is "Accommodation and food service activities" that obtains 55.6%.

For “Accommodation and food service activities”, “Arts, entertainment and recreation and other service activities”, “Human health and social work activities”, and “Real estate activities, professional, scientific and technical activities, administrative and support service activities”, the graph shows a constant increase in employment. As expected, particular evidence emerges in the pandemic period in which from one side “Accommodation and food service activities” and “Arts, entertainment and recreation and other service activities” collapse, while on the other side “Human health and social work activities” maintain the same increasing trend.

“Agriculture, forestry and fishing”, “Construction” and “Manufacturing” are the sectors that experience the worst performance. All these sectors reduce the number of workers over time. In contrast to the others two sectors in this group, “Construction” represents the only industry that increase its figure for a limited time (from 1998 to 2010) just before the crisis collapse. “Agriculture, forestry and fishing”, and “Manufacturing” maintain a relative stability after 2012.

[Figure 5 here]

In Figure 5, we complement the descriptive information provided above. We report the trends of employment quantity by sector, each one of them indexed to its own pre-shock peak value, for the sakes of cross-sector comparability.

Generally, Figure 5 confirms that sectors have reacted very differently to the shock. Some of them, for instance, “Accommodation and food service activities” and “Human health and social work activities” recover and improve with respect to precrisis periods; others like “Transportation and storage” and “Wholesale and retail trade: repair of motor vehicles and motorcycles” are experiencing a long-run stagnation, with virtually no recovery like in the case of “Manufacturing” and “Construction”. This latter represents a peculiar case, since it records an increasing trend until 2008 and after it obtains the worst results of the ten compared industries (see the grey line). A “fan-shaped” trend captures the reaction to the crisis of the different sectors. This has also given rise in some cases to among-sector divergent trends that appear to be persistent over time.

Focussing on tourism-related industries, the heterogeneity among sectors is neat. “Accommodation and food service activities”, and “Arts, entertainment, recreation and other service activities” report an increasing trend on the number of employees, although their respective curves are very dissimilar, while “Transportation and storage” recovers its previous levels: indeed, the increasing trend of “Accommodation and food service” is constant until the COVID-19 diffusion. Conversely “Arts, entertainment, recreation and other service activities” experiences a slight increasing trend until 2008 and after that experiences a general stability. “Accommodation and food service” industry represents a sector that improve its performance with respect to precrisis periods, whereas “Transportation and storage” seems to face a long-run stagnation, although this general trend is characterized by a particular volatility.

Moving to the empirical application of the two CIs, Table 2 reports the cross-sector variation in employment quantity measured against the six indicators, while Table 3 reports the results for the qualitative dimension of employment. The partial rankings’ values related to the indicators TCD and RCD for quality employment are reported in online supplementary materials - Appendix B. Table 4 summarizes the final ranking for both *CI_QUANT* and *CI_QUAL*.

In both tables 2 and 3, we have reported for each sector the value of the indicators and the respective position in the partial ranking *I*. The higher the value is, the higher the position in the relative ranking. We also report for each sector the geographic mean (*gM*) encompassing the six individual indicators and the associated final ranking for both the quantitative (*CI_QUANT*) and the qualitative (*CI_QUAL)* dimensions.

Concerning the synthetic quantitative index *CI_QUANT*, table 2 shows that the best performer is “Accommodation and food service activities”, while the worst is “Construction”. Looking at the synthetic qualitative index *CI_QUAL*, “Financial and insurance activities” reaches the best score while “Agriculture, forestry and fishing” the worst position in the ranking.

It is worth to note that “Accommodation and food service activities” ranks high in *CI_QUAL*, while “Construction” ranks as the worst sector also in *CI_QUANT*. This makes “Accommodation and food service activities” the overall best performing sector, while “Construction” the worst for both CIs.

“Human health and social work activities” and “Wholesale and retail trade: repair of motor vehicles and motorcycles” record a medium-high ranking position (respectively, the 2nd place in quantity and 6th in quality and *vice versa* for the case of wholesale and retail trade). Other two sectors achieve a medium-low classification: “Arts, entertainment, recreation and other service activities” (7th place in quantity and 5th in quality), “Transportation and storage” (5th rank in quantity and 7th in quality). “Real estate activities, professional, scientific and technical activities, administrative and support service activities”, are the only industries that obtain the same place in both ranking, the fourth.

“Manufacturing”, as it is the case of “Construction”, experiences a negative performance both in terms of quantity and quality employment, scoring overall as the second last worst sector, after “Construction”.

It is worth to zoom in on the partial ranking positions scored by each sector. On the quantitative side, “Accommodation and food service activities” obtain good results for what concerns industry drop velocity and industry recovery velocity; “Human health and social work activities” have the highest industry rebound rate and more in general high results of the indices; “Transportation and storage” shows the highest index regarding the velocity of the employment decline, while “Financial and insurance activities” have the highest value related to the counterfactual measure of the trough. “Construction” has the worst values nearly for every one of the six partial indicators.

Turning to the six quality indicators, the only sector - by the way the best performer - that records a good result across all of the indicators is “Financial and insurance activities”. All the other industries show heterogeneous values. For instance, “Agriculture, forestry and fishing” have the worst result on the counterfactual measure of the rebound and on the industrial average employment and in contrast a relatively high trough-counterfactual difference ratio; “Construction” registers the lower drop velocity, and difference of the trough-counterfactual and a high industry rebound rate;

"Transportation and storage" report a rebound velocity very low and the highest drop velocity, while "Manufacturing" has the lower industry rebound rate.

The analysis of the partial ranking for the four tourism-related industries highlights that:

1) "Transportation and storage" shows, on the quantitative side, the highest result for the IDV indicator, while a very low performance for the two counterfactual indices. Concerning the quality indicators, the rebound and the recovery velocity are very low;

2) "Accommodation and food service activities" performs very well on each single quantitative indicators by reaching the higher place in the ranking. On the qualitative side, the sector obtains medium results with a high industrial average employment performance;

3) For "Arts, entertainment and recreation and other service activities", it is important to remark how under the quantitative profile the sector obtains a low result in the industry rebound and in the recovery velocity indicators instead a very high performance for the rebound and a trough-counterfactual index on the qualitative side.

[Table 2 here]

[Table 3 here]

[Table 4 here]

Figure 6 reports the matrix representing quantitative and qualitative resilience jointly. The main result emerging from the matrix is that sectors behave quite heterogeneously among them in terms of both employment quantity and quality. Indeed, all of the sectors under analysis are equally distributed across the matrix where in each quadrant lie at least two sectors. In two additional cases, we have sectors located on the border line: 1) "Wholesale and retail trade: repair of motor vehicles and motorcycles" between the first and second quadrant; and 2) "Human health and social work activities between first and fourth quadrant". Overall, sectors in the Italian economy show different *postshock industry resilience* capacities. Such a heterogeneity seems to take in some cases the form of a trade-

off between the quantitative and the qualitative aspects of employment. In particular, it is worth to note that all of the sectors in the service industry are scattered on the first, second or fourth quadrant: this means that they have scored sufficiently good either on the quantitative or the qualitative side. Conversely, "Manufacturing" and "Construction" are the only industries located in the third quadrant, which means that they performed negatively for both quantity and quality employment.

Tourism-related industries show the same abovementioned dynamics. The three sectors are located on three different quadrants. "Accommodation and food service activities" show the overall best performance (high in quantity and quality) lying on the first quadrant. "Arts, entertainment, recreation and other service activities" and "Transportation and storage" are located respectively in the second and in the fourth quadrant, scoring medium results on both dimensions. Specifically, these two sectors have indeed experienced opposite performance in terms of quality and quantity employment: while "Transportation and storage" has experienced a good performance in terms of quantity, "Arts, entertainment, recreation and other service activities" has done better on the qualitative side.

[Figure 6 here]

Robustness Check

In order to test the robustness of the two CIs, we resort to uncertainty analysis (UA), which is a Monte Carlo simulation–based procedure applied to the formula defining the composite indicator. UA "focuses on how uncertainty in the input factors propagates through the structure of the composite indicator and affects the composite indicator value" (JRC-EC, 2008; 34), and it is frequently used to assess the synthetic index robustness. We follow Di Tommaso et al. (2022) and perform an uncertainty analysis where we assume that the major source of the uncertainty that might affect the CIs could arise from weights distributions. Indeed, we have assumed equal weights for each of the six indicators, although an inherent degree of uncertainty often surrounds weight values (Pontarollo and Serpieri, 2020; JRC-EC, 2008; Munda and Nardo, 2005). We thus perform a randomly weights perturbation to assess whether and to what extent our CIs could depend on the underling weights.

To perform the uncertainty analysis, we use the R software package COINr (Becker, 2021). We run 10,000 Monte Carlo simulations and obtain 10,000 alternative combinations of the input values that make up our CIs. COINr assumes equal probability for all alternatives, i.e., uniform distributions of the outcomes (Becker, 2021).

For each replication of the composite indicator, a random value is attributed to the weight ω_i', following the form (Becker, 2021):

$$\omega_i' = \omega_i + \epsilon_i, \epsilon_i \sim U[-\phi\omega_i, \phi\omega_i] \quad (3)$$

where ω_i is the nominal weight, ϵ_i is the added noise, and ϕ is a "noise factor". In our case, ϕ =0.3, which means that we let ω'_i vary between +/-30% of its nominal value, following a uniform distribution.

The results of the uncertainty analysis are reported in Figures 7 and 8. The graphs reports sectors' ranking positions and their associated uncertainty interval: the narrower the uncertainty interval, the more robust the ranking position. In other words, this means that the ranking position depends to the associated weight only to a limited extent, and thus it is reasonably independent form the CI design.

Both figure 7 and 8 show that the CIs are sufficiently robust to weights perturbances. For both cases, the heads of the rankings are stable. For the intermediate positions, the confidence intervals tend to be generally narrow, with a maximum possible variation of only two positions. The tail of the ranking is highly stable for *CI_QUANT*, while it experiences limited variation (maximum one position) for *CI_QUAL*.

[Figure 7 here]

[Figure 8 here]

Discussion and Conclusion

This paper is grounded into the debate on selective industrial policy, societal goals and government failures. As we have highlighted, in our present times government selective interventions have to be justified according to their capacity of achieving specific normatively-defined societal goals: developing innovative framework and methodologies, such as the one used in this paper, can help with that. In particular, in this study we have defined *industrial resilience,* as "*the way, the extent and the speed at which industries return to the previous state trend or trajectory after a shock, thus achieving a partial or a full recovery (or even what we might define an "ultra-recovery")"* and we have contended that it should be considered as a valuable framework supporting policymakers to promote more resilient economies and societies as well as a structural change that is socially sustainable. Moreover, building upon Di Tommaso et al. (2022), we have presented a methodology to measure *industry resilience* and apply it to the case of Italy, showing how different sectors reacted to the 2008 shocks, with particular attention to to tourism-related industries.

The general evidence, presented in figure 6, shows that industries reacted heterogeneously in response to the 2008 shock. This means that sectors display different capacities of dealing with employment retention and good quality jobs. This reinforces the idea that policy-makers should be aware of such different postshock sectoral behaviors when framing industrial policy intervention aiming at supporting the resilience of our economies and societies.

Overall, the rankings and their visualization through the *industry resilience* matrix we have elaborated (figure 6) enable a novel *modus operandi* (one among the many possible) (Di Tommaso et al 2020a; Di Tommaso et al. 2022) for selecting and prioritizing policy targets. However, it is worth specifying that the value of the methodology and of the illustrative exercise on the Italian case do not lie in the specific rankings we presented; rather, it is grounded into the idea that robust methodologies for sectors selection matter for policymaking. Indeed, sectors' rankings may vary according to different societal goals, but what is important is that such rankings represent an informative basis to support decision-making to communicate – both to internal and external actors and stakeholders – why some

sectors could be preferable over other. In this perspective, such methodologies contribute to mitigate the rise of potential government failures, while increasing policy transparency and social accountability.

As for the results on tourism-related industries, the quantity and quality performances displayed by the CIs point to a high heterogeneity in terms of their respective ranking positions. The overall matrix (figure 6) reveals different degrees of resilience characterizing tourism-related industries: this would suggest policymakers that policy initiatives targeting tourism should be crafted taking into the account the specificities - included their individual *industry resilience* capacity – of the sectors that make up the tourism industry. These results call, on the one side, for the need of studying tourism-related industries individually, with the aim of capturing their specific reactions in the aftermath of a shock; on the other side, for a renovated research approach able to develop a more comprehensive analysis of the tourism-related industries through the lens of complex adaptive systems (Farrell and Twining-Ward, 2004; 2005), in line with the studies that firstly introduced the notion of resilience in the field of tourism.

However, customizing industrial policy intervention (also) according to their *postshock industry resilience* capacity might entail the involvement of a multitude of actors and stakeholders in the policy design and implementation; the latter, through lobbying activities and rent-seeking behaviour, could eventually oppose a genuine recovery and adaptation of the sector after the shock, drifting the sectoral trajectory away from a desirable transformation. Policymakers should take into account this risk and act accordingly to avoid the rise of this kind of government failure.

The paper has some limitations. First, the main variable taken into consideration is employment. We account for both the quantitative and qualitative aspect of it across sectors, in line with Di Tommaso et al. (2022). We do not look, instead, at other possible dimensions of *industry resilience* that could, in principle, encompass changes in value added, trade flows, output. The choice of the specific dimension to look at should be justified on the basis of the normative societal goals that policy-makers might want to achieve. In this paper, we have stressed the importance of making our economies and

societies more resilient face to future shocks, as well as to ensure a socially sustainable structural change. In view of this, we have considered employment as a relevant variable for supporting sectoral interventions that would match this objective. However, future studies might explore other dimensions of *industry resilience* related to other societal goals, thus enriching the concept and its measurement.

Other limitations refer to the possibility of analyzing Italian sub-sectors that make up the wider industry level considered in this paper. This has not been possible due to the lack of data and breaks in time series for both employment quantity and quality. Third, our results are context specific, refer to a market economy and cannot be generalized, for instance, to other economic systems, for instance that of a developing country. Future research could test this methodology against other economic system, such as China, or focus on more limited geographical levels, such as region/province.

Moreover, while we have offered a contribution on how to measure industrial resilience, future studies are needed to identify the industry-level determinants of resilience, which could depend upon a number of factors, including the organization of production, the structure of the production network, and technological endowments (OECD, 2021; Scazzieri, 2021; Li et al., 2022). In this stream, an interesting analysis could be carried on different tourism destinations at a national or regional level and consequently by encompassing also their different stage of the life-cycle.

Further, another interesting and under investigated domain refers to the performances of tourism-dependent regions or the estimation of the weight of tourism in the overall resilience results of these territories. A pioneering study of Watson and Deller (2022), for instance, by using US county-level resiliency data found that, overall, greater dependency reduces rates of resiliency, however, at the same time they found pockets within the United States, where greater dependency enhanced economic resiliency. In the light of these contrasting results, they state that the "location and nature of the tourism and hospitality industry matter and blanket generalizations might lead to incorrect policy interpretations".

Finally, further research could expand on this evidence by exploring the *industry resilience* of sectors facing shocks of a different nature and transmission mechanisms like for example in the case of COVID-19 pandemic. Of course, this latter point calls for actions from governments. The tourism industry, as argued by Assaf and Scuderi (2020), needs for credible measures from governments to generate market confidence and reduce the risks by incentivizing sustainable recovery and innovation. Clearly, there is also space for questioning the ways through which policy-makers should include tourism into their development strategies on innovation.

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TABLES

Table 1 – Peaks and troughs by sector

Sector	Peak Quarter	Trough Quarter	Rebound Quarter	Peak to Trough (Months)
Agriculture, forestry and fishing	2010 – Q4	2014 – Q1	2016 – Q1	39
Manufacturing	2007 – Q3	2013 – Q2	2015 – Q2	69
Construction	2008 – Q4	2013 – Q1	2015 – Q1	51
Wholesale and retail trade; repair of motor vehicles and motorcycles	2008–Q3	2011 – Q2	2013 – Q2	33
Transportation and storage	2008–Q4	2009 – Q2	2011 – Q2	6
Accommodation and food service activities	2009 – Q3	2014 – Q4	2016 – Q4	63
Financial and insurance activities	2011 – Q4	2014 – Q1	2016 – Q1	27
Real estate activities; Professional scientific and technical activities; Administrative and support service activities	2007 – Q4	2012 – Q1	2014 – Q1	51
Human health and social work activities	2009 – Q2	2010 – Q4	2012 – Q4	18
Arts, entertainment, recreation and other service activities	2007 – Q3	2011 – Q4	2013 – Q4	51
Mining and quarrying	Data for this sector covering the period 1998 - 2008 use the NACE Rev. 1.1 classification. The latter, for the aim of this research, is not fully compatible with data covering the period 2008 - 2022 which use the NACE Rev. 2 classification instead. Such a break in the time series and transitions from NACE Rev. 1.1 to NACE Rev. 2 prevent us from calculating the counterfactual indicators. See online supplementary materials - Appendix A for further details.			
Education	*Ut supra*			
Public administration and defence; compulsory social security	*Ut supra*			
Electricity, gas, steam and air conditioning supply	*Ut supra*			
Water supply; sewerage, waste management and remediation activities	*Ut supra*			
Information and communication	*Ut supra*			
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	*Ut supra*			

Sources: Authors' elaboration based on BLS data

Note: Q1 encompasses January, February and March, Q2 encompasses April, May and June, Q3 encompasses July, August, and September, while Q4 encompasses October, November, December.

Table 2. Quantitative resilience: Building *CI_QUANT*

Sector	A												B	
	IR		***IDV***		***IRV***		***RCD***		***TCD***		$\bar{X}$		***gM***	***CI_QUANT***
	Value	***I***	**Value**	***I***	**Value**	***I***	**Value**	***I***	**Value**	***I***	**Value**	***I***		
Accommodation and food service activities	11.5	9	0.446	10	1.91	10	0.342	7	-0.169	8	100.4	10	8,92	**1**
Human health and social work activities	12.7	10	-0.282	8	1.36	9	0.810	9	-1.13	7	100.3	9	8,61	**2**
Agriculture, forestry and fishing	9.84	7	-0.757	4	1.25	8	2.35	10	7.42	9	91.4	4	6,57	**3**
Real estate activities, professional, scientific and technical activities, administrative and support service activities	4.45	5	-0.234	9	0.426	5	-0.684	6	-1.73	5	92.8	6	5,86	**4**
Transportation and storage	5.9	6	-4.04	1	0.49	6	0,80	8	14.77	10	96.2	8	5,33	**5**
Wholesale, retail trade, repair of motor vehicles and motorcycles	2.89	4	-0.486	7	0.217	4	-0.892	4	-2.69	4	95.7	7	4,29	**6**
Arts, entertainment, recreation and other service activities	2.2	2	-0.54	6	0.39	2	-0.78	5	-1.34	6	88.8	3	4,04	**7**
Financial and insurance activities	10.6	8	-1.16	2	1.17	7	-1.90	3	-9.53	1	91.6	5	3,45	**8**
Manufacturing	2.47	3	-0.622	5	0.218	3	-4.93	2	-7.73	2	87.3	2	2,38	**9**
Construction	-4.10	1	-1.08	3	-0.667	1	-2.51	1	-3.20	3	86.5	1	1,62	**10**

Source: Authors' elaboration based on Eurostat data

Notes: IR= Industry Rebound; IDV= Industry Drop Velocity; IRV= Industry Recovery Velocity; RCD= Rebound-Counterfactual Difference Ratio; TCD= Trough-Counterfactual Difference Ratio; $\bar{X}$= Industrial Average Employment gM = geometric mean

Table 3. Qualitative resilience: Building CI_QUAL

Sector	A										B	
	IR		*IDV*		*IRV*		*RCD*	*TCD*	$\bar{X}$		*gM*	*CI_QUAL*
	Value	*I*	Value	*I*	Value	*I*	*I*	*I*	Value	*I*		
Financial and insurance activities	-31,1	10	-3,93	9	-1,73	10	10	10	69,9	10	**10.00**	**1**
Wholesale, retail trade, repair of motor vehicles and motorcycles	7,7	5	-0,10	7	0,80	6	9	7	93,5	8	**6.85**	**2**
Accommodation and food service activities	2,6	6	0,72	3	1,44	5	7	4	88,5	9	**5.92**	**3**
Real estate activities, professional, scientific and technical activities, administrative and support service activities	-4,5	7	0,07	6	-1,12	9	6	3	106,7	2	**5.14**	**4**
Human health and social work activities	12,9	3	-1,93	8	1,99	3	2	9	95,0	6	**4.54**	**5**
Arts, entertainment, recreation and other service activities	-19,6	8	0,65	4	0,10	7	5	2	95,9	6	**3.73**	**6**
Manufacturing	22,7	1	0,25	5	3,02	2	4	6	99,4	5	**3.66**	**7**
Construction	-22,8	9	1,37	1	-0,47	8	3	1	106,4	3	**3.30**	**8**
Transportation and storage	15	2	-10,95	10	3,19	1	8	5	91,2	8	**3.15**	**9**
Agriculture, forestry and fishing	8,9	4	1,07	2	1,87	4	1	8	106,82	1	**2.70**	**10**

Source: Authors' elaboration based on Eurostat data.

Notes: IR= Industry Rebound; IDV= Industry Drop Velocity; IRV= Industry Recovery Velocity; RCD= Rebound-Counterfactual Difference Ratio; TCD= Trough-Counterfactual Difference Ratio; $\bar{X}$= Industrial Average Employment; gM = geometric mean

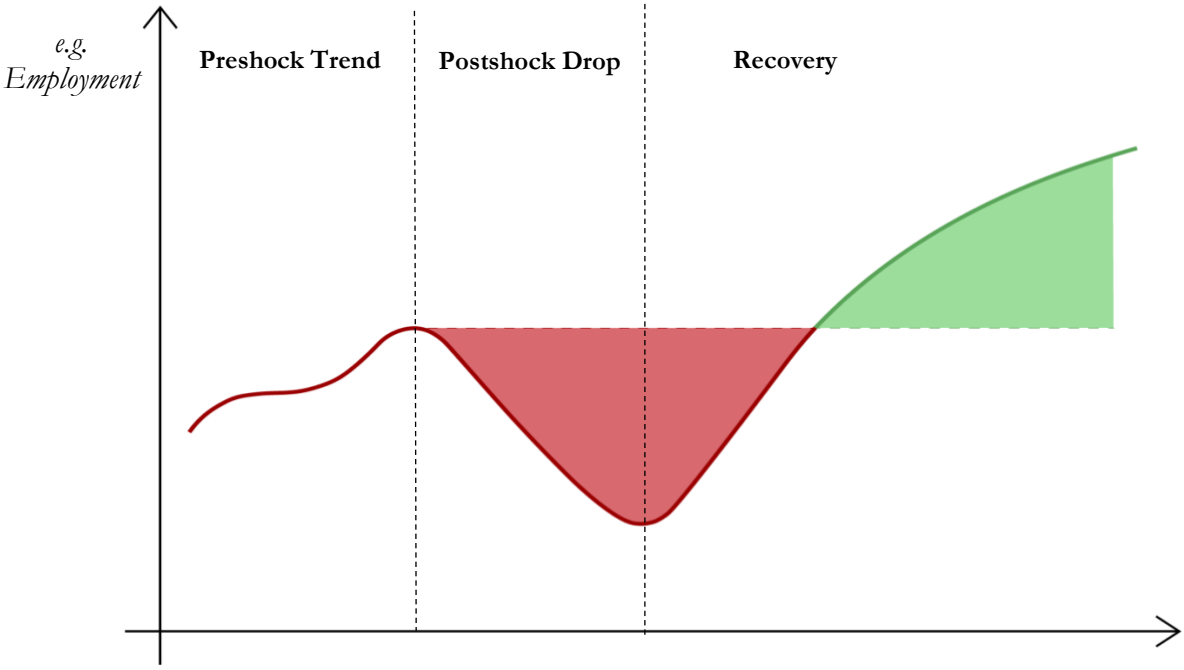
Table 4. *CI_QUANT* and *CI_QUAL* – all sectors

Sector	*CI_QUANT*	*CI_QUAL*
Accommodation and food service activities	**1**	**3**
Human health and social work activities	**2**	**6**
Agriculture, forestry and fishing	**3**	**10**
Real estate activities, professional, scientific and technical activities, administrative and support service activities	**4**	**4**
Transportation and storage	**5**	**7**
Wholesale, retail trade, repair of motor vehicles and motorcycles	**6**	**2**
Arts, entertainment, recreation and other service activities	**7**	**5**
Financial and insurance activities	**8**	**1**
Manufacturing	**9**	**8**
Construction	**10**	**9**

Source: Authors' elaboration based on Eurostat data

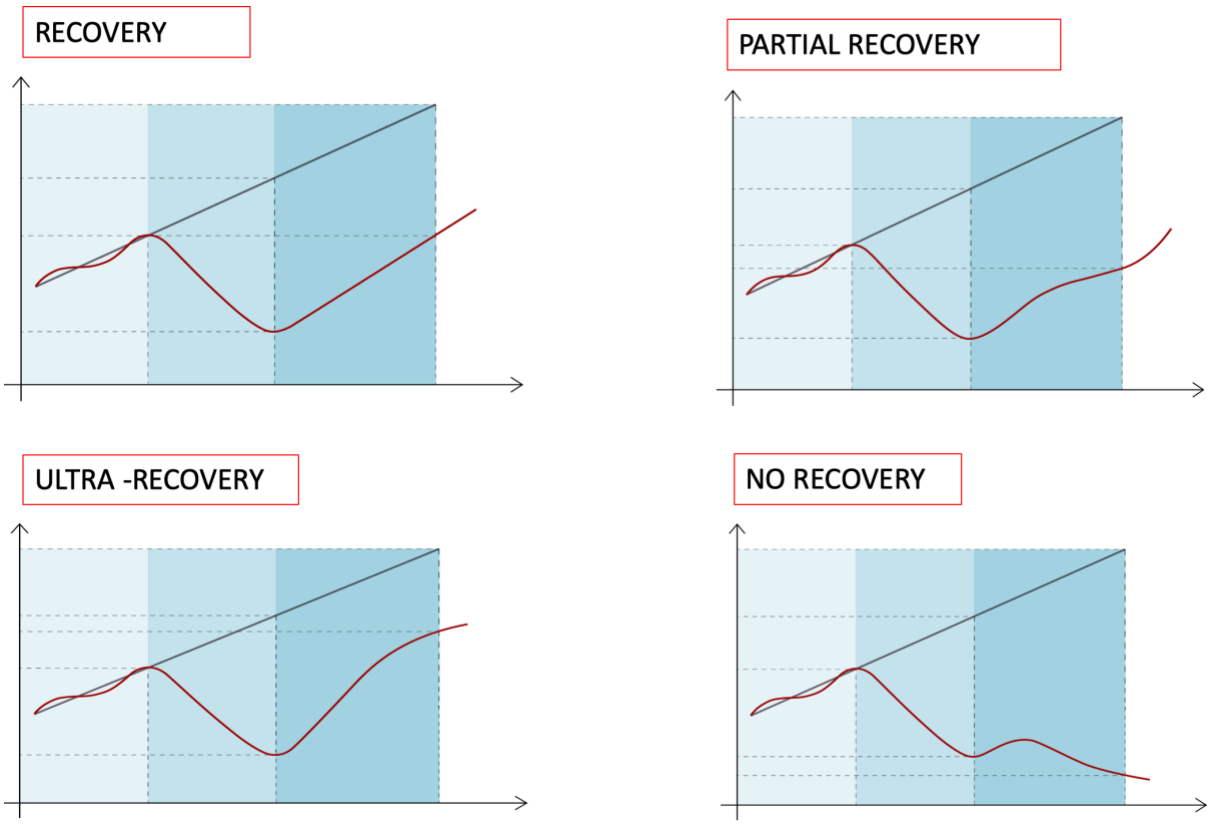
FIGURES

Figure 1 – Resilience: Drop and Recovery



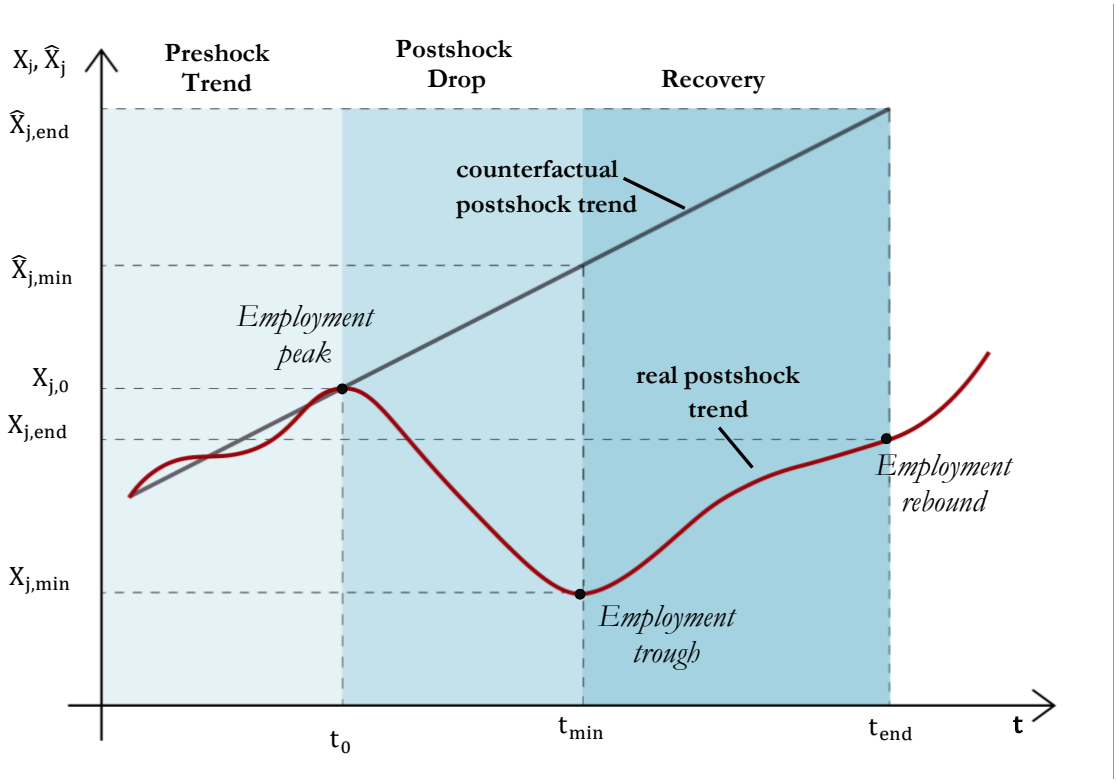
Source: authors' elaboration

Figure 2 – Postshock industry resilience: different recovery trajectories



Source: authors' elaboration

Figure 3 – Industry resilience



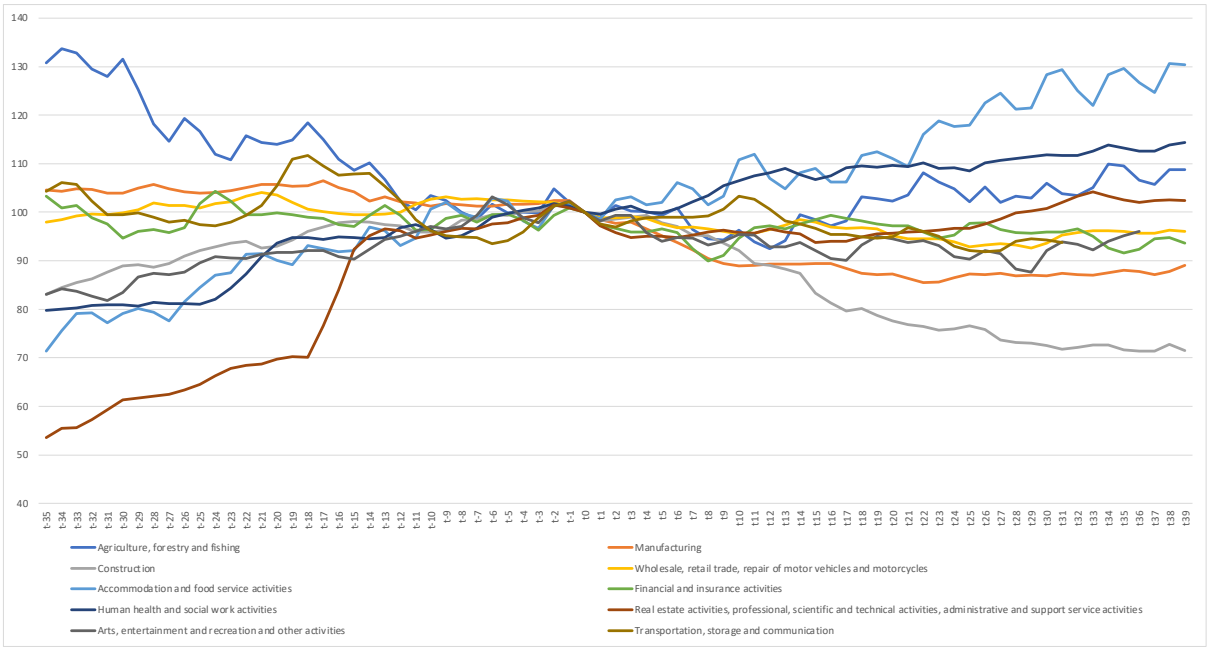
Source: Authors' elaboration on Di Tommaso et al. (2022)

Figure 4 – Employment trends for Italy's sectors from 1998 to 2021

Source: authors' elaboration on EU-LSF quarterly data. Data smoothed using the moving average technique.

Note: RPA: Real estate activities, professional, scientific and technical activities, administrative and support service activities

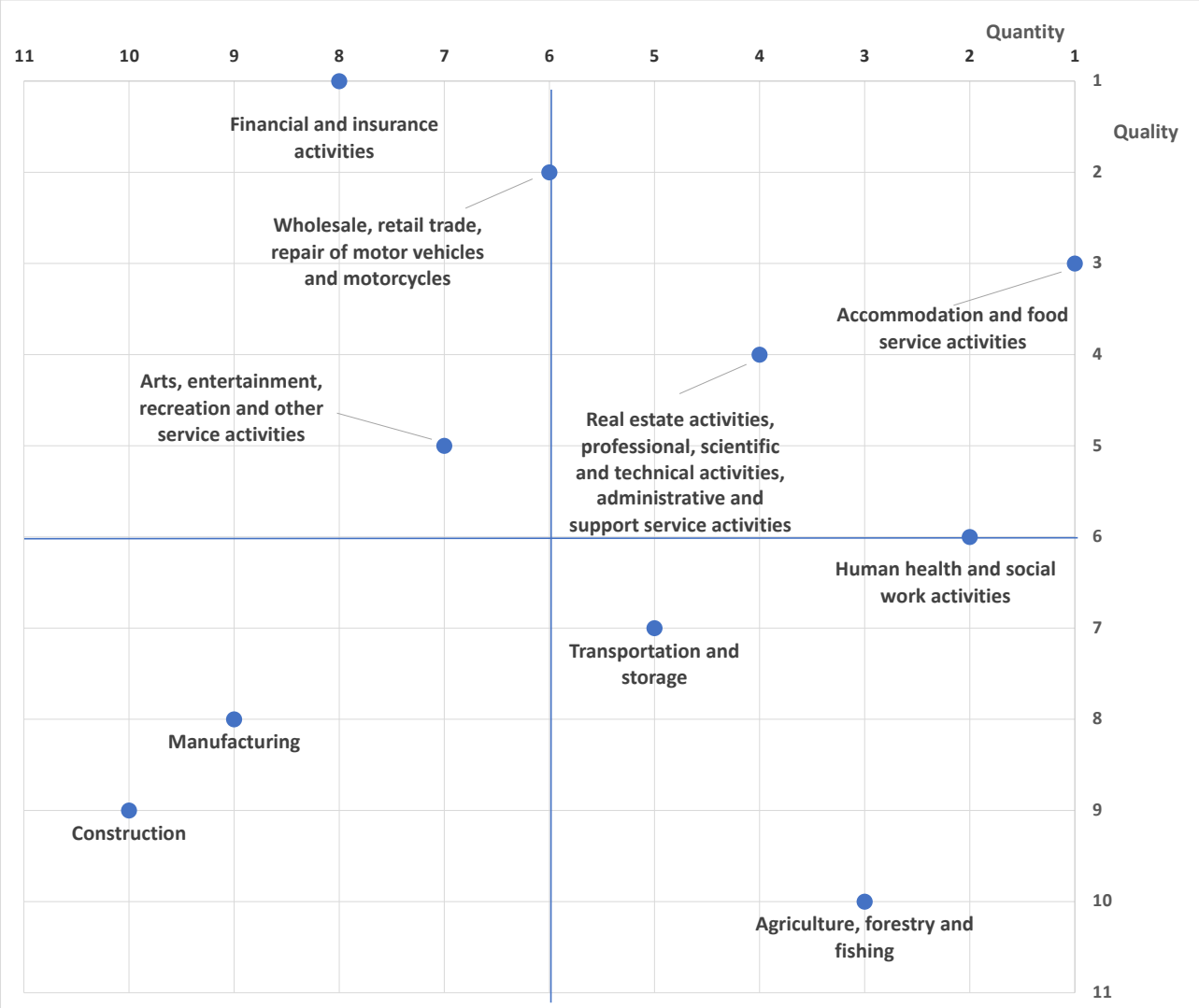
Figure 5 – Employment trends for Italy's sectors during the 2008 recession (preshock peak value=100)



Source: Authors' elaborations on EU-LSF quarterly data. Data smoothed using the moving average technique.

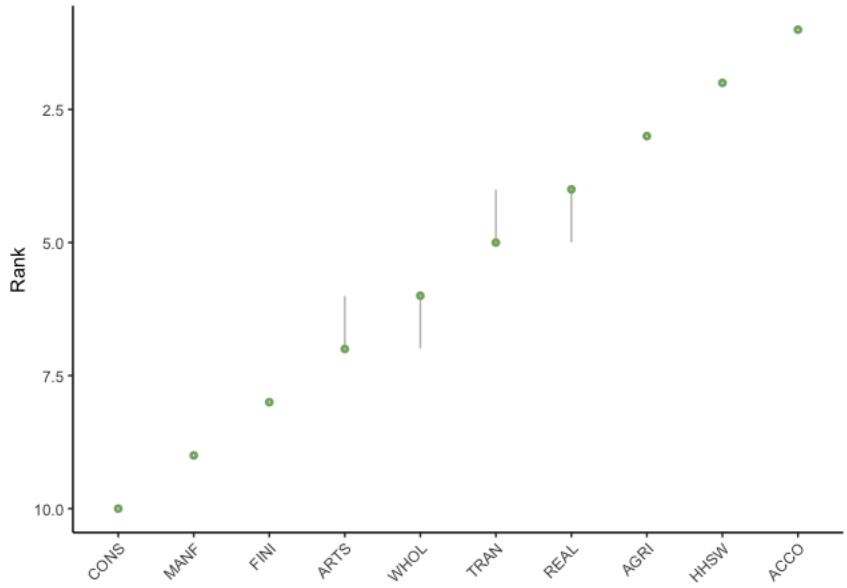
Note: All variations are measured as the percentage change with respect to the preshock peak value of each sector

Figure 6. Industry resilience matrix



Source: Authors' elaboration based on Eurostat data

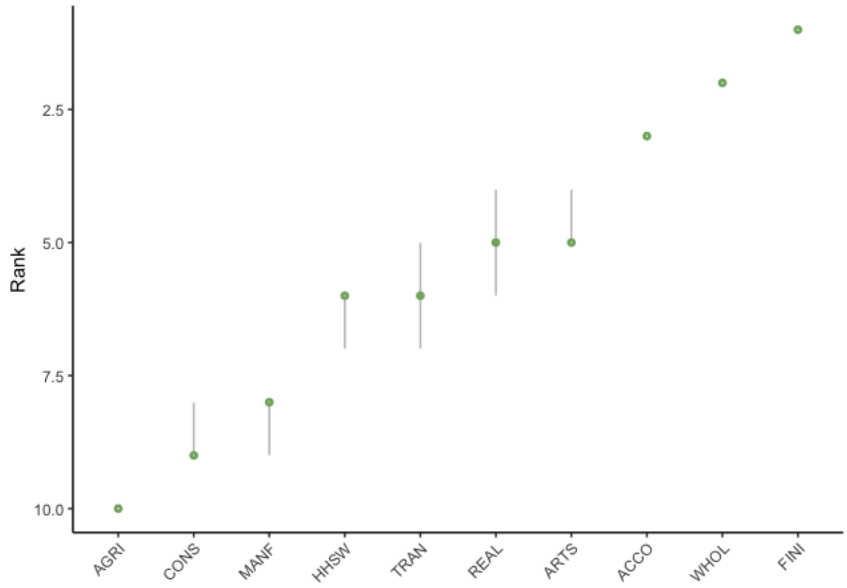
Figure 7: Uncertainty analysis on *CI_QUAN*



Source: Authors' elaboration

Note: The results show the median (green dot) and the corresponding 5th and 95th percentiles (bounds) of the distribution of sectors. Uncertain input factor: weights. Sector coding: AGRI - Agriculture, forestry and fishing; MANF – Manufacturing; CONS – Construction; WHOL – Wholesale and retail trade; repair of motor vehicles and motorcycles; ACCO - Accommodation and food service activities; TRAN - Transportation and storage; FINI - Financial and insurance activities; REAL - Real estate activities; Professional, scientific and technical activities; Administrative and support service activities; HHSW - Human health and social work activities; ARTS - Arts, entertainment and recreation; Other service activities.

Figure 8: Uncertainty analysis on *CI_QUAL*



Source: Authors' elaboration

Note: The results show the median (green dot) and the corresponding 5th and 95th percentiles (bounds) of the distribution of sectors. Uncertain input factor: weights. Sector coding: AGRI - Agriculture, forestry and fishing; MANF – Manufacturing; CONS – Construction; WHOL – Wholesale and retail trade; repair of motor vehicles and motorcycles; ACCO - Accommodation and food service activities; TRAN - Transportation and storage; FINI - Financial and insurance activities; REAL - Real estate activities; Professional, scientific and technical activities; Administrative and support service activities; HHSW - Human health and social work activities; ARTS - Arts, entertainment and recreation; Other service activities.