

Innovation as a resilience strategy to economic crises for international food and drink firms

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Abstract

The 2008–2009 global economic downturn emphasized the role of demand contractions and the potential mediation role of trade on firms' performance in times of crisis. Evidence in anticyclical sectors such as the food industry is scarce. Using European firm-level data on the 2008–2009 crisis, we explore (i) whether the internal demand or market synchronism (external demand) prevailed when assessing their relation with the crisis and (ii) the role innovation strategies played in mitigating this in weathering the drop in demand. Results indicate that the more internationalized firms are, the more they suffer from economic crises, with exporters the most affected, but that innovation can have a mitigating role. [EconLit Citations: F14, G01, O32].

KEYWORDS

export, economic crisis, firm-level analysis, food manufacturing, innovation, internationalization

1 | INTRODUCTION

The real consequences of socioeconomic shocks are unpredictable, especially due to the notable—but still unclear from a research point of view—spill-over effects between economies. Over the last three decades production networks have powerfully altered the interdependence of countries and firms around the world by generating patterns of intra-area interdependence resulting in firms' linkages being particularly vulnerable to economic crises

Abbreviations: EFIGE, European Firms in Global Economy survey; EU, European Union; FDI, Foreign Direct Investment; ICT, Information and Communication Technologies; NACE, Nomenclature of Economic Activities; ROA, Return on Asset; R&D, Research and Development; TFP, Total Factor Productivity.

(EC, 2020). Studies in economics have long been interested in understanding the determinants of firms' performance and vulnerability from a macro- and microeconomic perspective (Schumacher & Boland, 2005).

The drastic reduction of internal and foreign demand is considered one of the main reasons for firms' vulnerability (Claessens et al., 2012), albeit to a different level (Altomonte et al., 2012; Baldwin, 2009; EC, 2016). Noncyclical sectors, such as the food and drink industry, show in fact, more stability during economic crises than other sectors, although the degree of profit persistence tends to be lower. The reason for this is the strong competition between firms and retailers in the sector (Araujo & Martins, 2009; Békés et al., 2011; EC, 2013; Hirsch & Gschwandtner, 2013; Hirsch et al., 2020). For instance, the budget share for food and nonalcoholic beverages remained roughly unchanged during the 2008 recession in Italy (CIAA, 2011; Rondinelli et al., 2014). This holds true for the recent drastic shocks that since March 2020 affected the global economy due to the COVID-19 pandemic (Rowan & Galanakis, 2020). The agrifood economy is regarded as a crisis-proof sector, less affected by business cycles due to a demand for food products that remain stable (Chaddad & Mondelli, 2013; Hirsch & Gschwandtner, 2013; Schumacher & Boland, 2005).

For manufacturing sectors, the literature shows that in times of crisis most internationalized firms are more likely to survive in the market (Wagner, 2013), especially if they are involved in specific internationalization activities, such as imports or outsourcing (Békés et al., 2011; Wagner & Gelübcke, 2014). However, the extent to which internal demand prevails over external demand in the agrifood sector when assessing its relationship with a crisis is still not clear and a gap remains in the literature on the role played by "internationalization connectivity" (defined here as the extent to which companies are involved in international activities connecting them to other companies beyond national boundaries) in times of crisis (Crescenzi & Iammarino, 2017).

In this paper we address such a gap by analyzing whether involvement in internationalization activities affects the extent to which food and drinks firms are hit by economic crises (our first research question). Being active in international activities and value chains has in fact been recognized as one of the characteristics having a role in affecting businesses' vulnerability to shocks and profitability in this sector (Schumacher & Boland, 2005).¹ In times of crisis, firms often face the challenge of adjusting their production to changing economic conditions and demand trends (Costa et al., 2019). In the case of internationalized firms involved in global networks and international dynamics this is even more important. Flexibility (i.e., the capacity to change and innovate to address external challenges) generally has a positive impact on the capacity of firms to make profits, which is significantly higher during an economic crisis than after it (Hirsch et al., 2020). In this vein, innovation and new product development are key determinants of firm performance, resonating with the Schumpeterian view on the role of innovation (Schumpeter, 1942), especially given the increased levels of competition in the agrifood economy (Chaddad & Mondelli, 2013; Conz & Magnani, 2020). Indeed, according to the industrial economic literature, internationalization and innovation strategies coevolve, shaping firms' resilience to economic crises (Meliciani & Tchorek, 2019). However, while recently Landini et al. (2020) provided the first evidence of an innovation premium (i.e., intangible strength) in the survival of internationalized manufacturing firms, the extent to which innovation can temper the effects of the economic crisis for food and drink firms, and thus act as a form of resilience to negative shocks, is still an open question. For this reason, we analyze whether innovation plays a mediating role in mitigating the negative consequences of a crisis (second research question).

To address these issues, we gathered firm data from the most complete harmonized database for European countries: the European Firms in Global Economy survey (EFIGE).² The global 2008–2009 crisis currently represents the most recent sharp economic downtrend for which data are available to detect evidence-based

¹As affecting factors, literature pointed out the role of financial constraints (Garcia-Appendini & Montoriol-Garriga, 2013), spatial concentration (Brancati et al., 2017), and the presence of intangible assets, such as knowledge (Lengnick-Hall & Beck, 2005; Meliciani & Tchorek, 2019) and working environment (Aranega et al., 2021).

²EFIGE provides a unique set of information on firms' internationalization, innovation, investment and finance, and pricing for firms in seven different European countries over the period 2007–2009. A database collected within the EFIGE project "European Firms in a Global Economy: internal policies for external competitiveness." The project has been supported by the Directorate General Research of the European Commission through its seventh Framework Programme and is coordinated by Bruegel, a think tank based in Brussels. The questionnaire includes questions on: ownership structure of the firm, structure of the workforce, investment, technological innovation and R&D, internationalization; finance, market, and pricing.

insights: We retrieved a sample of about 1000 European Union (EU) food and drink firms from EFIGE to analyze our research questions.³ Results show that—*ceteris paribus*—internationalized firms are more likely to suffer from economic crisis, with exporters, among other forms of internationalization, being affected the most. The role of demand contractions is also confirmed for anticyclic sectors, due to market synchronism. However, this negative relationship is mitigated by (process) innovation and Research and Development (R&D) activities. Our evidence supports innovativeness as a core competence leading to the ability to cope with economic shocks. To the best of our knowledge, this is the first paper using firm-level data that simultaneously addresses the extent to which internationalized food and drink firms develop resilience to economic shocks and whether different internationalization strategies and innovation activities temper the consequences of economic crises. Moreover, this paper moves beyond the existing literature (Chaddad & Mondelli, 2013) offering insights into the association of strategic factors with firm vulnerability.⁴ On the basis of this, we contribute to an informed policy debate on the advantages that innovation might have in accelerating the recovery from economic crises. From a policy perspective, this evidence supports the need to enhance policies that stimulate the adoption of innovation in the food and drink sector.

2 | BACKGROUND OVERVIEW: INTERNATIONALIZATION AND INNOVATION FOR AGRIFOOD FIRMS

Many economists and business-strategy scholars worldwide (Archibugi & Filippetti, 2011; Archibugi et al., 2013a, 2013b) have focused on the following question: What type of firms suffered the most from the 2008 economic crisis? Although research has provided so far both theoretical and empirical evidence on the matter, no consensus has yet been reached on the way specific market and business strategies (such as international openness and innovation activities) relate to enhancing the resilience of agribusinesses to economic shocks. The majority of existing contributions focus on other manufacturing sectors and conduct their analysis at the national level (Correa & Ito, 2010; Filippetti & Archibugi, 2011; Ramalho et al., 2009), whereas only a few have provided empirical evidence at industrial level so far (Paunov, 2012; Wagner, 2013). In the agrifood domain, studies tend to mainly refer to the years before the 2008 crisis (Chaddad & Mondelli, 2013), leaving managers and policy makers with limited evidence to inform their decision making over what leverages the resilience of agribusinesses facing an economic shock. The EU food and drink industry is worth considering as a setting for analyses. It is generally competitive on a global scale and during the global 2008–2009 economic crisis it performed better than other manufacturing sectors, even if the trade value contracted by 11% (CIAA, 2011).

2.1 | Internationalization in times of crisis

Among firm characteristics, studies demonstrate that trade was one of the vehicles for the transmission of the global 2008–2009 economic crisis (Claessens et al., 2012). One stream of the literature suggests that exporters were the more vulnerable to the consequences of the crisis, whereas importers and firms that outsourced part of their production were, to some extent, insulated from the crisis (Accetturo & Giunta, 2017; Altomonte et al., 2013; Békés et al., 2011). According to Wagner and Gelübcke (2014), the chance of survival of a firm during a crisis is

³The year 2009 is indeed the year in which the effect of the crisis starts to be more evident in Europe, where the crisis arrived at the end of 2008. For our empirical aims, 2009 is therefore the reference point for analyzing our research questions.

⁴We do not limit the effect of the crisis only on the expenditure for innovation as in other papers. For example, Archibugi and Filippetti (2011) and Archibugi et al. (2013b) proxy the effect of the crisis on the innovation activities of the companies analyzed using only information on the total amount spent on all the innovation activities in which the firms are involved.

negatively correlated with exporting, but positively with importing. Conversely, more sophisticated forms of internationalization (e.g., Foreign Direct Investment [FDI]) seem to decrease firm vulnerability (Meliciani & Tchorek, 2019). However, other contributions, such as Wagner (2013), provide evidence that exporting firms were actually more likely to survive in the market with respect to the nonexporting counterparts. Recently, Landini et al. (2020) found no significant effect of export-related indicators on the probability of exiting the market during the crisis. This might also explain the synchronism of the recession: as exports reduced dramatically, imports of intermediate inputs declined too (see Baldwin, 2009). As the majority of these studies focused on different manufacturing sectors, the debate is still open when it comes to agrifood businesses.

2.2 | Innovation in times of crisis

Although EU firms differ considerably in terms of innovation (Arundel et al., 2007), there is widespread consensus that innovation and technological capabilities play a crucial role in developing resilience to shocks (among others, Aghion & Howitt, 1998; Archibugi & Filippetti, 2011; Grossman & Helpman, 1991). Firms that invest more in R&D and innovation tend to perform better than their noninnovative counterparts during economic crises (Archibugi & Cellini, 2017) and economic recovery (Bristow & Healy, 2018). This also resonates with a regional economic view (Crescenzi & Iammarino, 2017): innovation capacity increased the resilience of European regions and supported a rapid recovery from the 2008–2009 crisis (Bristow & Healy, 2018).

Meliciani and Tchorek (2019) find that, in manufacturing sectors, internationalized firms investing in intangible assets, such as knowledge and innovation, were more resilient to the global 2008–2009 economic crisis. By increasing firms' product differentiation, R&D becomes a source of resilience to trade shocks (Hombert & Matray, 2018). By focusing on the profit persistence in the EU food processing industry before the 2008 crisis, Hirsch and Gschwandtner (2013) show that encouraging the "right" innovations, more than a general R&D expenditure, leads to success within the food sector. Continuous innovation is also essential to keeping agrifood firms competitive (Mancini et al., 2019). Laple and Thorne (2019) show that agrifood firms' economic performance increases in tandem with their level of innovation. With focus on Spain, Zouaghi et al. (2018) conclude that know-how and innovation played a crucial role in mitigating the effects of the global 2008–2009 economic crisis.

We know from the literature, however, that innovation investment tends to be globally procyclical and decreases significantly during recessions (Archibugi et al., 2013b; Correa & Ito, 2010; Francois & Lloyd-Ellis, 2003), largely due to financial constraints (Békés et al., 2011). Armand and Mendi (2018) show that the decrease in innovation-related investments during the Great Recession occurred mostly among smaller firms.⁵ During a crisis, market opportunities trigger agrifood businesses to exploit innovations and technological knowledge to respond to consumer needs (Traill & Meulenber, 2002; Triguero et al., 2013). Innovation performance depends on factors, such as interdisciplinary arrangements and knowledge integration across different sectors. As shown by Ferraris et al. (2020), this is particularly true in the case of the food industry, whose innovation performance has been spurred by partnership with creative industries. The promotion of knowledge creation is of considerable benefit for export-oriented firms, given that innovation and internationalization strengthen each other (Cefis & Marsili, 2019). On the one hand, innovativeness facilitates export intensity (Aw et al., 2011; Constantini & Melitz, 2007; Guarascio et al., 2017), on the other hand, being part of global networks increases innovation propensity (Brancati et al., 2017). Yet, while evidence has been provided for other manufacturing sectors, it is still lacking for the food and drink industry.⁶

⁵In 2008, tougher competition due to the trade shock led the most innovative firms to increase their innovation, while less innovative firms either reduced or halted their innovation activity (Bustos, 2011; Kugler & Verhoogen, 2008).

⁶Giotopoulos and Vettas (2018) demonstrate that, in Greece, innovation facilitated the export intensity in the adverse times after the 2008–2009 crisis. Meliciani and Tchorek (2019) find that innovation prevented a drop in Italian firms' sales and exit in times of crisis. Landini et al. (2020) confirm this result: innovation intangible assets, measured by the share of accumulated R&D expenditures, the number of patents, licences and trademarks, strengthen the firm's resilience capacity in both the immediate and later stages of an economic crisis.

3 | DATA AND EMPIRICAL STRATEGY

3.1 | Data

To obtain information on firms' behavior during a crisis, we use data from the EFIGE survey (developed by the European think tank, Bruegel), which provides both quantitative and qualitative information on the manufacturing structure of seven EU countries: Austria, France, Germany, Hungary, Italy, Spain, and the UK.⁷ The survey is stratified by industry, region and firm size, and collects cross-sectional information for the period of the global crisis (2007–2009). Data are fully comparable across countries and have the advantage of being neither focused entirely on nor limited to internationalized and innovative firms, which could have led to selection bias. The EFIGE dataset includes in total 14,759 manufacturing firms. For the purpose of this study, we selected data for the food and drink industry (Nomenclature of Economic Activities [NACE] Rev. 2), which include a sample of about 1354 firms, of which 442 in Spain, 329 in Germany, 200 in France, 233 in Italy, 58 in the UK, 60 in Hungary, and finally 32 in Austria. To clean the data, we applied a standard procedure according to which firms with negative values for the main variables of interest (i.e., those used to build our indicators and the control variables used in the estimates) were excluded from the sample. After which due to the lack of information in balance-sheets, the final sample was reduced to about 850 firms. In Supporting Information Figures A.1 and A.2, we present two graphs with the distribution of firms in the different countries and NACE 3-digit sectors, respectively. The first graph indicates that the most representative country in the sample is Spain (about 380 firms), followed by Italy (about 200 firms), and France (about 130 firms). The other countries (Germany, the UK, and Hungary) all have fewer than 50. Supporting Information Figure A.2 shows that the most represented sectors are Meat (NACE 101) and Bakery and farinaceous products sectors (NACE 107), which both account for about 200 firms; followed by, Beverages (NACE 110) and Other food products (NACE 108), which include about 100 firms each. All the other sectors have less than 100 firms.

3.2 | Empirical strategy

The aim of our empirical analysis is twofold: first, to assess whether the level of firms' involvement in international activities affected their vulnerability to the crisis (first research question). Second, to analyze the extent to which innovation had a role in mitigating the consequences of the crisis (second research question). To capture crisis, internationalization, and innovation intensity, we work out the following indexes.

3.2.1 | Crisis intensity

The *Crisis Intensity* indicator captures to what extent firms were affected by the crisis. We refer to a set of questions in the EFIGE survey dealing specifically with the effect of the crisis related to the year 2009: (a) turnover reduction; (b) reduction in workforce; (c) Information and Communication Technologies (ICT), machinery or equipment investment reduction; (d) demand of external financing for liquidity needs. These variables are counted as dichotomic variables that take the value of 1 if the respondent firm declares to have experienced a negative outcome for each of the selected variables and 0 otherwise. Therefore, the index ranges from 0 (i.e., no crisis effects) to 4 (i.e., highest crisis effects). Figure 1 reports the distribution of firms in the different categories of the

⁷Data provided by EFIGE on firms' Total Factor Productivity (TFP) are calculated using balance-sheet data from AMADEUS. However, data from AMADEUS are not available for all the firms in the EFIGE dataset and/or for all the years under investigation.

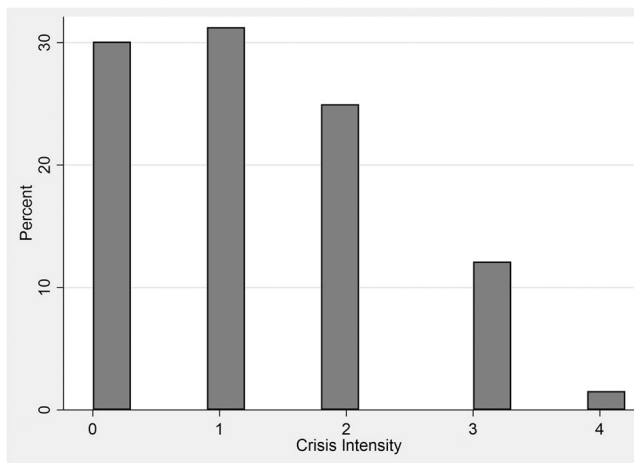


FIGURE 1 Distribution of observations into the different categories of the crisis intensity index

Crisis Intensity. We believe that our index is a more comprehensive measure to account for firms' vulnerability than the Return on Assets (ROAs) firm's profit-loss or net sales, particularly common in the agrifood literature (Hirsch & Gschwandtner, 2013; Schumacher & Boland, 2005). As demonstrated by Hirsch et al. (2020), focusing only on efficiency is, in fact, insufficient to explain firm performance.

According to our indicator about one-third of the firms in the sample has not been affected by the crisis. More than 60% of the firms is distributed between the values of 1 and 3, and only very few firms present a value of 4, that is, the effects of the crisis manifested in all the four aspects selected for this study.

3.2.2 | Internationalization intensity

Following the approach used by Altomonte et al. (2013), we built an *Internationalization Intensity* index that captures the extent to which firms are involved in different activities abroad: It depicts not only the classic dyad exporters/importers, but also the presence of FDI and outsourcing. More specifically, the index is composed of the following EFIGE variables. *Exporter* if the firm has sold abroad, directly from the home country, some or all of its own products/services in 2008 and/or previous year. *Importer* if the firm has purchased at least part of its intermediate goods from abroad in 2008 and previous years, distinguishing for services and materials. *Outsourcer* if the firm produces in response to an order from another nondomestic firm (*Active outsourcer*) or if the firm's turnover is derived, at least in part, from production activities carried out through contracts and agreements in 2008, or if the firm purchased services from abroad in 2008 or previous years (*Passive outsourcer*).⁸ Finally, *FDI* if the firm derives at least part of its turnover from production activities abroad based on FDI (foreign affiliates/controlled firms) in 2008, or if the firm acquired (totally or partially) or incorporated other foreign firms between 2007 and 2009 or has at least one foreign affiliate, that is, the FDI investor holds at least 10% of the foreign affiliate's shares (Altomonte et al., 2013).

Figure 2 presents the distribution of the index over the different categories.

The index varies between 0 (i.e., no internationalization activities) and 5 (i.e., involvement in all the considered internationalization activities). About 40% of the firms in the sample operates exclusively in the domestic

⁸Unless otherwise specified, outsourcer refers to firms involved in international outsourcing. It excludes firms involved in domestic outsourcing.

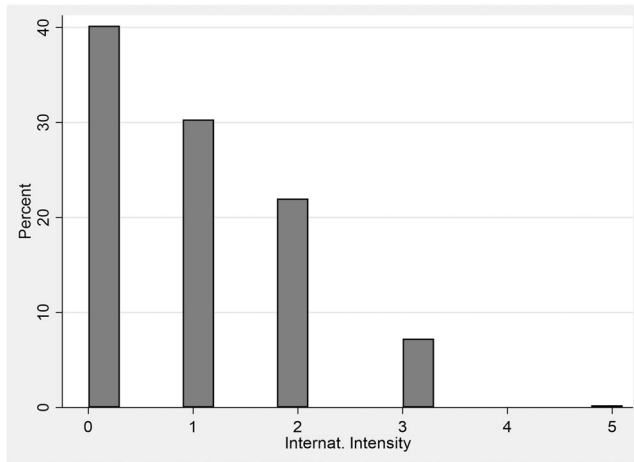


FIGURE 2 Distribution of firms into the different categories of the internationalization intensity index

environment, while more than 30% is at least involved in one of the considered internationalization activities. Around 20% of the firms in the sample is involved in two internationalization activities, about 6% in three activities, while very few firms are involved in four or five activities.

3.2.3 | Innovation intensity

Besides assessing whether the level of internationalization is related to the extent to which they have been affected by the crisis, our analysis also aims at understanding whether innovation mitigates the consequences of the crisis. To capture firms' *Innovative Behavior*, we rely on the approach used by Crinò and Epifani (2012) and Curzi and Olper (2012). We select a set of variables that capture firms' innovative behavior, and generate a synthetic proxy for innovation activities by extracting the principal component through factor analysis. Specifically, the following variables have been selected from the EFIGE dataset: Sales from innovative products, Total investment in R&D, Product Innovation, Process Innovation, Patent and Percentage of employees involved in R&D and ISO certification. We present a detailed description of the Factor Analysis results in Supporting Information Appendix B.

Supporting Information Table A.2 presents the descriptive statistics of the variables used to capture the innovative behaviors of firms. Differences between domestic and internationalized firms are particularly evident in the average values of sales of innovative products, total R&D investments and patents. In particular, firms active abroad show, on average, higher values than domestic firms.

3.3 | Model and estimation issues

Our empirical strategy to test the relationship between internationalization and innovation intensity on the extent to which firms in the food and drink sector were hit by the 2009 crisis is based on the following ordered logit model:

$$CrisisInt_{ic} = \alpha_0 + \beta_{ic}InternatInt_{ic} + I_{ic} + X_{ic} + \mu_c + \varepsilon_{ic}, \quad (1)$$

where i is the firm, and c the country. $CrisisInt_{ic}$ is the crisis intensity index, built as explained in Section 3.2.1. $InternatInt_{ic}$ is the index for firms' internationalization (see Section 3.2.2). I_{ic} represents the synthetic indicator proposed for firms' innovation (see Section 3.2.3). X_{ic} is a vector containing control variables that, according to the

literature, are likely to affect firm performance during the crisis: age of the firm, firm size (proxied by the number of employees), and two dummy variables indicating the financial situation of the firms, namely, the presence of external financing and financial constraints. In addition, we also control for average TFP in the years 2007–2008.⁹ The inclusion of this last variable is relevant to our analysis, since the TFP represents a measure of firm efficiency. Our analysis aims at assessing the relationship between the crisis and firms' internationalization activities, and, according to the literature, TFP is one of the major determinants of firm performance in the international markets (Melitz, 2003).¹⁰ Finally, μ_c and ε_{ic} represent, respectively, country fixed effects and the error term.¹¹

Although the variables used to build the innovation index are not directly linked to these investments, but rather to R&D and more in general to firms' innovation, the causal direction between crisis and innovation intensity is difficult to disentangle given the cross-sectional dimension of our data (Altomonte et al., 2013). However, as all the data on internationalization activities refer to year 2008, while those related to the crisis intensity index refer to 2009, this potential simultaneous endogeneity bias is mitigated.¹² The use of a composite indicator allows us to disentangle the level of complexity related to firms adopting different innovation strategies (Materia et al., 2017).

A complex index captures firms' participation in the global economy better than the conventional approaches used by the literature so far. The majority of existing research articles, in fact, exploit simple exporters/nonexporters dichotomy variables (EC, 2020), the probability of collapsing or surviving when facing a crisis (Landini et al., 2020; Meliciani & Tchorek, 2019) or sales rates (Accetturo & Giunta, 2018).

4 | RESULTS AND DISCUSSION

4.1 | International behavior and consequences of the crisis

As shown by the summary statistics in Supporting Information Table A.1, the differences between domestic and internationalized firms are important: internationalized firms are bigger, with the mean value of the number of employees for domestic firms in category 1 (10–19 employees), while firms active abroad have a mean value higher than 2 (20–49 employees). Moreover, internationalized firms are, on average, older and show a higher TFP than domestic firms. The financial situation of the two samples is quite similar (Supporting Information Table A.2).

The first step of our analysis aims at testing the relationship between internationalization and the extent to which firms were affected by the crisis. Results are presented in Table 1, while Supporting Information Table A.3 reports marginal effects.¹³

⁹The TFP variable has been provided by EFIGE estimated with the Levinsohn and Petrin (2003) methodology. No balance-sheet data are in fact available to the authors. Therefore, no details can be provided on the variables included nor on the coefficients obtained from the LP estimation. Note that TFP has been calculated using the Levinsohn and Petrin (2003) methodology. The variable used in our estimations represents the average TFP at the firm level over the years 2007–2008.

¹⁰This is important since the international activity is increasingly characterized not only by exports, but also by FDIs, imports and outsourcing within global value chains (Altomonte et al., 2013).

¹¹Note that all the results tables report for all the coefficients robust standard errors in parenthesis. We decided not to cluster the standard errors, as the structure of our database does not allow us to identify a reliable clustering strategy. This is because all the different clustering options (i.e., country level or sectoral level) would lead to identify a number of groups lower than 50, which is well known to represent the threshold above which a clustering strategy can be considered as reliable. Anyway, in the Supporting Information Appendix we present all our main estimations with standard error clustered at the firm level (Supporting Information Tables A.5–A.8). The results are almost unaffected.

¹²To test the potential collinearity of the different variables used in the model, we present in Supporting Information Appendix D different tables where we report the correlation between the variables used in our empirical analysis (see Supporting Information Tables D.1–D.3). The figures in the tables are quite reassuring as they do not show a strong correlation between the variables.

¹³We built this index as the sum of the percentages for which each of the selected internationalization activities contributes to the final turnover (by construction, this variable can assume values ranging from 0 to 100). Then, we divided the resulting variable into four categories, representing the extent to which firms' turnover depends on internationalization activities. In particular, this variable assumes the value of 0 if the turnover does not depend at all on these activities; 1 if turnover depends less or equal to 10% by internationalization activities, 2 if these activities contribute more than 10% and less (or equal) to 50%, 3 if depends on more than 50%. Supporting Information Figure A.3 shows the distribution of firms within categories.

TABLE 1 Internationalization intensity and firms' crisis effect

	(1)	(2)	(3)	(4)
	Crisis Intensity	Crisis Intensity	Crisis Intensity	Crisis Intensity
Internationalization intensity	0.248*** (0.0683)			
Active abroad		0.403*** (0.135)		
			0.217*** (0.0620)	
Internationalization intensity (% turnover)				
Exporter				0.399*** (0.142)
Importer				0.151 (0.153)
FDI				0.803 (0.549)
Outsourcing				0.0448 (0.208)
(ln) Age	0.169 (0.109)	0.162 (0.109)	0.175 (0.109)	0.166 (0.110)
Employees (1–4)	0.0431 (0.0810)	0.0724 (0.0796)	0.0522 (0.0801)	0.0425 (0.0813)
External financing 2008–2009	0.123 (0.130)	0.126 (0.130)	0.120 (0.130)	0.118 (0.131)
Financial constraint 2007–2009	0.768*** (0.155)	0.764*** (0.155)	0.762*** (0.156)	0.774*** (0.156)
TFP 2007–2008	−0.497*** (0.140)	−0.512*** (0.144)	−0.529*** (0.142)	−0.522*** (0.139)
Observations	841	841	841	841
Pseudo-R ²	0.064	0.062	0.064	0.065

Note: This table reports the results of estimating (1) with ordered logit. The results in column (4) allow distinguishing across the different internationalization activities. All regressions include a full set of country-level dummies. Robust standard error in parentheses. *, **, and *** indicate significance at 90%, 95%, and 99% confidence levels, respectively.

Abbreviations: FDI, Foreign Direct Investment; TFP, Total Factor Productivity.

Our findings show that *Internationalization Intensity* is positively related to the *Crisis Intensity*: the more a firm is involved internationally, the more it is affected by the crisis (column 1). Quantitatively, if we interpret the results in terms of odd ratios, a unit increase in our *Internationalization Intensity* index implies that firms might be 28% more likely to suffer the consequences of the crisis, other variables being equal. Note that to refine our findings, we use the odds-ratio interpretation of the coefficients and ensure that the *Innovation Intensity* index has been

standardized to have zero mean, zero standard deviation equal to one. Quantitatively, a one unit increase in our *Internationalization Intensity* index suggests a reduction of the odds of suffering the crisis by 1.28 times ($=\exp(0.248)$) and, therefore, an increase of 28% ($=1.28 - 1$). We will adopt this strategy to interpret the coefficients in the rest of the paper.

Age and size of the firms (number of employees) are not significant. However, firms with financial constraints during the whole period under investigation seem more likely to suffer from the crisis. Firm TFP is negatively associated with crisis intensity: in other words, the more productive firms have suffered less the consequences of the crisis.

The sign and significance do not change with alternative specifications in columns (2) and (3). In column (2) we introduce *Active Abroad* expressed as a dichotomous variable, which captures whether a firm is involved in at least one of the internationalization activities considered to build our *Internationalization Intensity* index, and found that being involved in at least one activity increases vulnerability by 1.49 times ($=\exp(0.403)$). In column (3), as a first robustness check, we consider a different internationalization proxy, namely, the percentage of turnover deriving from internationalization activities.¹⁴ This allows us to consider not only whether firms are involved in the selected internationalization activities, but also the extent to which each activity contributes (in percentage) to the final turnover in the year selected (i.e., 2008). We acknowledge that export activity is the most straightforward and least complex internationalization strategy (Altomonte et al., 2013; EC, 2015), especially for the food and drink sector (Fernández-Olmos & Díez-Vial, 2014). In our sample (Supporting Information Table A.4), and, in fact, exporting proves to be the most common activity adopted by firms (45.54%). Other rather activities are importing (28.54%) and passive outsourcing (20.45%). By contrast, few firms are active outsourcers (1.07%) or operate FDI (2.14%).

Therefore, we test the relation of different internationalization activities and find that it is sharper for exporters, 47% (column 4): While other forms of internationalization are less likely to suffer significant effects of the crisis, ceteris paribus exporters seem to have the highest correlation with the crisis. Our evidence is in line with the literature (e.g., Békés et al., 2011; Wagner & Gelübcke, 2014). The focus is on a specific sector which has proved to maintain its internal demand despite the crisis. Although the 2008–2009 crisis was a global shock and therefore such a result might be surprising, the fact that exporters were the most affected can be explained by the fact that such activity is associated with a low level of complexity, as suggested by Altomonte et al. (2013). According to these authors, who consider the same source of data (i.e., EFIGE), different internationalization modes have different setup costs, which are the lowest for exporters, and the highest for outsourcers and FDI investors. Exporters are usually smaller and less productive than firms involved in other (more complex) internationalization activities. This leads the authors to argue that “the ranking of internationalization modes in terms of corresponding firm performance can be interpreted as driven by an underlying ranking in terms of their international complexity as determined by the corresponding setup costs” (Altomonte et al., 2013, p. 13). As a consequence, in our analysis firms involved in more complex modes of internationalization are characterized by higher productivity, which is a key parameter affecting their resilience, and thus better equipped to overcome the financial crisis. This is because according to the *firm-heterogeneity* literature, more productive firms are likely to have more success in the international markets as they are larger, more efficient, serve more and more distant markets and are able to cope with the high costs of entry in the export markets (Bernard et al., 2009; Melitz, 2003; Melitz & Ottaviano, 2008).

The consequences (of the crisis) for exporters can be mediated by different trade conditions, partners, and experiences (Accetturo & Giunta, 2018). In the following, we test this relation with a set of heterogeneity dimensions of internationalization by augmenting the baseline model (i.e., considering only exporting as internationalization activity) with new control variables and interaction terms (Table 2).

¹⁴The inclusion of a variable related to firms' financial situation (i.e., liquidity needs) in our dependent variable may lead to a simultaneity bias in the results displayed in columns (2) and (3). However, we are not interested in the causality of these relationships. Furthermore, even excluding the variable related to firm liquidity needs from the crisis intensity index, the main results are unaffected. The results of these additional checks are available from the authors upon request.

TABLE 2 Further insights on the relationship between exporting activity and firms' crisis effect

	(1)	(2)	(3)	(4)
	Crisis Intensity	Crisis Intensity	Crisis Intensity	Crisis Intensity
Exporter	0.290** (0.141)	0.362** (0.142)	0.863*** (0.220)	
Exporters * TFP 2007–2008	–0.576*** (0.184)			
New exporters		0.380** (0.159)		
Number of exports destinations (0–3)			–0.255** (0.105)	
Export to EU				0.469*** (0.154)
Export to China–India				–0.369 (0.408)
Export to other Asian countries				0.0114 (0.320)
Export to the United States–Canada				–0.256 (0.260)
Export to Latin America				0.0919 (0.346)
Export to other destinations				0.173 (0.321)
Control variables	Yes	Yes	Yes	Yes
Observations	841	841	841	841
Pseudo-R ²	0.061	0.065	0.065	0.063

Note: This table reports the results of estimating (1) with ordered logit. The *Number of export destinations* variable refers to number of markets served by each exporting firms. *New Exporters* identifies firms exporting for the first time in 2009. The results in column (4) allow for distinguishing the exporters effect across the different destinations served. All specifications include the following control variables: (log) Age; Employees (1–4); External financing (2008–2009); Financial constraint (2007–2009); TFP (2007–2008); country-level dummies. Robust standard error in parentheses. *, **, and *** indicate significance at 90%, 95%, and 99% confidence levels, respectively.

Abbreviation: TFP, Total Factor Productivity.

First of all, we focus on the TFP (column 1), a synthetic parameter of the efficiency of a firm, which we have already acknowledged to be a core determinant of resilience in times of crisis. TFP is confirmed to be crucial according to our results: The interpretation of the odd ratios suggests that exporting firms with higher TFP are 75% less likely to suffer the consequences of the crisis than the other firms. Higher productivity, therefore, represents a means to increase firms' resilience to economic shocks regardless of the complexity of the internationalization activity involved.

Second, we investigate whether such a relationship changes for “new” and “old” exporters by including a new dummy variable in the baseline model where the value is 1 for firms that exported for the first time in 2009 (i.e., “new”

exporters), and 0 if they had exported in previous years (i.e., either they are “old” exporters or not exporters at all). The main results still hold, but new exporters seem to suffer more as indicated by the positive high-magnitude of the coefficient. This evidence suggests that previous experience in exporting can reduce the probability of suffering the consequences of the crisis by 46% (column 2). This result corroborates evidence on the so-called *learning by exporting*, which refers to a mechanism where firms operating in international markets increase their productivity over time (see De Loecker, 2013). This is likely due to a number of issues, such as learning from their rivals, improving product quality, or innovating more.

By shifting the focus on the impact's heterogeneity of the impact related to the export destinations, we first consider differences in market dimensions (i.e., number of destinations) and thereafter in trade partners (i.e., geographical areas). In the first case (column 3), the results show that, on average, the relationship is confirmed, albeit with significant negative differences for the number of export destinations: firms that serve a higher number of markets have 23% less probability to suffer the crisis. This is because multideestination firms are likely to be of greater size (and thus more productive). This result is in line with Héricourt and Nedoncelle (2016), who provide evidence that multideestination firms react better to shocks due to the volatility of Real Exchange Rate, as they are more able to divert their exports to other destinations unaffected by these dynamics.

In the second case (column 4), significant coefficients for exporters to the EU are estimated. This result may suggest that, when firms operate in a less complex market, such as the EU single market, they are 59% more likely to suffer the consequences of a crisis. This result can be explained by the fact that exporting towards destinations outside the EU is more complex due to tariffs and trade barriers. Besides the complexity of the activity in itself, products need, for example, to be adapted to the new market specificities, which explains why the crisis did not derive from demand-related dynamics. Entering markets outside the EU represents a challenge, especially for small and less efficient firms, as they are not able to cope with the setup costs required to have access to these markets. In this framework, more efficient firms that can meet these requirements are potentially better equipped to absorb the consequences of the crisis.

With the aim of corroborating the robustness of the results presented in this section, we run the same analysis as Table 2 using two alternative crisis intensity indexes described in Annex A1 in the Supporting Information. Estimations confirm our main results (Supporting Information Table A.5): the intensity of firms' internationalization activities and the extent to which firms were affected by the crisis are positively related.

In sum, exporters, especially new and EU-oriented exporters, have paid the consequence of the global economic crisis the most. However, in this framework, firm TFP seems to play a crucial role: more productive and efficient firms, which also have more experience in exporting and serve a wider number of destinations seem to suffer less from the increasing level of competition triggered by the global crisis than the other firms. This supports evidence from the firm-heterogeneity literature on trade, suggesting that TFP is a key driver of firm performance, especially in the export field (Curzi & Olper, 2012; Melitz, 2003).

4.2 | Firms' innovation and mitigation of consequences of the crisis

We analyze now whether firms' innovation activities can mitigate the consequences of the crisis. To acknowledge how innovation relates to the crisis, we look at the synthetic indicator proposed for firms' innovation (I_c). Table 3 presents the results (see Supporting Information Table A.6 for marginal effects).

Findings confirm the positive and significant association with *Internationalization Intensity* with a one unit increase leading to a rise in the probability of suffering the crisis by 35%; the relationship between *Innovation Intensity* and the *Crisis Intensity* index is negative and significant (column 1): highly innovative firms were less likely to be affected by the crisis than others. To check the robustness of these results we re-estimate the models considering a different Internationalization Intensity proxy (namely, calculated on turnover, see Supporting Information Table A.9), and find that the main results still hold. The significance and sign of the internationalization

TABLE 3 Effects of the crisis and firms' innovation activity

	(1)	(2)	(3)
	Crisis Intensity	Crisis Intensity	Crisis Intensity
Internationalization intensity	0.302*** (0.0711)		0.300*** (0.0723)
Innovation intensity	-0.211*** (0.0675)	-0.227*** (0.0702)	
Internationalization intensity * Innovation intensity			-0.125*** (0.0483)
Exporter		0.498*** (0.149)	
Importer		0.177 (0.154)	
FDI		0.863 (0.588)	
Outsourcing		0.188 (0.218)	
Control variables	Yes	Yes	Yes
Observations	841	841	841
Pseudo- R^2	0.068	0.088	0.067

Note: This table reports the results of estimating (1) with ordered logit. All specifications include the following control variables: (log) Age; Employees (1–4); External financing (2008–2009); Financial constraint (2007–2009); TFP (2007–2008); country-level dummies Robust standard error in parentheses. *, **, and *** indicate significance at 90%, 95%, and 99% confidence levels, respectively.

Abbreviations: FDI, Foreign Direct Investment; TFP, Total Factor Productivity.

and innovation indicators do not change in the specification, even when different internationalization activities are explicitly indicated (column 2). Exporters are confirmed to be the ones suffering the most of the consequences of the crisis. Moreover, when interacting the *Internationalization Intensity* index with the *Innovation Intensity* one (column 3), the results suggest that more innovative firms involved in more internationalization activities suffered the effect of the crisis less (i.e., lower association).

We shall now explore the question of innovation in more detail, by disentangling the effects that the individual dimensions (or forms) constituting our proxy for innovation have on mitigating the consequences of the crisis (Table 4).

To avoid potential problems of collinearity, we do not introduce all the variables together, we rather group them in similar categories. First, we run our model considering, together with the internationalization intensity of the firms, innovation activities performed in the context of R&D (i.e., investments in both research personnel and in research activities). The literature suggests, in fact, that investing in R&D represents an anchor in times of crisis (Bustos, 2011; Fernandes & Paunov, 2015; Hombert & Matray, 2018; Kugler & Verhoogen, 2008; Landini et al., 2020). We find that—in line with previous results—the more internationalized the firms, the more they suffer from the crisis (column 1), but those who invest more in R&D might be more resistant to the effects of the crisis (although the coefficient is not strongly significant). As in Hombert and Matray (2018), our results confirm that investing in

TABLE 4 Innovation activities and crisis intensity

	(1)	(2)	(3)	(4)
	Crisis Intensity	Crisis Intensity	Crisis Intensity	Crisis Intensity
Internationalization intensity	0.253*** (0.0692)	0.276*** (0.0696)	0.283*** (0.0713)	0.273*** (0.0694)
Sales of innovative products	-0.00109 (0.00739)			
Employees involved in R&D	0.0531 (0.457)			
Total R&D investments	-0.0275* (0.0141)			
Product innovation		-0.0968 (0.139)		
Process innovation		-0.347** (0.136)		
Patent			-0.0205 (0.278)	
ISO certification			-0.326** (0.142)	
ISO certification—product				-0.624*** (0.227)
ISO certification—process				-0.173 (0.252)
Control variables	Yes	Yes	Yes	Yes
Observations	841	841	841	841
Pseudo-R ²	0.065	0.067	0.066	0.067

Note: This table reports the results of estimating (1) with ordered logit. All specifications include the following control variables: (log) Age; Employees (1–4); External financing (2008–2009); Financial constraint (2007–2009); TFP (2007–2008); country-level dummies Robust standard error in parentheses. *, **, and *** indicate significance at 90%, 95%, and 99% confidence levels, respectively.

Abbreviations: ISO, International Organization for Standardization; TFP, Total Factor Productivity.

R&D provides a buffer in times of crisis: In other words, investments in R&D are conducive to higher resistance to shock.

Second, we investigate whether the association with innovation intensity changes according to product or process innovation specifications rather than to firm R&D behavior. In our sample, about 40% of the domestic firms declared they had introduced product innovations and 40% of firms product innovations, while these percentages rise to about 60% for both the innovation types when considering internationalized firms. It seems, therefore, that firms see investments in both the innovation types as equally important. We find that, although our results remain overall stable and robust, it is process innovation rather than product innovation to be key to surviving a crisis:

Firms adopting process innovations have, in fact, 30% less probability to suffer the consequences of the crisis (column 2).

Lastly, we investigate whether the mitigating role of innovation in times of a crisis changes when firms issue patents and are accredited the ISO certifications (column 3) and, more in depth, whether it changes specifically according to the type of ISO certifications the firms have adopted, that is, product vs process certifications (column 4).¹⁵

Our findings show that firms with accredited ISO are more resistant to the crisis (column 3). The effect is particularly marked for product ISO certifications, leading to a reduction of around 50%. As indicated by Traill and Meulenberg (2002), innovation in the food and drink industry is mainly process oriented and consumer focused, which explains our results. Although it is process innovation that provides the most resistance to an economic shock, it is also investment in product quality—for example, an ISO certification on products—that represents an opportunity for the food and drink firms to survive (Bojnec & Fertő, 2017).

These results are in line with evidence that innovation builds distinctive and long-lasting adaptive capabilities, which help firms develop resistance to external shocks also by means of diversifying internationalization channels as a way to innovate their processes (Giotopoulos & Vettas, 2018; Landini et al., 2020; Meliciani & Tchorek, 2019). In fact, process innovation seems to be key to greater resilience in the food and drink industry with respect to product innovation, although product quality (indicated by the ISO certification) still indicates focus on consumers (Triguero et al., 2013).

5 | CONCLUSIONS

The 2008–2009 global economic crisis exerted a tremendous effect on firm performance worldwide, with the recession in international demand being its most distinctive feature. However, innovation may temper the consequences of economic crises. Evidence on whether this also holds true for EU agrifood businesses is rather limited. With previous studies focusing mainly on the manufacturing sector at a national level, there is a lack of information on which to build public policy and managerial strategies in the agrifood sector. By looking at the Great Recession, and using granular firm-level data on EU food and drink firms, this paper has uncovered significant new insights. Our results show that export activities suffered negative consequences the most, while other forms of internationalizations were less seriously affected. The impact is stronger for new exporters, suggesting that experience in exporting is a mitigating factor in times of crisis. One core element explaining our results regarding internationalization is TFP, as more productive firms—that can better cope with the setup costs of more complex activities—were less likely to be affected by the global crisis than other firms.

When looking into the relationship with innovation, we find that highly innovative firms (i.e., firms characterized by more intangible assets) are less associated with the crisis, indicating that innovation helps counterbalance the challenges an economic crisis brings. Investing in innovation and R&D, therefore, represents a viable strategy to increase the probability of survival, and mitigate the consequences of global crises. Process innovation, requiring in principle less investment, triggers the most resistance to an economic shock. Accordingly, investing in product differentiation—for example, by means of quality certifications—represents a useful survival strategy for food and drink firms.

We highlight the opportunity to reconsider public policy options to support firms' innovation, especially in a sector like agrifood, which has a history of low investment in R&D (Birner et al., 2021; Matera et al., 2017). The design of an investment promotion architecture should therefore reflect an informed awareness of the interventions that, in times of crisis, could be crucial to both mitigate the unpredictable effects in the short run

¹⁵According to Crinò and Epifani (2012), the use of variables capturing firms' innovative behavior can be also associated with firms' product quality. This is because, as suggested by the literature on quality differentiation (Kugler & Verhoogen, 2008; Sutton, 1998), firms' quality upgrading is associated with the intensity of R&D activities and more in general to those activities that lead to the production of new goods, or new processes of production.

and rebuild economic confidence in the long term. From a firm-level perspective, the novel results in this paper may also have important implications for agribusiness managers who could use the theoretical and empirical evidence to support their internationalization decisions and innovation strategies. The interplay between private actors and institutions will indeed be essential for shaping innovation in the agriculture and food sectors in the coming 20 years (EC-JRC, 2020).

This evidence is particularly relevant today due to policy makers currently dealing with how to accelerate the transition towards more sustainable and resilient socioeconomic systems in times of the crisis, such as the COVID-19 pandemic (European Green Deal, 2020 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en).¹⁴ To build a “systemic resilience,” policy interventions could focus on providing the incentives companies (in the food and drink sector) need to build their capacity to develop economic resilience by providing access to financial resources and investing in people and in research and innovation. Examples of such incentives are the sharing of the costs of innovation projects, support for the enhancement of R&I networks and of public-private collaborations to ensure preparedness for turbulence, and the enhancement of digital skills. In fact, nowadays the digital and ecological transformation of society represents a lever for sustainable recovery.

This is the first paper that investigates the association between the involvement in internationalization activities and the role of innovation behavior of food and drink EU firms and the consequences of the crisis in heterogeneous scenarios. However, it will be important to verify the linkages explored in this study in each specific section of the agrifood market will be important to draw up specific policy implications. Finally, resolving the key methodological limitations of this paper remains to be addressed in our future research.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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