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ORIGINAL RESEARCH

The Resilience of EU Member States to the Financial and Economic Crisis

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Abstract
Based on the JRC conceptual framework for resilience (Manca et al. in Building a Scientific Narrative Towards a More Resilient EU Society, JRC Science for Policy Report, JRC28548, 2017), this study presents an empirical analysis of the resilience of EU Member States to the recent financial and economic crisis. We address two main research questions: (1) Which countries had a resilient outcome, in terms of both shock absorption during the crisis and recovery in its aftermath? (2) Are there pre-determined country characteristics that help to explain resilient performance? To address these questions, we first select 34 key indicators of economic performance and societal well-being, going well beyond the merely economic growth perspective. Resilience is then measured by the properties of the joint dynamic response of these variables to the crisis shock at different time horizons. Our results demonstrate substantial differences between countries in each of the resilience capacities considered. Regression analysis also reveals that certain predetermined characteristics—such as government expenditures on social protection, political stability or a favourable business environment—are strongly associated with resilient outcomes. Our methodology and findings offer lessons for monitoring resilience and for entry points for effective policy interventions in the future.

Keywords Resilience · Absorption · Adaptation · Transformation · Well-being · Financial crisis

1 Introduction

Interest in resilience has been rising rapidly during the last 20 years, as a response to increasing uneasiness about potential shocks that test the limits of coping capacities of individuals and societies. In all likelihood, these shocks are here to stay and will present

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continuous challenges around the world, from digital transformation, globalisation, and demographics to climate change and food security. To successfully tackle these challenges, it is important to understand what makes a society able to cope with shocks and to continuously measure and monitor its coping capacities.

The concept of resilience has grown apace in the literature since the 70's. The first use of resilience started in physics to study the deformability of materials caused by compressive stress and it has been adopted also in ecology (Holling 1973; Pimm 1984), psychology (Garmezy 1973) and economics (Hill et al. 2008; Martin 2012; Sensier et al. 2016). To allow for an approach that is not field-specific, we build on our previous work (Manca et al. 2017), and operationalize the notion of resilience as the ability to face shocks and persistent structural changes in such a way that current societal well-being is preserved, without compromising that of future generations. Hence, resilience is key for staying on or returning to the sustainable development path of our society.

At the same time, there is no universally accepted methodology for operationalising and measuring resilience empirically (Bristow and Healy 2014; Boschma 2015; Martin and Sunley 2015). The recent years have witnessed a number of resilience indicators proposed and used both by researchers (Martin 2012; Sensier et al. 2016; Faggian et al. 2018) and policymakers (CLES 2010; IPPR North 2014; ARUP 2014; Figueiredo et al. 2018). Still, operationalising the concept of resilience is not a straightforward task for many reasons. Resilience is a multidimensional concept, which cuts across many different aspects of the performance of countries or regions. Therefore, it is paramount to decide the issues of the resilience of what, to what and over what period (Carpenter et al. 2001). Further, the choice of using few or many variables for the assessment of resilience, in absolute terms or relative to the performance of others, is not neutral (Sensier et al. 2016).

Within this context, this paper contributes to the debate in two aspects: by proposing a methodology able to measure resilience across fields, and by having a better understanding of societal features and characteristics that ensure a resilient response of countries to shocks. While many authors consider that economic resilience relates to the capacity of an agent to withstand, recover from, and bounce back to a pre-shock situation (Pendall et al. 2010; Bristow and Healy 2014; Martin and Sunley 2015), we also emphasize the ability to improve performance and bounce forward to a different development path.

We use the recent financial and economic crisis experience of EU countries as a unique natural experiment to provide identification for measuring resilience at the country level. In particular, we address the following research questions: Which countries had resilient outcomes during and after the crisis? Is economic and broad societal resilience the same? Have some countries been able to use the crisis as an opportunity for improvement and 'bounce forward'? Is it possible to identify country characteristics that are associated with resilient outcomes?

Our concept of resilience views it as a cross-cutting phenomenon, so it needs to be tackled from the economic and the social perspective. Therefore, our analysis takes into account a large set of variables to capture relevant aspects of economic performance and societal well-being production. We move away from the most used parsimonious approach in measuring economic resilience (Sensier et al. 2016; Lagravinese 2015; Martin et al., 2016; Faggian et al. 2018), and combine the joint dynamic response of many selected variables to the crisis, at different time horizons.

The selection of these variables was guided by the "system view" of our conceptual framework (Manca et al. 2017). It finally relies on 34 system variables. For each of these, we compute four resilience metrics, which correspond to different time dimensions considered. The short-run measures the absorptive capacity of a country and

provides an indication of the *impact* of the crisis. The second indicator refers to the ability to rebound from the shock (Martin 2012). It recalls the ecological resilience of Holling (1973) in which the system exhibits the capacity to absorb a shock without changing its structure, identity and function (Walker et al. 2004). Based on this notion of resilience, our *recovery* indicator provides a measure of how much an agent is able to recover from the worse level due to a shock.

The third indicator (*the medium-run*) is the difference between the pre-crisis level and the latest year available. By widening the time horizon, it allows a better evaluation of the new equilibrium reached by countries as a response to the shock; the importance of which has been emphasized by Martin and Sunley (2015) and in evolutionary resilience (Simmie and Martin 2010; Davoudi 2012). Our last indicator of *bouncing forward* attempts to emphasize the evolutionary aspect of resilience even more and takes into account the ability of the system to change pattern in its development growth. This indicator assesses whether the difference between the pre-crisis level and latest available year is significantly positive, negative, or not significant.

These four metrics are calculated for all our selected system variables and then aggregated into four composite resilience indicators. We then explore their statistical relationship with respect to a long list of pre-determined country characteristics, describing the economic, societal and institutional country features. The aim of this statistical analysis is to better understand why certain countries were more successful in coping with the crisis than others. In other words, our resilience characteristics represent features that enable countries to react to economic shocks in a resilient way. As such, they bridge the gap between resilience capacity indicators, typically based on expert consensus, and indicators of revealed resilience (Sensier et al. 2016). Moreover, they can be monitored continuously, and may even point to specific policies that can enhance the resilience of countries. To our knowledge, this is the first attempt to look for resilience characteristics in such a wide set of candidate variables.

Our main results are as follow. First, there are substantial differences between countries' performance in each of the resilience indicators considered. For example, a normalized difference of around two standard deviations separates the most consistently resilient countries (such as Germany and Poland) from the least resilient ones (such as Greece and Cyprus) in any given indicator.

Second, ranking countries according to their resilience is not trivial: their performance, both in absolute and relative terms, depends considerably on the chosen indicator of reference (short-term vs. medium-term) and the breadth of the focus employed (purely economic perspective vs. a broad socio-economic viewpoint). This calls for a nuanced assessment of resilience and reinforces the recent increased emphasis on the social dimension in European policy-making.

Third, some countries (such as Germany and Malta) were able to 'bounce forward', i.e. to take advantage of the challenges posed by the crisis and make improvements in absolute terms compared to the pre-crisis period. This is particularly true of certain monetary factors of well-being (GDP, consumption, and income) while non-monetary factors such as happiness, inequality, or social cohesion have surpassed their respective pre-crisis levels only for a limited number of countries.

Fourth, having tested over 200 potential pre-determined characteristics for their association with resilience, it turned out that the strongest predictor of the absorptive short-run resilience, the adaptive medium-run resilience, and the bouncing forward capacity are, respectively, high government expenditures on social protection, political stability, and a

favourable business environment. Net creditor countries vis-à-vis the rest of the world have also tended to be more resilient in most dimensions.

The structure of the paper is as follows. Section 2 presents a brief overview of the evolution of thinking about societal resilience and the policy landscape around it. Section 3 outlines the measurement strategy, from selecting the system variables to creating resilience indicators and resilience characteristics. Section 4 discusses the resilience performance of countries in detail, for different socio-economic perspectives, time horizons, and resilience capacities. Section 5 presents the analysis related to resilience characteristics and identifies those country features that are most closely associated with resilience from a statistical standpoint. Section 6 concludes while additional results and details are presented in Annexes.

2 Resilience and its Policy Context

Resilience became a very popular topic in the last decade, but traces of the concept go back at least to the 70's. The term resilience originates from the Latin *resilire*, which means to leap back, to recover from (Reggiani et al. 2002; Martin 2012; Modica and Reggiani 2015) and it describes how a system responds to shocks, disturbances, and perturbations. The concept of resilience has been used across many disciplines and its interpretation changes according to the field it was applied to.

The first use of resilience was in physics and engineering, as the capability of a strained body to get back to its size and shape after deformation caused especially by compressive stress. Following the seminal paper of Holling (1973), this concept, known as *engineering resilience,* emphasizes the capacity of a socio-ecosystem to maintain and regain stability (Holling 1973; Pimm 1984). In economics, this notion is associated with the ability of a market to self-restore the system through compensating mechanisms towards the pre-shock equilibrium state (Duval and Vogel 2008; Martin 2012; Rose and Krausmann 2013).

A second definition of resilience, known as *ecological resilience,* focuses on the ability of the system to absorb a shock without changing its structure, identity and function (Holling 1996; Gunderson and Pritchard 2002; Walker et al. 2004). This definition allows the existence of multiple equilibria, and the possibility to switch to a new, typically less favourable situation than the original one, as a result of the inability of the system to bounce back to the pre-crisis equilibrium. When applying this notion to economics, authors tend to consider that if a shock is too severe for a certain economy, the latter will change permanently its structure and it will lead to a new path (Cross 1993; Folke et al. 2002; Setterfield 2010; Martin and Sunley 2015).

Such an approach extends naturally to the concept of *adaptive resilience*, which describes the ability to adapt, learn and reorganize in response to certain shocks. It originates in behavioural psychology and typically refers to the capacity of individuals to maintain or regain their lost well-being as a consequence of personal stress, trauma or any crisis (Masten et al. 1990; O'Dougherty Wright et al. 2013). Adaptive resilience brings the idea of a dynamic process of learning, which involves structural/operational adjustment as a response to shocks, and also allows the system to evolve into a new development path (Folke et al. 2010; Simmie and Martin 2010; Davoudi 2012; Martin and Sunley 2015;).

This notion incorporates the idea of *transformation* when ecological, economic, or social pressures and tensions make the existing state untenable (Walker et al. 2004; Folke et al. 2010; Armitage et al. 2012). Within this approach, transformability has a *strong*

normative component, as it is not obvious who decides whether and for whom the situation is untenable (Perrings 2006; Armitage et al. 2012).

As emerged from the above discussion, since the 1970s the notion of resilience went through various definitions depending on the field of application. This has contributed to maintaining a field-specific nature of empirical analysis, with only a few shy attempts to extend the analysis across disciplines (Folke et al. 2002).

Yet, understanding and building resilience require a broader perspective, which includes social, economic and environmental aspects (Folke et al. 2010; Sensier et al. 2016; Manca et al. 2017). Such a systemic view should encapsulate the entire production process of societal well-being, to ensure that not only economic but also natural, social and environmental resources are harnessed in an efficient, equitable and sustainable way (Manca et al. 2017).

Furthermore, the lack of a commonly agreed definition or a unified measurement approach makes it difficult to apply the concept of resilience in the policy context. Nevertheless, international policy organisations have started to recognise its importance for policymaking. The European Union, for example, has recently produced several declarations and policy documents which state resilience (sometimes in the narrow economic, sometimes in a broad societal sense) as a primary policy objective.[1] There are specific discussions and proposals to make the Euro Area more resilient to future economic distress (European Commission 2017, 2018b). Other international organizations—such as the ECB, IMF or the OECD—have also made significant efforts to put resilience at the forefront of their political agenda, understand its drivers, and promote it through effective policies.

Different organisations have chosen different ways to address and contextualize the issue of economic resilience. The G20, for example, adopted a list of resilience principles (G20, 2016), while the IMF laid out an extensive list of specific policies essential for a robust and resilient economy. On the other hand, the OECD's related efforts have been mostly devoted to analytical work on the role of structural policies (Duval and Vogel 2008), the relationship between economic growth, macroeconomic stability and vulnerability (Caldera-Sanchez et al. 2016; Sutherland and Hoeller 2014), as well as the creation of a new set of vulnerability indicators. The European Central Bank has also analysed to factors driving economic resilience in a similar vein (European Central Bank 2016; Sondermann 2018).

To synthesise the various academic and policy discussions, the Joint Research Centre (JRC) of the European Commission, in co-operation with the European Political Strategy Centre, started a common reflection on resilience in the policy context (Joint Research Centre 2015) and set up a dedicated Commission-wide research and policy network. The first result of these efforts was the development of a conceptual framework devoted to the assessment and measurement of resilience (Manca et al. 2017). It was also incorporated into the second Stiglitz Report on well-being metrics (De Smedt et al. 2018).

According to the JRC framework, which represents the starting point of the current study, a society is resilient if it retains the ability to deliver societal well-being in a sustainable way even in the face of shocks and persistent structural changes. Sustainability means that one should not preserve current societal well-being in a way that compromises

[1] The leading examples are the Rome Declaration, the document Harnessing Globalisation (https://ec.europa.eu/commission/sites/beta-political/files/reflection-paper-globalisation_en.pdf), and the Joint Communication "A Strategic Approach to Resilience in the EU's External Action" (https://ec.europa.eu/europeaid/2017-joint-communication-strategic-approach-resilience-eus-external-action_en).

that of future generations.[2] The nexus between resilience, sustainability, and well-being are increasingly being discussed in European policy fora (Folke et al. 2002; Stiglitz et al. 2009; Andor et al. 2011; Raworth 2017) and slowly are being considered as a basis for new policy frameworks (European Commission 2018b).

This notion of resilience highlights the importance of individuals and connects them to the context where they live and act: nature, as a vital element and source of resources, and society as the space where individual group and establish relations. These together represent a complex system. Individuals are the final recipient, but they also contribute to the expected outcome.

It is important to stress that our notion of resilience is different from the psychological approach, which focuses more on individual abilities to cope with stress, shocks, disorder or trauma (Cicchetti and Rogosch 1997; Glantz and Johnson 1999; Bonanno 2004). Our perspective looks at the society level reaction to shocks and focuses on the deterioration of societal well-being. Still, there is an important individual component, which affects the scope, the intensity and nature of the change in determining the resilience of a response. (Armitage et al. 2012). A resilient response of a country to a shock is delivered by individuals (households, consumers, workers, firms), helped or driven by government actions and policies. Our country-level analysis cannot trace the detailed behaviour of individuals during the crisis. Instead, we look at country level changes in the ingredients and components of well-being.

Another source of important normative elements in this resilience notion is the transformative capacity, for which one needs to assess whether conditions have become unsustainable and the situation calls for a transformation (Carpenter et al. 2001; Walker et al. 2004; Folke et al. 2010; Armitage et al. 2012).

The focus on well-being reflects recent policy discussions and developments. The explicit recognition of well-being as a policy target has an official milestone: the 2007 Istanbul declaration, signed by the main international organisations during the second OECD World Forum on measuring and fostering progress. They committed to support initiatives to measuring and fostering the progress of societies in all dimensions and to support initiatives at the country level. Already in 2008, the French government commissioned a study on the measurement of economic performance and social progress. The Stiglitz-Sen-Fitoussi committee was tasked to analyse how wealth and social progress could be measured without relying exclusively on the system of national accounts (GDP). The Stiglitz-Sen-Fitoussi committee noted an important connection between the assessment of well-being and sustainability. One of their concerns was precisely whether the current level of well-being and economic performance can be maintained for future generations, and how it is possible to assess it. This has led to the advancement of the (four) capital approach. It recognises that the key to sustainable development is to preserve the most important resources (capitals) that will be needed to generate future well-being: natural, human, social and economic (built) capital.

As argued by De Smedt et al. (2018), the capital approach implicitly assumes the independence of these capitals and has difficulties in recognising the role of various interactions

[2] This definition of resilience and the concept of sustainability are very close. Some authors view resilience as a necessary precondition for sustainability (Arrow et al. 1995; Lebel et al. 2006; Perrings 2006), others consider the two concepts as basically equivalent (Levin et al. 1998, Holling and Walker 2003). Finally, an opposite view is that resilience is not sufficient for sustainability and it cannot be taken as an objective of its own (Holling and Walker 2003).

among different parts of the system. Building on Manca et al. (2017), the authors advocate the systems approach, which implements a broad and disaggregated view of the society.

This paper also builds on this approach. It considers three main parts of the socio-economic-ecological system. The first is asset utilization (human, social, built and natural capital). The second includes outcomes (well-being measures), which can be negative as social exclusion or positive as life satisfaction. The third contains those structures such as institutions, communities or markets which function as an "engine" in connecting the assets to the final production of societal well-being (Manca et al. 2017). It enables a multi-dimensional treatment of well-being, recognises the role of the four capitals, and highlights the complexity of and interconnections in the process of generating well-being.

3 Measuring Societal Resilience

The ultimate objective of our research is to provide practical tools and methods for policy-making. At the same time, we believe that it is important to go beyond expert assessment based (perceived) resilience indicators and work with indicators that are based on the observed performance of our society (revealed resilience indicators). For this reason, we first review available variables from existing data sources with the goal to track their performance during distress. Following Manca et al. (2017), in the choice of the variables we take a *system view* that aims to cover equally inputs (assets), outputs and main functionalities (the engine) of societal well-being production. One can assume to place sensors on these variables to track the performance of various *entities* during distress, be them individuals, local communities or broader aggregates.

Though we are interested in studying the effect of the economic and financial crisis on the European countries, our analysis expands the measurement of resilience to a systemic perspective through the lens of societal well-being. We thus depart from the most used strategy for the measurement of economic resilience based on indicators such as employment (Martin 2012; Lagravinese 2015), growth rate (Augustine et al. 2013), and per capita GDP (Cellini and Torrisi 2014), and we enlarge our analysis to cover additional aspects of wellbeing such as income inequality, poverty rates, wages, occupation rate, local government debt or revenues (Foster 2007).

We focus on *revealed* resilience, which is based on the dynamic response of these variables to disturbances. A drawback is that the direct monitoring of such indicators would require a continuous re-assessment. For example, should the unemployment rate be considered as a system variable, one would regularly need to re-estimate how it responds to each new disturbance. This may not only be inconvenient but also impossible given the absence of identifiable new shocks most of the time. Moreover, studying the dynamic responses of system variables in an ongoing manner would not provide direct guidance on what policies may foster resilience, or how a system could deal with unknown future disturbances.

To overcome these difficulties, we propose a three-step approach to monitor resilience in an indirect way. Using a specific (and quite unique) historical episode characterized by a set of shocks, we first select a large list of economic and non-economic indicators (the system variables as discussed above) that span the entire process of societal well-being production. Second, for each system variable, we compute the joint dynamic response of these variables to the crisis to derive resilience metrics. These metrics are then aggregated into composite resilience indicators. Third, once the resilience indicators have been

constructed, it becomes possible to search for some pre-determined systemic features that differentiate resilient entities from non-resilient ones. These resilience characteristics are meant to proxy an entity's general ability to respond to disturbances. They typically measure outcomes but non-necessarily they are linked to a specific policy. Moreover, they can be monitored on a regular basis to assess resilience performance in the future, identify resilience gaps or guide policy-making.

The discussion of the measurement strategy below focuses on three main aspects. First, we discuss the collection of relevant system variables, each of which acts as a "resilience sensor" and captures the performance of specific parts of the system. Second, we illustrate the construction of the various resilience indicators adopted, which describe the joint outcome of the system at various time horizons. Third, we discuss the choice of 2007 as a common last pre-crisis year.

3.1 System Variables

The system view of the JRC conceptual framework (Manca et al. 2017) and the well-being interpretation of Stiglitz et al. (2009)[3] guided the selection of variables that make up the system. In particular, three considerations were given priority. First, in order to describe each part of the system adequately, the selected variables should span the entire socio-economic-institutional system in a balanced way. Second, they should exhibit substantial variation in the post-crisis period, both in the cross-section and over time. Third, in an attempt to go "beyond GDP" and capture resilience at the broad societal level, indicators of individual and societal well-being should be included among the selected system variables.

With these criteria in mind, we first selected a list of approximately 100 variables from various existing indicator sets such as the European Union's Europe 2020 strategic targets, the UN's sustainable development indicators, elements of the Social Pillar scoreboard, or the Macroeconomic Imbalance Procedure. In addition, we also generated a series of subjective, self-reported indicators using various representative micro-level datasets and population surveys such as the European Union Statistics on Income and Living Conditions (EU-SILC), the European Social Survey (ESS) and the European Quality of Life Survey (EQLS). These contain regular information on individuals' subjective assessment of matters of both private (e.g. health status, life satisfaction, social life) and public interest (e.g. trust in the legal system, fairness) in a representative way. From among all this information, we derived a balanced set of variables with sufficient country coverage, annual or bi-annual frequency, as well as ample absolute and relative variation during the crisis period.

The final set of 34 system variables are listed in Table 1, with a more detailed description available in Table 7. To underscore the potential linkages between these variables from a systemic standpoint, the variables are classified according to which part of the system they belong to. Assets and outcomes represent, respectively, the inputs to and outputs of societal well-being production, while the engine represents those processes and services that connect these two (see Costanza et al. 1997 and Manca et al. 2017). System variables are further differentiated along whether they are financial-economic indicators (i.e. *core economic variables*) or primarily societal constructs (i.e. *non-core variables*). While at

[3] The Stiglitz-Sen-Fitoussi report call for a multidimensional interpretation of well-being and identify eight key wellbeing dimensions: (1) material living standards, (2) health, (3) education, (4) personal activities including work, (5) political voice and governance, (6) social connections and relationships, (7) environment, and (8) insecurity, of an economic as well as a physical nature (Stiglitz et al. 2009, pp. 14–15).

Table 1 List of system variables

	Assets	Engine	Outcomes
Financial-economic variables CORE	Investment	Government deficit Government debt Household loans House prices Inflation Labour productivity Corporate loans Private debt Stock prices	Employment rate Gross domestic product Unemployment rate
Beyond economic and financial NON-CORE	Dwellings Expenditures on education Expenditures on health Fairness Trust in people	Social activity Trust in European Parliament Trust in legal system Expenditures on active/passive labour market programs Expenditures on R&D Incidence of temporary work Wages	Happiness Health Household consumption Income inequality Youth not in employment, education or training (NEET) Social exclusion Household income Satisfaction

least for some variables, the above classification is somewhat arbitrary, it does provide relevant and helpful information about the functioning of European socio-economic systems in crisis periods. It is worth noting that even though some variables are correlated by construction (e.g. GDP and investment, employment and unemployment), the association in terms of their dynamic outcome is still very high.

3.2 Resilience Indicators

To characterize the resilience performance of countries, we first measure the dynamic outcome of each system variable by defining four different resilience metrics:

1. Impact of the crisis,
2. Recovery from the crisis,
3. Medium-run performance,
4. Bounce forward.

Each metric captures different features of the dynamic response and can be associated with different resilience capacities. The first metric concerns absorption, driven by the ability to resist shocks. As the duration or intensity of the exposure increases, the adaptive capacity will start playing a role, requiring flexibility and adjustment. This should be reflected by the recovery and medium-run metrics. Even larger and more persistent disturbances necessitate the use of the transformative capacity, implying a fundamental and qualitative re-configuration of the system. The bounce forward indicator tries to assess this capacity, though it is not easy to do it with a time window of only a bit more than a decade (see Cutter et al. 2008; Folke et al. 2010; Béné et al. 2012; and Manca et al. 2017 for more discussion and details).

It is important to note that the commonly used (narrow) definition of economic resilience (as advocated in G20, 2016; International Monetary Fund 2016; or European Commission 2017, 2018a, b) uses a similar though markedly different terminology. Its three main aspects are vulnerability, absorption, and recovery. In terms of our capacities, vulnerability can be viewed as part of absorption, while recovery corresponds mostly to adaptation. In terms of our measurement, vulnerability and absorption are included in the impact, while recovery corresponds to our recovery and medium-run measures.

All our resilience metrics are computed by assuming that the crisis was a common, single and instantaneous episode hitting all EU Member States. As discussed earlier, this is a simplifying assumption: while the global financial crisis started from the US and hit Europe as a common exogenous shock, the degree to which individual countries were exposed to it varied considerably. Since it would be virtually impossible to pin down the magnitude of the shock in each particular case, our chosen approach simply acknowledges that vulnerability and the lack of resilience are not separable in the early phase of the crisis. As long as reducing an entity's vulnerability is tantamount to increasing its shock absorption capacity, this seems a reasonable assumption.[4]

Countries may also have differed in the timing the crisis hit them. More importantly, the shock might have impacted different socio-economic variables with different time lags. To deal with this, we assume that a country is already hit by the shock if at least some of the assessed variables show a response. By analysing the country-specific patterns of the variables (see Sect. 3.3 for details), we find that 2007 can be safely chosen as the last pre-shock year for all countries.

Table 2 presents the definition and measurement for each individual metric, listing also the associated resilience capacity. The impact metric is then calculated as the difference between a variable's minimum value in the post-crisis period (2008-2016) and its last pre-crisis value (2007), and captures the degree of shock absorption in the first place. The recovery metric is calculated as the difference between the most recent data and the aforementioned trough, measuring primarily adaptation. The medium-run performance metric is equal to the net effect of the previous two metrics and captures the combined efficiency of shock absorption and adaptation. Given the focus on (relative) resilience rankings across countries and the importance of ensuring comparability between system variables, all of these metrics are normalized using their z-scores.[5]

The fourth metric is slightly different in nature: the bounce forward metric is a categorical one that measures countries' performance in absolute terms, on the basis of their medium-run performance. In particular, a country *bounces forward* with respect to a certain variable if its most recent value exceeds its pre-crisis value by more than what is implied by its observed fluctuation in the pre-crisis period. It is *still recovering* if the medium-run level is substantially below the starting level. In every other case, it is considered *just recovering*.[6]

[4] A further simplification concerns the lack of distinction between cyclical and trend behaviour of system variables.

[5] This normalization entails that the raw changes are first demeaned by the cross-country average, and then divided by the cross-country standard deviation.

[6] Formally, the metric takes value $+1$ (-1) if the medium term level is above (below) the 2007 level by at least one standard deviation of the observed values around a trend during the pre-crisis period (2000–2007). It is equal to 0 otherwise.

Table 2 The list of resilience metrics

Metrics	Measurement	Resilience capacity
Impact of the crisis	Difference between the worst level in the 2008–2016 period and the 2007 level	Absorption
Recovery from the crisis	Difference between the most recent level and the worst level in the 2008–2016 period	Adaptation
Medium-run performance	Difference between the most recent level and the 2007 level	Absorption and adaptation
Bounce forward	Three-way categorical indicator based on the medium-run performance	Adaptation and transformation

Once these metrics are computed for each of the 34 system variables, they are combined into composite *resilience indicators* to assess system-wide resilience. The aggregation involves using the arithmetic mean of the z-scores specific to each system variable by country and metric.[7] In the case of the first three metrics, the resulting indicators show resilience performance (in terms of standard deviations) relative to other countries: a score of plus (minus) one, for example, indicates that a country's resilience is a full standard deviation higher (lower), on average, than that of the mean performer. The bouncing forward indicator, instead, expresses the absolute difference between the share of system variables characterized as 'bouncing forward' and 'still to recover': for example, an aggregate score of 0.5 signals that there are 17 (half of 34) more 'bouncing forward' variables in a country than 'still to recover' ones. Notice that a country may exhibit a high degree of medium-run resilience without bouncing forward, and vice versa.

It is important to note that the commonly used (narrow) definition of economic resilience (as advocated in G20 2016; International Monetary Fund 2016; or European Commission 2017, 2018a, b) uses a similar though markedly different terminology. Its three main aspects are vulnerability, absorption, and recovery. In terms of our capacities, vulnerability can be viewed as part of absorption, while recovery corresponds mostly to adaptation. In terms of our measurement, vulnerability and absorption are included in the impact, while recovery corresponds to our recovery and medium-run measures.

3.3 The Choice of the Pre-crisis Benchmark Year

The literature offers three broad approaches to identifying the onset of a crisis (or the first impact of a shock). One method is to apply multivariate statistical techniques (VARs and SVARs) to a set of variables and identify the shocks from these estimates. Examples include Canova et al. (2012) and Sondermann (2018). Another approach, specific to the analysis of the short run (impact) resilience, is to look at the immediate drop at the onset of a well-identified shock episode. For example, Faggian et al. (2018) compare the employment of Italian regions between the pre-crisis (2007–2008) versus the recessionary period (2009–2010). The most frequent approach is to identify shocks as the move from the peak to the trough of the underlying variables (Caldera-Sanchez et al. 2016; Martin 2012).

[7] The results to be presented in the following section are robust to the normalization technique used for calculating metrics at the level of system variables. Alternative and more elaborate weighting schemes to aggregate the resilience metrics also lead to qualitatively similar results.

Our choice is close to this last approach. Here we briefly discuss the reasons why we have selected a common last pre-crisis year (2007) for all countries. First of all, there are many different dating schemes for the onset of the crisis: according to the IMF criteria, the global recession occurred in the single calendar year 2009. The US recession began in December 2007, and many European countries already felt the consequences of the sub-prime crisis in 2008. Based on this, if one wants to select a common last pre-crisis year in Europe, then it should be 2007.

It is possible, however, that different countries have been hit at slightly different points in time. As Sensier et al. (2016) argue, it is important to "treat each region as an individual entity and consider its response to the shock according to its own unique evolutionary trajectory." To explore this, we looked at the drop and/or structural breaks in the 13 core economic variables in our time series sample. In some cases, there were drops or breaks even (well) before 2008. In most countries and for most variables, the first sign of "being hit" was either in 2008 or 2009. In all countries, however, there were at least a couple of variables that already showed signs of being hit by a shock in 2008.[8]

To avoid the confusion coming from different baseline years for different variables for the same country, we have fixed the common baseline year 2007 for all countries. Due to our choice of metrics (level difference, "peak to trough"), our indicators should not be too sensitive to the choice of the baseline year: even if a variable did not drop from 2007 to 2008, its evolution was usually flat so the difference relative to 2007 or 2008 is very similar to each other.

4 Resilience Performance of European Countries

This section presents and discusses the main results of our empirical analysis based on the different resilience indicators. These condense the dynamic performance of a large number of system variables into a single number for each country and thus serve as handy and informative summary statistics for the resilience capacities.

Several important features stand out from our results. First, there is a great deal of heterogeneity across European countries as far as their resilience is concerned. As the coloured maps in Fig. 1 demonstrate, regardless of the resilience capacity, a great divide (amounting to several standard deviations) separates good and bad performers. Bulgaria, Germany, Malta, and Poland are among the most consistently resilient countries, while Cyprus, Greece, and Italy have had the most difficulty withstanding the crisis. These results are consistent with other studies which employ either GDP measures (Sensier et al. 2016) or rely on composite indicators (Pontarollo and Serpieri 2018).

Second, Fig. 1 also shows that the resilience performance of most countries depends considerably on the indicator of reference. Indeed, comparing the different panels reveals that countries that are more (less) resilient in the short-run or in relative terms are not

[8] From the 13 × 28 core economic variable-country pairs, 60 experienced a drop already before 2007 (predating the crisis – almost half consists of private debt which started to deteriorate even before). 167 pairs had 2007 as their last pre-shock year, 127 had 2008, 1 had 2009 or later, and 9 registered no drops. For every country, there are at least 3 variables that had 2007 as the last pre-shock year. On average, countries had almost six variables for which the last pre-shock year was 2007. For a handful of variables, 2007 was a strongly dominant last pre-shock year: government deficit (1 before, 23 in 2007), stock prices (7 before, 21 in 2007), government debt (1 before, 19 in 2007) and the inflation deviation from 2% (6 before, 19 in 2007).

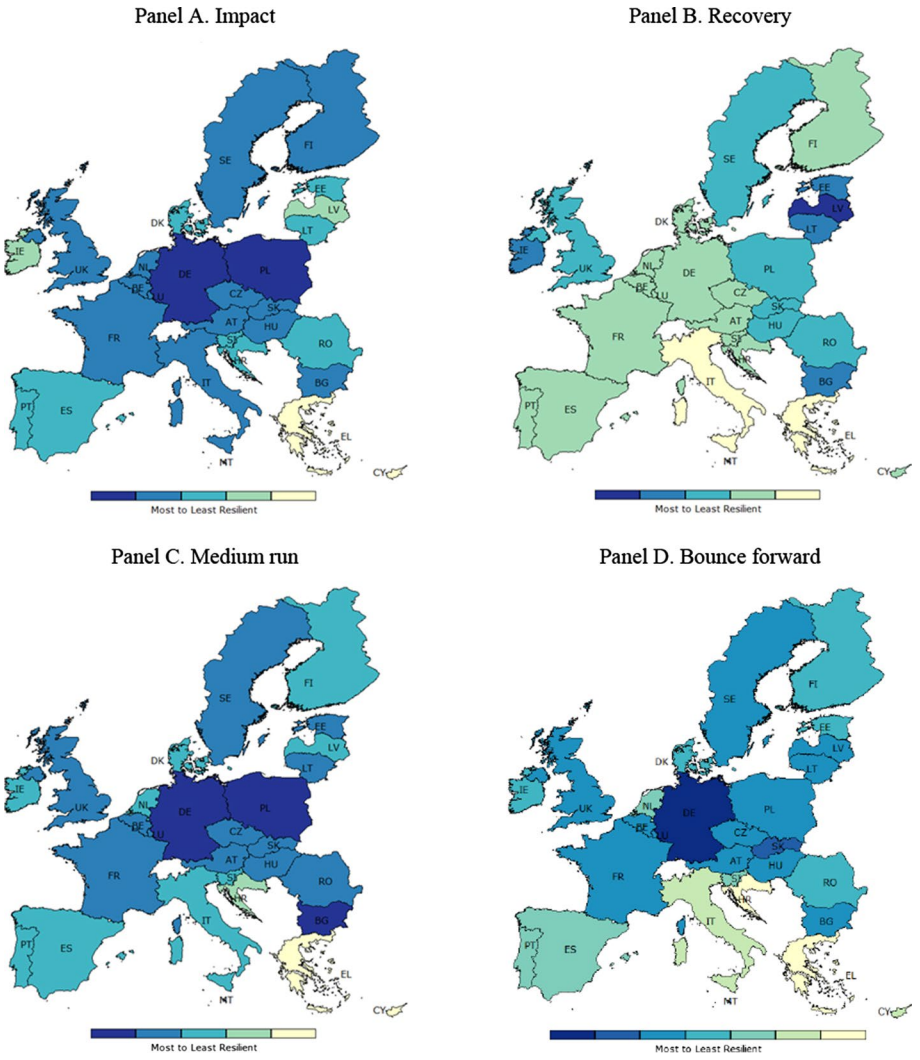

Fig. 1 Performance of European countries by resilience indicator Notes: More resilient countries have darker colours. While not readily visible, Malta is coloured light blue in impact, recovery and bounce forward resilience, and dark blue in medium-run resilience. *Source*: Authors calculation

necessarily the ones performing well in the medium-run or in the absolute sense. This is nicely demonstrated by the example of high-impact, low-recovery Italy and low-impact, high-recovery Ireland, which nevertheless exhibit a comparable performance in the medium-run.[9]

[9] Note that it is rather difficult to provide an unambiguous interpretation for the recovery indicator for countries with relatively little impact (or high impact resilience). For this reason, impact and medium-run resilience should probably be considered the most informative and reliable indicators of resilience.

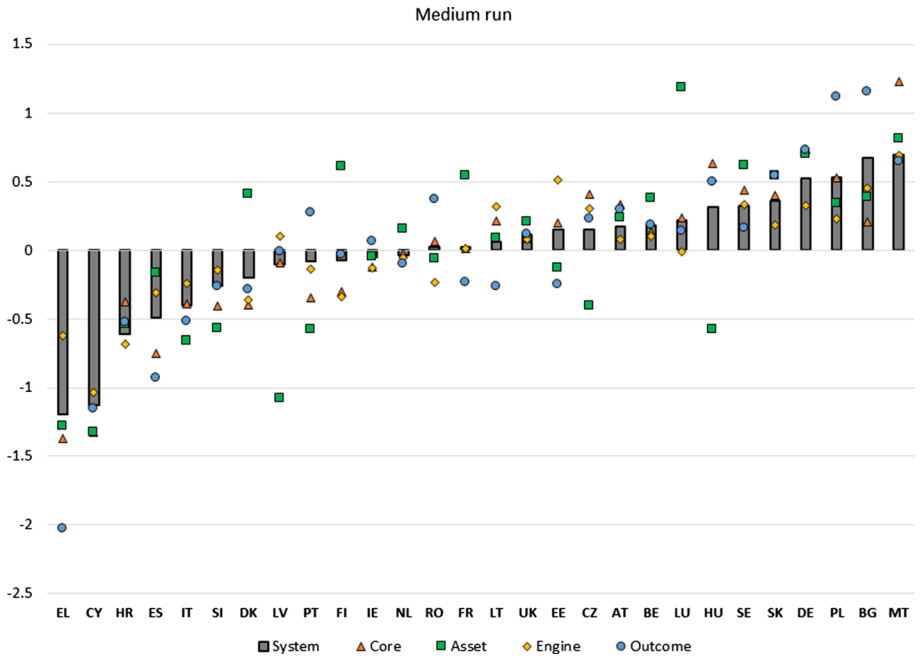

Fig. 2 Decomposition of European countries' resilience across different parts of the system and the economic-social domain. *Source*: Authors calculation

Third, being resilient relative to other countries does not necessarily imply resilience in the absolute sense, as demonstrated by the capacity to bounce forward. While the statistical association between the bouncing forward and medium-run indicators is very strong (with a correlation coefficient of 0.9), they capture conceptually different aspects of resilience. For example, Germany, the country that ranks only fourth in terms of medium-run resilience, displays the best bouncing forward performance by a wide margin. At the other end of the spectrum, while Croatia or Spain do much better than the worst performers in medium-run resilience, they do just as poorly as the latter when the pre-crisis performance is considered as the reference point.

Finally, Fig. 2 below breaks down countries' medium-run resilience and highlights their performance associated with different parts (assets, engine, outcomes) and domains (core, non-core variables) of the system, respectively. These comparisons reveal that resilient countries tend to exhibit good performance in all parts and dimensions of the system, which supports the theoretical consideration that a system can only be resilient in its outcomes as long as it is also resilient in its assets and engine (Manca et al. 2017). Yet, Fig. 2 also shows that different parts of a country's socio-economic system do perform very unequally in some cases: for example, Luxembourg and Finland function uncharacteristically well in terms of assets, Estonia and Greece in the engine, Poland and Romania in outcomes. Moreover, Fig. 2 demonstrates the importance of employing a broad societal perspective when discussing resilience: the resilience performance of several Member States changes considerably when the focus is shifted from the core set of economic-financial variables to non-core set of social ones. For instance, Hungary and Malta perform considerably better

in traditional economic areas, while the resilience of Portugal and Spain has been greatly improved by their performance in the social domain.

5 Resilience Characteristics

Once the resilience performance of European countries has been determined, the most immediate policy objective concerns the identification of certain deep-seated features that are robust, significant and meaningful predictors of resilient outcome at the country level.[10] It is important to stress that our aim is not to discover specific policy tools that can be directly utilized in a crisis. Instead, these resilience characteristics are meant to capture some underlying, pre-existing features of countries that enable them to act resiliently in a crisis. Some of these features may be directly linked to policies, while others can be more deep-seated or even invariant.

In order to succeed in this exercise, we select our exploratory variables ranging from institutional features to government finances to measures of subjective well-being. Our approach of looking for significant characteristics reflects the multidimensionality of resilience. It is also similar to the city-level indicator sets of ARUP (2014) and Figueiredo et al. (2018), and the country-level approach followed in European Commission (2017, 2018a). We collected data on about 200 potential resilience characteristics, which can be classified into the following broad areas: digital development, education, gender equality, government expenditures, innovation, labour market policies, macroeconomic indicators, business and regulatory environment, governance, quality of life, societal attitudes.

Potential characteristics were drawn from many sources such as the Global Competitiveness Index of the World Economic Forum, the World Bank, the OECD, the Gallup World Poll Survey, the Macroeconomic Imbalance Procedure Scoreboard, the Eurostat, the EC digital scoreboard, as well as the European Institute for Gender Equality, Furthermore, additional characteristics featured in various related studies (Joint Research Centre 2015; Martinez Turegano and Marschinski 2018) were also considered.[11] The detailed list of characteristics we tested is available in Table A5 of the Online Annex.

To study the statistical association between resilience performance and candidate characteristics, multi-year averages of these latter were constructed. In particular, we considered the 2000–2007, 2005–2007 and 2008–2010 averages to serve as pre-determined characteristics that are unaffected by the crisis (the first two) or at least its second phase (the 2008-2010 average).[12] For impact assessment in the immediate aftermath of the crisis, only the first two

[10] In a parallel work, Bruha and Kucharcukova (2017) follow a similar two-step methodology. In their first step, they characterize commonalities and differences in macroeconomic developments (GDP growth and unemployment) across countries. The second step is to look for characteristics to explain the differences.

[11] We restricted our attention only to those variables that were consistently available for at least 26 EU member states from 2000 onwards. An online Annex to this paper provides the detailed definitions of 85 characteristics out of the total: the variables from the World Economic Forum database that proved to be correlated with resilience indicators, and all the other characteristics (even if they did not prove to be meaningful predictors of resilient outcome).

[12] The first choice reflects the situation well before the crisis, while the second considers only a shorter history. As it is not immediate whether and how much resilience during the crisis can be explained by conditions of the last few years before or a more extended time period, we included both versions. For the recovery and medium-run, developments in the early crisis period can also be relevant explanatory factors, which motivates the choice of our third time period.

averages were used, while the medium-term analysis (with respect to the recovery, medium-run and bounce forward indicators) featured the 2008-2010 averages as well.[13]

The empirical analysis itself consists of univariate and bivariate regressions, where resilience indicators are regressed on resilience characteristics. Table 3 below contains, by resilience indicator, the list of resilience characteristics (along with the corresponding coefficient estimates) that resulted in the best statistical fit.[14] Tables 4, 5 and 6 in the Annex reports a larger set of meaningful univariate and bivariate regression results. Though the methodology is admittedly rudimentary and the conclusions drawn from it are tentative, the characteristics identified are robust enough to provide important signals about the strength of the absorptive (impact), adaptive (medium-run) and transformative (bouncing forward) capacities of European countries.

Panel A of Table 3 reports characteristics with the highest explanatory power for impact resilience. Results of univariate regressions suggest that high government expenditures on social protection, low growth in labour costs and a favourable net external investment position are the features most closely associated with higher short-run resilience. It is worth noting that, along with the current account balance that features in the favoured bivariate specification, most of these characteristics are key indicators to be monitored in the context of the EU's Macroeconomic Imbalance Procedure[15] (MIP) as vulnerability factors. Expenditures on social protection, on the other hand, would be more closely related to the concept of shock absorption, as has been demonstrated by recent policy work related to the European Pillar of Social Rights or the OECD's "Growth-Fragility" framework (e.g. Cingano 2014; Ostry et al. 2014; Roca and Ferrer 2016). Additional characteristics that are positively correlated with impact resilience in a statistically significant way include the share of non-manual workers in the labour force, gender equality, current account balance, foreign market size (exports and imports), innovation capacity, and the availability of local suppliers to meet business needs. (See Tables 4, 5 and 6 in the Appendix for more details).

Panel B reports characteristics with the highest goodness-of-fit scores for medium-run resilience. Results of univariate regressions suggest that higher political stability, wages perceived to reflect differences in productivity, and limited financial sector liabilities are all associated with higher medium-term resilience of a country. The importance of a stable and predictable political landscape to foster both absorption and adaptation is hardly surprising as it plays an important role both for resisting and responding efficiently to distress. Bivariate specifications deliver much improved explanatory power and tend to highlight the importance of non-domestic drivers of resilience in the medium run (such as net international investment position and export growth).

[13] One may notice that some candidate characteristics are also featured as system variables. When used as candidate resilience characteristics, these variables are taken in their level (average pre-crisis value); the resilience metrics are instead based on their change relative to 2007. This ensures that there is no mechanical relationship between indicators and candidate characteristics.

[14] Regression results associated with the recovery indicator are not presented as the interpretation of the results is less straightforward due to the potential impact-recovery linkages mentioned earlier. Unreported estimates nevertheless reveal that, somewhat surprisingly, a higher part of the cross-sectional variation in recovery resilience can be explained through characteristics. The best-performing candidates are GDP growth, change in export market share and ease of doing business.

[15] The Macroeconomic Imbalance Procedure aims to identify, prevent and address the emergence of potentially harmful macroeconomic imbalances that could adversely affect economic stability in a particular Member State, the euro area, or the EU as a whole. (https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/macroeconomic-imbalance-procedure_en).

Table 3 Results of the regression analysis of resilience characteristics. *Source*: Authors calculation

		Adjusted R^2	Coefficient
Panel A: impact resilience			
Univariate			
C14	Expenditures on social protection (00–07)	0.30	0.07***
C48	Unit labour cost % change (05–07)	0.29	−0.03***
C43	Net int'l. investment position (05–07)	0.26	0.007***
Bivariate			
C42	Current account balance (05–07)	0.52	0.09***
C16	GDP per capita (05–07)		−0.99***
Panel B: medium-run resilience			
Univariate			
C65	Political stability (08–10)	0.18	0.50**
C82	Wages related to productivity (08–10)	0.17	0.42**
C52	Financial sector liabilities (08–10)	0.14	−0.02**
Bivariate			
C43	Net int'l investment position (05–07)	0.38	0.008***
C44	Export market share (05–07)		0.009***
C65	Political stability(08–10)	0.30	0.68***
C16	GDP per capita (05–07)		−0.43**
Panel C: bouncing forward resilience			
Univariate			
C82	Wages related to productivity (08–10)	0.28	0.32***
C70	Efficacy of corporate boards (08–10)	0.22	0.27***
C80	Intensity of local competition (08–10)	0.18	0.28**
Bivariate			
C80	Intensity of local competition (08–10)	0.49	0.40***
C44	Export market share (08–10)		0.007***

The period in parenthesis denotes the time window used for the calculation of multi-year averages associated with each characteristic. *** means the variable is significant at 1%, ** significant at 5% and * significant at 10%

As far as absolute resilience performance is considered (Panel C of Table 3), no standard macroeconomic indicator features among the specifications offering the best fit. Instead, the characteristics most closely related to bouncing forward resilience—the perception of productivity-aligned wages, the efficacy of corporate boards, or the perceived intensity of competition in the local market—all point to the importance of the business environment in promoting a country's adaptive and transformative capacities. As for the bivariate results, they are consistent with the previous finding that good absolute performance is more prevalent in the core-economic domain: a few structural economic indicators, such as domestic competition and export performance, can explain roughly half of the cross-sectional variation in bouncing forward resilience.

Overall, these regression results confirm that resilience may sometimes, in particular as far as absorption is concerned in the short-run, be reliably predicted with only a few

characteristics. In other cases, notably at longer horizons and in absolute terms, the opposite is true, which suggests that resilience may ultimately be the outcome of a complex interplay of several factors. Our analysis also shows that certain variables are not closely related to resilience, despite one's expectations to the contrary. Examples may include measures of governance quality, educational attainment or the capacity for fiscal stabilization. These omissions certainly deserve further investigation in the future.

6 Conclusions

This paper sheds some light on how EU countries have responded to the 2007–12 financial and economic crisis. In particular, it has addressed the following questions. Which countries showed resilient outcome during and after the crisis? Is resilience related only to the economic dimension? Has any of the EU countries been able to use the crisis as an opportunity and 'bounce forward'? Is it possible to identify any particular country characteristics linked to resilience?

The exercise has led to the following main results and conclusions. First, there is a great divergence in terms of how and to what extent European countries have responded to the crisis. Germany appears to be among the most resilient, Ireland was severely hit but showed a good absorptive capacity, lesser-hit Italy seems to be still struggling with recovery, while Greece suffered the most serious consequences.

Second, ranking countries according to their resilience is not obvious. Resilience performance typically depends on the indicator of reference: countries that are more resilient in their short-term response may not necessarily be the ones better performing in the medium-term. For example, while Poland appears to be among the most resilient both in the short and medium run, Baltic countries were much less resilient in initial shock absorption than in subsequent recovery.

Third, for a better understanding of resilience, the social dimension needs to be taken into account. Broadening the perspective has an impact on the resilience assessment of a number of countries. For instance, Bulgaria appears more resilient when factors such as social exclusion, happiness, health expenditures are accounted for, while the opposite is true for Hungary. This further reinforces the case for the endorsement of societal factors by European and international policymakers.

Fourth, resilience based on country rankings and resilience in absolute terms are two distinct categories. While some relatively resilient countries such as Slovenia or Spain still lag behind their pre-crisis performance in the majority of relevant socio-economic dimensions, others like Malta and Slovakia managed to bounce forward in many areas. When considering the bouncing forward performance by individual system variable, economic and monetary variables (such as productivity, GDP, consumption) turn out to be among those most likely to exceed their respective pre-crisis levels.

Fifth, having tested around 200 candidate resilience characteristics to identify drivers of resilient outcomes, we find that no single characteristic can explain resilience alone, and different characteristics differ in their association with resilience in the short- and the medium-run. Impact resilience is most closely associated with high government expenditures on social protection, medium-run resilience with political stability, bounce forward resilience with a favourable business environment. While net creditor countries tend to be more resilient than

net debtors in all dimensions analysed, governance quality, educational performance and the capacity for fiscal stabilization are not strong predictors of resilience at the country level.

Our analysis contributes to enhancing resilience thinking in the policy arena in important ways. First and foremost, we present a measurement framework for the quantitative assessment of resilience that is broad enough to consider the socio-economic system as a whole. We also emphasize the concept of 'bouncing forward', linked to a definition of resilience where crises are taken as opportunities to actually transform and improve. Finally, we identify some underlying resilience characteristics that may be associated with resilient outcome and provide entry points for resilience-enhancing policy interventions.

Extending this analysis to a regional level is a major ongoing line of research. Preliminary analyses in this regard have already revealed a large degree of regional heterogeneity in resilience to the crisis, though more strongly between than within countries. Another attempt is underway to increase the robustness of our findings by extending the historical focus of the analysis to include other crisis episodes as well.

Such extensions and refinements would allow creating a dashboard of resilience characteristics at the country level. It would allow the continuous assessment of each country's ability to successfully weather a potential future economic shock. Such a dashboard could become an effective tool able to assess risks and vulnerabilities and the capacity to recover and eventually bounce forward.

It is important to highlight that it is not the composite resilience indicator (of impact, recovery, medium-run or bounce forward) but the resilience characteristics that we advocate. The resilience indicators themselves refer to a single episode, and would not lend themselves to continuous monitoring. At the same time, existing indicator sets (like the city-level frameworks of ARUP 2014 and Figueiredo et al. 2018, or the country-level indicators featuring in European Commission 2017, 2018a) are based dominantly on expert opinion. They are suitable for multiple policy applications: the monitoring, design, implementation, and assessment of policies. However, they are not necessarily linked to observed behaviour in distress episodes.

Resilience characteristics can unite the advantages of these two approaches. They are observable, pre-crisis features of countries, that are rooted in statistical analyses of resilience in actual periods of distress (revealed resilience indicators, as discussed in Sensier et al. 2016). As such, they offer statistical support to the selection of expert-based resilience indicators.

Appendix

See Tables 4, 5, 6 and 7.

Table 4 Detailed results for the analysis of resilience characteristics—impact. *Source*: Authors calculations

Var code	Variables	Adjusted R^2	Coefficient	Significance level
Impact of the crisis: univariate regressions				
C14	Expenditures on social protection (00–07)	0.30	0.07***	0.00
C48	Unit labour cost growth (05–07)	0.29	−0.03***	0.00
C43	Net int'l. investment position (05–07)	0.26	0.007***	0.00
C42	Current account balance (05–07)	0.25	0.04***	0.00
C74	Foreign market size (2007)	0.24	0.29***	0.00
C69	Innovation capacity (2007)	0.22	0.24***	0.01
C81	Quantity of local suppliers (2007)	0.19	0.44**	0.01
C17	Investment per GDP (05–07)	0.19	−0.05**	0.01
C19	Non routine manual tasks (00–07)	0.19	−6.37**	0.01
C4	Gender Equality Index (2005)	0.12	0.02**	0.04
Impact of the crisis: bivariate regressions				
C42	Current account balance (05–07)	0.52	0.09***	0.00
C16	GDP per capita (05–07)		−0.99***	0.00
C15	Expenditures on social protection (00–07)	0.46	0.10***	0.00
C51	Real effective exchange rate (00–07)		0.05***	0.01
C48	Unit labour cost growth (05–07)	0.44	−0.04***	0.00
C44	Export market share—5 year % change (05–07)		0.008***	0.01
C14	Expenditures on social protection (00–07)	0.37	0.05**	0.03
C43	Net int'l. investment position (05–07)		0.005*	0.06
C14	Expenditures on social protection (00–07)	0.35	0.04*	0.07
C48	Unit labour cost growth (05–07)		−0.02*	0.10
C14	Expenditures on social protection (00–07)	0.30	0.05*	0.10
C42	Current account balance (05–07)		0.02	0.35
C19	Non routine manual tasks (00–07)	0.35	−3.97	0.10
C14	Expenditures on social protection (00–07)		0.05**	0.01

The univariate specifications are the best eight of the meaningful ones, followed by selected interesting findings (marked by gray). The bivariate specifications are the best three of the meaningful pairs, followed by some selected interesting findings (marked by gray). *** means the variable is significant at 1%, ** significantat 5% and * significant at 10%

Table 5 Detailed results for the analysis of resilience characteristics—medium-run. *Source*: Authors calculations

Var code	Variables	Adjusted R^2	Coefficient	Significance level
Medium-run: univariate regressions				
C65	Political stability (08–10)	0.18	0.50**	0.01
C82	Wages related to productivity (08–10)	0.17	0.42**	0.02
C52	Financial sector liabilities (08–10)	0.14	−0.02**	0.03
C43	Net int'l. investment position (05–07)	0.14	0.005**	0.03
C78	Imports per GDP (2007)	0.13	0.007**	0.04
C72	FDI generating technology transfer (08–10)	0.13	0.33**	0.04
C70	Efficacy of corporate boards (08–10)	0.12	0.35**	0.04
C62	Trade openness (08–10)	0.12	0.003**	0.04
Medium-run: bivariate regressions				
C43	Net int'l investment position (05–07)	0.38	0.008***	0.00
C44	Export market share—5 year % change (05–07)		0.009***	0.00
C52	Financial sector liabilities (08–10)	0.37	−0.03***	0.00
C10	GDP growth (08–10)		0.11***	0.00
C43	Net int'l investment position (05–07)	0.37	0.008***	0.00
C51	Real effective exchange rate (00–07)		0.05***	0.00
C65	Political stability (08–10)	0.34	0.50***	0.01
C52	Financial sector liabilities (08–10)		−0.02**	0.01
C52	Financial sector liabilities (08–10)	0.33	−0.03***	0.00
C77	Trust in the financial system (08–10)		0.47***	0.01
C65	Political stability(08–10)	0.30	0.68***	0.00
C16	GDP per capita (05–07)		−0.43**	0.03

The univariate specifications are the best eight of the meaningful ones. The bivariate specifications are the best three of the meaningful pairs, followed by some selected interesting findings (marked by gray). *** means the variable is significant at 1%, ** significantat 5% and * significant at 10%

Table 6 Detailed results for the analysis of resilience characteristics—bouncing forward. *Source*: Authors calculations

Var code	Variables	Adjusted R^2	Coefficient	Significance level
Bouncing forward: univariate regressions				
C81	Wages related to productivity (08–10)	0.28	0.32***	0.00
C69	Efficacy of corporate boards (08–10)	0.22	0.27***	0.01
C79	Intensity of local competition (08–10)	0.18	0.28**	0.01
C71	FDI generating technology transfer (08–10)	0.17	0.23**	0.02
C82	Prevalence of foreign ownership (08–10)	0.16	0.19**	0.02
C76	Trust in the financial system (08–10)	0.15	0.26**	0.02
C64	Political stability (2008–2010)	0.14	0.28**	0.03
C42	Net int'l investment position (05–07)	0.14	0.003**	0.03
C60	Ease of doing business index (2010)	0.10	0.01*	0.06
Bouncing forward: bivariate regressions				
C79	Intensity of local competition (08–10)	0.49	0.40***	0.00
C43	Export market share—5 year % change (08–10)		0.007***	0.00
C69	Efficacy of corporate boards (08–10)	0.46	0.33***	0.00
C43	Export market share—5 year % change (08–10)		0.006***	0.00
C81	Wages related to productivity (08–10)	0.46	0.34***	0.00
C42	Net int'l investment position (05–07)		0.004***	0.00
C64	Political stability (2008–2010)	0.34	0.20*	0.08
C81	Wages related to productivity (08–10)		0.28***	0.01

The univariate specifications are the best eight of the meaningful ones, followed by a selected interesting finding (marked by gray). The bivariate specifications are the best three of the meaningful pairs, followed by some selected interesting findings. *** means the variable is significant at 1%, ** significant at 5% and * significant at 10%

Table 7 List of system variables

Nr.	System variables		Source	Definition/construction	Time period	System part	Core view	Adjustment
	Shorthand	Name						
V1	Corp. Loans	Loans to Non- Financial Corporations	Eurostat	Loans to Non-Financial Corporations (million Euros)	2004–2016	Engine	1	% Difference from 2007 level (see notes)
V2	Dwellings	Value of dwellings	Eurostat	Balance sheets for non-financial assets dwellings in current prices million euros divided by consumer price index	2000–2014	Asset	0	Log transformation of deflated measure
V3	Employment	Employment Rate	Eurostat	Number of persons aged 20 to 64 in employment by the total population of the same age group	2000–2016	Outcome	1	
V4	Exp. education	Government Expenditures on Education	Eurostat	Government Expenditures on Education, per GDP value multiplied by GDP, chain-linked volumes (2010), million euro	2000–2015	Asset	0	Log transformation
V5	Exp. health	Government Expenditures on Health	Eurostat	Government Expenditures on Health, per GDP value multiplied by GDP, chain-linked volumes (2010), million euro	2000–2015	Asset	0	Log transformation
V6	Exp. R&D	Total expenditures on R&D	Eurostat	Government Expenditures on R&D, million purchasing power standards (PPS) at 2005 prices	2003–2015	Engine	0	Log transformation
V7	Fairness	Self-perceived fairness	ESS	Survey-based –subjective measure. The survey question "Most people try to take advantage of you if they got the chance, or try to be fair". The variable is the share of those answering 7 to 10 (agree with fairness) out of a scale of 10.	2002–2014, biannual	Asset	0	
V8	GDP	Gross Domestic Product	Eurostat	Real GDP volume, index 2010 = 100	2000–2016	Outcome	1	Log transformation
V9	Gov. debt	Government debt	Eurostat	Government debt as percentage of GDP	2000–2016	Engine	1	

Table 7 (continued)

Nr.	System variables		Source	Definition/construction	Time period	System part	Core view	Adjustment
	Shorthand	Name						
V10	Gov. deficit	Government budget balance	Eurostat	Government budget balance as percentage of GDP	2000–2016	Engine	1	
V11	Happiness	Happiness	EQLS	Survey-based—subjective measure. The survey question "How happy are you?" The variable is the share of those answering 7 to 10 (the happiest) out of a scale of 10	2003, 2007, 2011, 2016	Outcome	0	
V12	Health	Self-perceived health	EU SILC	Survey-based—subjective measure. Share of respondents indicating a level of "good" or "very good" (the top two out of 5)	2006–2015	Outcome	0	
V13	HH consumption	Household consumption	Eurostat	Household Consumption, volume index 2010 = 100	2000–2016	Outcome	0	Log transformation
V14	HH income	Household disposable income	Eurostat	Household real gross disposable income, PPS per capita	2002–2015	Outcome	0	Log transformation
V15	HH loans	Household loans	Eurostat	Loans to households as percentage of GDP	2000–2016	Engine	1	(See notes)
V16	House prices	House Prices Index	Eurostat	House prices index, 2015 = 100	2000–2016	Engine	1	Log transformation
V17	Inequality	Inequality	Eurostat	The S80/S20 ratio. The S80 is the share of income held by the 80–10 percentile of the income distribution; while S20 is the share held by the 0–20.	2006–2015 (HR 2010-, ROM 2007-)	Outcome	0	Log transformation
V18	Inflation	Inflation deviation	Eurostat	Absolute deviation of inflation from 2 percent.	2000–2016	Engine	1	

Table 7 (continued)

Nr.	System variables		Source	Definition/construction	Time period	System part	Core view	Adjustment
	Shorthand	Name						
V19	Investment	Investment	Eurostat	Gross fixed capital formation, volume index 2010 = 100. It includes capital formation of resident producers' acquisitions, less disposals, of fixed tangible or intangible assets. This covers in particular machinery and equipment, vehicles, dwellings, and other buildings.	2000–2016	Asset	1	Log transformation
V20	Labour prod.	Labour productivity	Eurostat	Labour productivity index, 2010 = 100. Real output per total hours worked in a year.	2000–2016	Engine	1	Log transformation
V21	LMP active	Active Labour Market Policies	Eurostat	Total active labour market policies (LMP measure 2–7), per GDP value multiplied by GDP, chain-linked volumes (2010), million euro	2000–2015	Engine	0	Log transformation
V22	LMP passive	Passive Labour Market Policies	Eurostat	Total passive labour market policies (LMP support 8–9), per GDP value multiplied by GDP, chain-linked volumes (2010), million euro		Engine	0	Log transformation
V23	NEET	Not in employment nor in education and training	Eurostat	Young people (15–24 years) neither in employment nor in education and training, percentage of the total population in the same age group	2002–2016	Outcome	0	
V24	Private debt	Private debt	Eurostat	Private debt (loans and securities) as percentage of GDP	2003–2015	Engine	1	

Table 7 (continued)

Nr.	System variables		Source	Definition/construction	Time period	System part	Core view	Adjustment
	Shorthand	Name						
V25	Satisfaction	Life Satisfaction	EQLS	Survey-based –subjective measure. The survey question: "How satisfied would you say you are with your life these days?" The variable is the share of those answering 7 to 10 on a scale from 1 (very dissatisfied) to 10 (very satisfied)	2003, 2007, 2011, 2016	Outcome	0	
V26	Social activity	Social ties	ESS	Survey-based –subjective measure. The survey question: How often people socially meet with friends, relatives or colleagues. The variable includes those answering they meet every day.	2002–2014, biannual	Engine	0	
V27	Social exclusion	At risk of poverty or social exclusion	Eurostat	Share of people at risk of poverty or social exclusion (AROPE), as percentage of total population. AROPE refers to the situation of people either at risk of poverty or severely materially deprived or living in a household with a very low work intensity.	2006–2015	Outcome	0	
V28	Stock prices	Stock price index	Bloomberg	Stock price index	2000–2016	Engine	1	Log transformation
V29	Temporary work	Temporary contracts	Eurostat	Share of people having a temporary contract, from 20 to 64 years, as percentage of total employment	2003–2016	Engine	0	
V30	Trust EP	Trust in the European parliament	ESS	Survey-based- subjective measure. The share of respondents answering 7-10 on a scale from 0 (not trust at all) to 10 (complete trust)	2002–2014, biannual	Engine	0	

Table 7 (continued)

Nr.	System variables		Source	Definition/construction	Time period	System part	Core view	Adjustment
	Shorthand	Name						
V31	Trust legal	Trust in the legal system	ESS	Survey-based—subjective measure. The share of respondents answering 7–10 on a scale from 0 (not trust at all) to 10 (complete trust)	2002–2014, biannual	Engine	0	
V32	Trust people	Self-perceived trust	ESS	The survey question "Most people can be trusted or you can't be too careful". The variable is the share of those answering 7 to 10 (agree with trust).	2002–2014, biannual	Asset	0	
V33	Unemployment	Unemployment	Eurostat	Unemployed persons as a percentage of the labour force (15–74 years). The labour force is the total number of people employed and unemployed.	2000–2016	Outcome	1	
V34	Wages	Real Wage	Eurostat	Compensation of employees per hour worked in Purchasing Power Standard (PPS) deflated by EU28 Consumer Price Index	2000–2016	Engine	0	Log transformation

Data for Belgium is available until 2015 for V20. Data for Croatia is available since 2002 for variables (V4, V5, V9, V10, V14, V15, and V28), since 2003 for variable V34, and since 2010 for variable V17. Data for Cyprus is available since 2001 (V5), 2002 (V14), and 2004 (V16). Data for Estonia is available since 2005 for V16. Data for Hungary is available since 2007 for V16. Data for Ireland is available since 2012 (V15) and until 2015 (V16, V1). Data for Latvia is available since 2004 for V15. Data for Lithuania is available since 2004 for V14. Data for Malta is available since 2004 for V15 and missing entirely for V14. Data for Luxemburg is missing entirely for V14. Data for Poland is available since 2002 (V4, V5) and 2008 (V16). Data for Romania is available since 2008 (V16) and 2007 (V17). Data for Slovenia is available since 2002 (V15) and 2003 (V16, V28). Data for Slovakia is available since 2016 for V16

Due to measurement issues, the value of new corporate and household loans can be negative (in case of more repayments than new disbursements). For this reason, we could not define the percentage drop in household loans relative to its 2007 level. Instead, we resorted to the slightly less informative per GDP variant

ESS European Social Survey, *EQLS* European Quality of Life Survey, *EU SILC* European Union Statistics on Income and Living Conditions

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