

## Structural Dynamics and 'Forward-Looking' Regional Economic Resilience

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### Abstract:

Building on the ongoing discussion, this paper introduces a new type of regional economic resilience, labelled as forward-looking or anticipatory resilience. Further, it advocates that empirical research over this type of resilience can be fruitful, especially in Central and Eastern European countries. Using an example of Polish NUTS-3 regions, it is shown that intensive structural dynamics may have a detrimental impact on regional resistance to external shocks, but, if launched after the shock has occurred, a positive impact on the recovery might be achieved. Finally, the paper suggests paths along which the research can proceed and discusses the problem of operationalization.

**Keywords:** resilience; regional growth; structural dynamics; CEE.

**JEL Classification:** E3; R10; R11.

### Introduction

The highly asymmetric impact of the recent global crisis across countries is widely acknowledged. Indeed, some countries weathered the crisis relatively well, while others were heavily affected<sup>1</sup> Similarly, some economies managed to "bounce back" to pre-shock growth rates, or even exceed them relatively quickly, while others have not managed to fully recover to date. Therefore, the academic interest in the sources and mechanisms of this varying performance is natural, and there are good reasons to take a national perspective for investigating economic resilience, as is done by Didier *et al.* (2012) or Gomes (2018), among others. First, a considerable amount of resilience is determined by country-level regulations. Second, a considerable number of shocks is generated or absorbed by national policies.

Country-wide factors, however, do not tell the entire story about economic resilience. On the contrary, it appears that cross-regional resilience differences within countries could have been as deep as cross-national ones (Giannakis and Bruggeman 2017). For example, within the hardly hit economy of Spain, where GDP (PPP) growth rate fell by 16% (peak-to-trough), NUTS-2 regional GDP growth losses ranged from 12% to 20%. The pace of recovery was also very differentiated. Between the outbreak of the crisis and 2015, GDP increased by 6% in Spain, ranging between 1% and 11% across individual regions. Even stronger variations were recorded in the relatively resilient Germany. The nation-wide loss of GDP (PPP) growth rate amounted to 12 percentage points, but it ranged between 8% and 18% across NUTS-2 regions. The subsequent rebound was generally much more potent than in Spain, as national GDP in Germany increased until 2015 by as much as 27%, ranging between 18% and 40% regionally.

The performance of CEE countries has proven to be even more diverse than 'old' EU members (Megyesiöva and Rozkosova 2018). While the GDP of Latvia and Lithuania decreased by more than 20% in real terms, Poland stood as the only country that avoided a recession. This does not mean, however, that the crisis led to no damage to the economy. Real GDP growth slowed by 4.2%, from 7% to 2.8%. Across voievodships (NUTS-2 regions), this loss varied between 2% and 9% and pushed some of them into a recession, whereas other enjoyed robust, hardly interrupted growth. Moreover, while the Poland's GDP (PPP) per capita increased between 2008 and 2015 by 38%, this number varied regionally between 22% and 47%.

In light of these divergent performances, it comes as no surprise that regional, local and urban resilience has emerged as one of the hottest research areas in the field of regional science, and the interest is still rapidly increasing (Martin and Sunley 2015).

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<sup>1</sup> The asymmetry was also visible in other breakdowns, *i.e.* between income groups (Kaya 2017).

Often, regional economic resilience has meant different things to different researchers. In the struggle to organize the concept, Martin and Sunley (2015) put forward the three dimensions of resilience:

- the ability of a regional economy to rebound to pre-shock state following the shock, and the speed at which it occurs (we will refer to it as type I resilience in the remainder of this paper);
- the ability of a regional economy to absorb the shock, *i.e.* remain near the pre-shock state (type II resilience);
- the capability of a regional economy to adapt its structure in response to the shock in order to maintain core performances (type III resilience).

While the last dimension encompasses positive adaptability not only in response, but also in anticipation of a shock, this 'forward-looking' perspective is not further elaborated in Martin and Sunley (2015), nor is it discussed elsewhere in the literature. We feel, however, that it might substantially improve our understanding of resilience; therefore, we explicitly propose to introduce another type of regional economic resilience that we define as: the capability of a regional economy to 'look forward' and 'modify' its structure, launch 'insurance mechanisms' against shocks and reroute its activity in order to minimize the effects of a negative shock and facilitate a recovery (type IV resilience).

The aim of this paper is twofold. First, it is to introduce the concept of type IV resilience (as defined above) and motivate launching empirical studies over it. Second, it is to emphasize the role of structural dynamics for this type of regional economic resilience, or its two distinct aspects: resistance to shocks and the ability to recover to pre-shock conditions.

## 1. State of the art

In the context of your research paper the literature review should be a critical synthesis of previous research in the subject field. The evaluation of the literature leads logically to the research question. Who is doing what? Who has done what? Who first did it or published it? Taken from published papers, research monographs, catalogues etc. based on primary sources. Offering a, probably new, structured view of the field of study.

Acknowledging the rapidly increasing awareness of regional resilience, Christopherson *et al.* (2010) admitted that one of the reasons could be the 'malleability' of the concept itself. Understanding the notion of economic resilience has progressed rapidly in the recent years, which is reflected in its evolving definition. Indeed, it has taken several years of debate to clarify and frame the concept theoretically. The foundations of the consensus, which we now seem to be arriving at, were laid in the 2010 special issue of the *Cambridge Journal of Regions, Economy and Society* 3(1), which comprised a number of important contributions including Hudson (2010), Simmie and Martin (2010), Hassink (2010), Pike *et al.* (2010), Pendall *et al.* (2010), Bristow (2010), and Wolfe (2010). Owing to these contributions, some critical issues related to the relationship between resilience, growth, competitiveness, and sustainability were addressed. It is useful to recall Scott (2013), who added that, among many other concepts, it is the explicit emphasis on shocks and unknowable perturbations that is distinctive for the concept of resilience.

Resilience, defined as the ability and speed of a regional economy to recover to their pre-shock equilibrium, was derived from engineering sciences and soon became known as the engineering approach. Another contribution came from ecological sciences, where resilience is understood as the ability to absorb or resist the shock. The main difference between these two approaches is that ecological resilience rejects the assumption of a single equilibrium and instead allows multiple equilibria and the possibility of regional economies to flip into alternative stability domains following a shock (Davoudi *et al.* 2012). Engineering and ecological approaches contributed to establishing the concepts of type I and II regional resilience, respectively. From this stage, we have observed the literature expanding in two directions. On the one hand, the two concepts were sufficiently framed to trigger their operationalization and application to empirical research, and we indeed observed the emergence of empirical studies on regional resilience (*e.g.* Brakman *et al.* 2015, Crescenzi *et al.* 2016, Giannakis and Bruggeman 2017). On the other hand, some theoretical dissatisfaction remained, and work on the notion and theory of resilience continued. Davoudi *et al.* (2012), for example, still complained about the lack of clarity around the concept, but the main critique towards the existing consensus was voiced by evolutionary economists and economic geographers. Even though the role of agents, institutions, and interactions were acknowledged earlier, Bristow and Healey (2014) have called for putting the evolutionary approach to understanding regional change at the center of the concept.

The evolutionary approach became a strong alternative to the engineering and ecological approaches by introducing a fundamental change in the perception of regional economies, here viewed as collections of agents, principally firms and institutions, who interact with each other in complex and non-linear ways (*i.e.* complex adaptive systems in the sense of Bristow and Healey 2014). Since resilience is still defined in terms of capability to absorb,

resist and respond to the disturbance, the evolutionary approach enriches the concept of type II resilience while also adding a new dimension (type III). Within the latter, agents are assumed to continually adapt their behavior based on observations of the system as a whole or of others around them through interactive mechanisms such as learning, imitation or evolution. This is how the system is adaptive and able to respond to changing conditions over time (Waldrup 1992, Bristow and Healey 2014, Boschma 2015). Another important distinction of the evolutionary approach, in general, is that it does not assume the economic systems to be in equilibrium prior to the shock or to return to it after the shock occurs. While this approach is intellectually appealing, it would be a real challenge to propose a framework to operationalize the evolutionary perspective of regional resilience. The first step was made by Duschl (2016), who suggested fitting a flexible Asymmetric Exponential Power density to firm-level data.

As mentioned earlier, we propose considering yet another form of resilience (type IV), which amounts to an anticipatory restructuring of the regional economy in order to avoid or minimize the negative impact of shocks and facilitate the subsequent recovery.

Some of the questions to be asked within this framework are: how do decisions taken by firms influence their performance (and also aggregate regional economic dynamics as a consequence) during the shock? What determines whether firms created before the shock perform well when the shock hits? Is this good performance related to taking up 'resilient' activities? Is there a structural shift visible in firm-level data that makes the regional structure resistant to shocks? To what extent are firms capable of reorienting their export activity towards markets, which are subsequently less affected by a shock? What are the linkages between regional resilience and regional specializations? Does the intensity of interactions between firms and other local actors, including research institutions, raise the immunity of regional economies to adverse shocks?

Empirically, disentangling type IV regional resilience from the other types requires using firm-level data and case studies to determine its relative importance. With the help of this data it would be more feasible to investigate whether *e.g.* a weak impact of a shock was due to the pre-existing structural features of a region, or because some changes were introduced consciously in advance of the shock. Additionally, was the fast recovery because of a swift reaction to the shock, or were the adjustments originally implemented ahead of the crisis.

Another strand of empirical research that shall open lies in the area of the determinants of type IV resilience. Attention should be devoted to firm-specific factors, such as their innovative and internationalization capabilities, and the local environment in which they operate. While innovation, *per se*, is disruptive to the current status quo, it can be seen as a forward-looking activity at the firm level. It would be interesting to examine what innovation and internationalization patterns can be identified at the regional level and their interrelationships with type IV (and other types) of resilience. Additionally, substantial information might be recovered from the processes of firm entry and the behavior of young firms. For example, it might be that young innovative companies (including startups) have a stronger ability to change the structure of sectors and businesses dynamics because of their higher adaptability and flexibility, compared to more mature companies. Innovation activity might also offset experience that was seen as a crucial factor determining the success of the companies, containing modes of internationalization. Finally, we believe that there may be a crucial role of cooperation between firms and other local actors, including universities and other research institutions, in building type IV resilience. All the above arguments underpin the hypothesis, that type IV resilience is generated endogenously within a region.

## **2. Central and Eastern Europe as a Laboratory to Investigate Type IV Resilience**

We believe that there are strong reasons to consider CEE as an excellent laboratory to investigate regional resilience. On the one hand, regional income disparities within CEE countries are as large as in comparable Western European ones, merely reflecting the extent of structural divergence, which influences all areas of economic dynamics (Anagnostou and Gajewski 2019). Most of these differences have deep historical roots. In the case of Poland for example, Wysokińska (2017) illustrated how the partitions-related paths of agrarian reforms in the 19th century determined the pattern of regional economic structures for the following decades. On the other hand, all CEE countries have some common features that may produce similarities in the patterns of regional resilience, such as comparable level of development, the ongoing catching-up process, the recent EU integration experience, and similar institutions, among others. One striking feature of this region, for example, lies in large differences of labour productivity across sectors, which is a legacy of non-market based factor allocation established under the centrally-planned system. This problem is especially striking when productivity is compared between overgrown and backward agriculture (partly of subsistence nature) and other sectors. To illustrate, labour productivity in the Polish agriculture industry is, on average, five times lower than in other sectors and much more diversified, compared to 1.5-2.1 times lower in other big EU countries, such as Germany, UK, France, Italy and Spain. Subsistence agriculture is also partly responsible for the relatively low differentiation of regional

unemployment rates, as it has been traditionally absorbing, in 'bad times', those people who lost jobs and were unable to find another in non-agricultural activities and releasing them in 'good times', a mechanism known as the 'sponge effect' (Landesmann and Romish 2006). This effect alone, also observed in other CEE countries, such as Romania, Bulgaria or Hungary, has the potential to impact regional resilience in a 'CEE-specific' manner, *i.e.* promoting type II resilience, but undermining types III and IV resilience. The latter presumption can be derived from possibly an inward-looking attitude of the agents in these areas, although it should also be subject to detailed empirical investigations.

Some earlier studies indicate great research potential and a number of possibly interesting findings. Anagnostou and Gajewski (2019), for example, using Bayesian Panel VAR models unveiled regional differences in the reaction to a common monetary policy shock in Poland. Their paper finds more heterogeneity with regards to the response of GDP and investment activities, compared to the unemployment rate or inflation. As far as GDP is concerned, for example, some eastern voivodeships seem to be much more vulnerable to interest rate shocks, compared to the western part of the country. Not only is the response stronger there, but monetary policy shocks are also substantially more persistent. Furthermore, it seems that these differences are related to the regional industry-mix (its role rises in importance over time for up to two or three years after the shock) and demographic situation, among others.

Some very intriguing results are also obtained in Gajewski and Tchorek (2017). The study exploited firm-level data to gain some insights into sources of regional export performance in Poland. The paper sheds a new light on the pattern of regional development in Poland and also suggests a potentially interesting research path in regional resilience in Poland. More specifically, we demonstrate that exporters in rural, eastern Poland follow a very distinct internationalization strategy, which cannot be deemed inferior. On the contrary (and contrary to the common perception), eastern exporters rely on innovation activity, non-price competitiveness, and family experience as sources of success in international markets to a greater extent than exporters in the western part of the country. While we could have only detected the beginning of the process, sustaining it might eventually earn the East solid grounds for its long-run development by rooting it in industries governed by increasing returns, and it can also exert an impact on regional resilience to shocks. Gajewski and Tchorek (2017) emphasize that that it is not possible to adequately describe regional economic mechanisms without investigating the behaviour and decisions taken at the firm level, and it calls for such an approach in the future. We also argue that after the great trade collapse in 2008/2009 and the fragile recovery thereafter accompanied by structural weaknesses, local resources and capabilities were more decisive in creating sustainable and resilient growth of regions and countries.

Acknowledging the importance of firms for regional economic dynamics, Gajewski and Kutan (2018) examined both long- and short-run drivers of new firm creation in the Polish NUTS-2 regions, as well as the role of firm entry for the region's economic activity. The results confirm the hypothesis that local economic structures and the broad business environment are critical for stimulating new business creation. The second exercise, in which we methodologically follow Gourio *et al.* (2016), turns out to be very informative as well. Using the Local Projections Method of Jorda (2005), we investigate the propagation of shocks to firm entry on regional GDP, non-agricultural employment, and the total number of firms. Firm creation is found to be facilitating optimal labour allocation, but their impact on total employment is much lower, if not negligible. Moreover, firm entry in agriculture-dominated (and low-income) regions constitutes a much weaker mechanism of raising productivity than in non-agricultural regions. Lower productivity growth reduces their relative competitiveness, which eventually limits the potential to pull employees out of agriculture (visible in the fourth year after the shock) and locks agricultural regions in a disadvantaged position, a source of regional divergence within CEE countries revealed in many studies (*e.g.* Monastiriotes 2014, Goschin 2015).

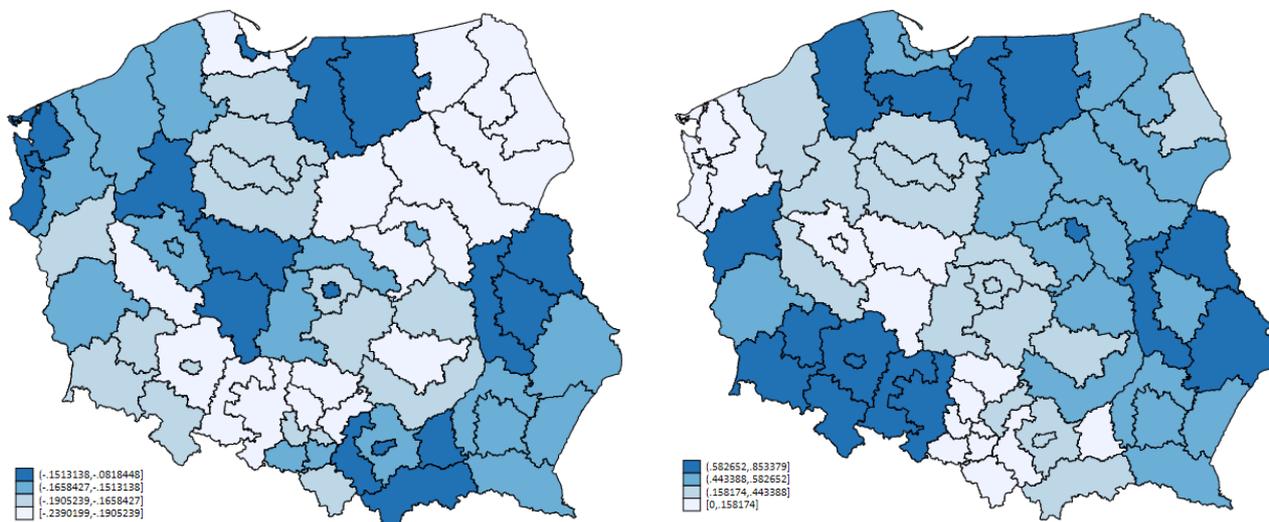
### 3. Preliminary Insights from Polish NUTS-3 Regions

Resilience to external shocks during the recent global crisis should be investigated carefully, since it overlaps with longer-run trends, associated (especially in the case of CEE countries) with structural transition or migrations. Another important distinction to be made is that of the resistance to shocks and recoverability, *i.e.* the ability to recover to pre-shock state, following the shock.

We employ data on non-agricultural employment changes in 66 NUTS-3 Polish regions, which is first stripped off the long-run effects by extracting a quadratic trend from the series. For each series maximum positive deviation from trend in the period 2007-2009 (peak) is identified. Further, maximum negative deviation in the mid-crisis period (2009-2011) is identified and labelled as trough. Finally, the resistance index is calculated as trough employment minus peak employment.

Figure 1 maps resistance in Polish NUTS-3 regions, which can now be attributed to the effects of the crisis – a negative shock. As it can be seen, no strong spatial dependence of resistance is observed. Recoverability in turn is defined as a share of non-agricultural employment restored between the mid-crisis trough and the year 2015, which marks the end of our sample. Importantly, recoverability is also calculated in terms of deviations from trend. Admittedly, there is no clear pattern that would link the resistance and recoverability indices.

Figure 1. Regional resistance index and recoverability index



The main focus of this paper is on the role of structural dynamics, *i.e.* the intensity of structural change in the regional economy. Hence, we construct modified Lilien indices (Ansari *et al.* 2014) of structural change in two periods: pre-crisis, *i.e.* 2005-2007 and mid-crisis, *i.e.* 2008-2010, using employment data in 11 sectors:

$$mli_i = \sqrt{\sum (\bar{b}_{ijt}) \times \left\{ \ln \left( \frac{b_{ijt_1}}{b_{ijt_0}} \right) - \ln \left( \frac{B_{it_1}}{B_{it_0}} \right) \right\}^2} \tag{1}$$

where:  $b_{ijt_1}$  employment in region  $i$ , sector  $j$ , time  $t_1$ ;  $B_{it_1}$  total employment in region  $i$ , time  $t_1$ ;  $\bar{b}_{ijt}$  average share of sector  $j$  in total regional employment (in region  $i$ ) in the period between  $t_0$  and  $t_1$ .

The two  $mli$  indices are used as regressors in the equations of resistance and recoverability, as defined above. Additionally, we also use the pre-crisis (*i.e.* 2007) share of agriculture in total employment (agriculture), as a control variable capturing the (inverse of) overall level of development. The functional form of the models read:

$$resistance = f(mli_{05-07}, agriculture) \tag{2}$$

$$recoverability = f(mli_{08-10}, agriculture) \tag{3}$$

Table 1 contains summary statistics for all the variables used in regressions. Note that the value of recoverability is restricted to be non-negative. Hence, the minimum value is zero (if the cyclical component of employment has not at all recovered since the mid-crisis trough) and 0.853, *i.e.* 85.3% of the crisis-induced employment loss was restored by 2015.

Table 1. Summary statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
Resistance	66	-0.166	0.031	-0.239	-0.082
recoverability	66	0.387	0.241	0.000	0.853
$mli_{05-07}$	66	1.127	0.491	0.309	2.376
$mli_{08-10}$	66	0.943	0.334	0.377	1.730
Agriculture	66	0.164	0.122	0.002	0.493
Resistance	66	-0.166	0.031	-0.239	-0.082

Source: Polish Central Statistical Office (GUS).

Table 2 presents estimation results of equations corresponding to functions (2) and (3). The estimated coefficient indicates that structural changes before the shock were detrimental to regional economic resistance. This might be because the newly created industries and firms tend to be relatively vulnerable. While exploiting resistance at a firm level might add some new information and enable extracting most relevant structural adjustments, *i.e.* those undertaken consciously with an intention to weather the coming negative shock, it is still likely that the fragility that accompany structural changes will prevail.

On the other hand, the results suggest that intense structural changes after the crisis has already struck, might facilitate the subsequent recovery. This conclusion goes beyond a trivial observation that modern, dynamic regions find it easier to recover from shocks. On contrary, regions with a higher share of agriculture (proxying backwardness in our study) recovered more swiftly, at least during the recent global crisis.

Table 2. OLS estimation results

Variable	Resistance	Recoverability
<i>mli 05-07</i>	-0.02*** [-2.94]	
<i>mli 08-10</i>		0.22** [2.22]
<i>agriculture</i>	0.00 [0.00]	0.64*** [3.03]
<i>intercept</i>	-0.14*** [-13.62]	0.08 [0.71]
<i>F</i>	4.34 [0.02]	5.99 [0.00]
<i>R</i> <sup>2</sup>	0.14	0.13
<i>N</i>	66	66

It should be reiterated that the above estimation results are not meant to answer the question about the nature of regional type IV economic resilience. Rather, they constitute a starting point to define the research agenda on this concept. The questions that must be addressed are those of the nature and motivation of structural changes. Firm-level data, including firm-level surveys are needed to get a deeper insight into these processes. A key research problem that should be solved is that of operationalization.

#### 4. Operationalization problems

To date, as Giannakis and Bruggeman (2017) stressed, there is no universally agreed upon approach for operationalizing and empirically measuring regional resilience, and regional and economic sciences are on the stage of proposing and testing various methodological approaches.

Given the current state of world research, it is easiest to operationalize resilience within the engineering approach. Fingleton *et al.* (2012) proposed to employ an empirical strategy using Seemingly Unrelated Regressions (SUR), derived from the Friedman's "Plucking Model" of Recessionary Shocks (Friedman 1993). Consider the following equation:

$$x_{it} = b_{0i} + b_{1i}R_{1t} + b_{2i}R_{2t} + \dots + b_{ni}R_{nt} + b_{n+1i}S_{1t} + b_{n+2i}S_{2t} + \dots + b_{n+mi}S_{mt} + e_{it} \quad (4)$$

where:  $x_{it}$  denotes a response variable (*e.g.* employment or output) in region  $i$  and time  $t$ ;  $b_{0i}$  is the autonomous (or potential) growth rate;  $b_{1i} \dots b_{ni}$  denote changes of the response variable following consecutive adverse shocks, while  $b_{n+1i} \dots b_{n+mi}$  are changes during the recovery periods. Negative shocks are denoted by  $R_{1t} \dots R_{nt}$  dummy variables, while  $S_{1t} \dots S_{mt}$  denote recovery periods.

Within this framework, various aspects of resilience can be investigated by imposing restrictions on parameters and testing whether these restrictions are permitted. Following Fingleton *et al.* (2012), we can test, for example, whether the impact of shocks is constant over time for each region, ( $b_{1i} = b_{2i} = \dots = b_{ni}$ ), whether a given shock has the same impact across  $k$  regions ( $b_{11} = b_{12} = \dots = b_{1k}, b_{21} = b_{22} = \dots = b_{2k}$ , etc.), whether for each region the post-shock recovery is constant over time ( $b_{n+1i} = b_{n+2i} = \dots = b_{n+mi}$ ), or whether for a given

shock the post-shock recovery is the same across regions ( $b_{n+2,1} = b_{n+2,2} = \dots = b_{n+2,k}$ ,  $b_{n+1,1} = b_{n+1,2} = \dots = b_{n+1,k}$ , etc.).

Doran and Fingleton (2016) approached the regional resilience issue from yet another perspective. They use individual-level data from the European Social Survey (ESS) combined with regional economic statistics. This modelling approach leads to calculating a resilience index:

$$r_{it} = \hat{E}_{it} - \bar{E}_{it} \quad (5)$$

The index is a simple difference between an individual's 'observed' (estimated) probability of employment  $\hat{E}_{it}$ , which accounts for a predefined shock, and the individual's probability of employment assuming there is no shock  $\bar{E}_{it}$ . The  $r_{it}$  resilience index is subsequently used as a dependent variable in regional equations capturing its possible determinants. Also, Giannakis and Bruggeman (2017) constructed resilience indicators, although their values depended on the relative performance of regions in the neighborhood of a shock.

The least progress so far has been in operationalizing the evolutionary approach. To our knowledge, the only contribution in this field comes from Duschl (2016). This paper analyzed firm dynamics and compared their distributional properties across different regions. Interestingly, a somewhat similar dataset to the one we plan to utilize is used for this study (*i.e.* combined firm-level data from the Amadeus database and regional data). The main idea of the paper was to estimate the parameters of an asymmetric exponential power density (Bottazzi and Secchi 2011), which accounts for normally distributed growth rates and fat-tailed distributions of growth events. It is the sum of the two shape parameters that are used to approximate regional resilience (Napoletano and Nesta 2016). The estimated distributional parameters are subsequently regressed on regional factors, related to industrial variety and availability of a skilled workforce.

The results (obtained for German regions) are indeed encouraging and the methodology itself might be considered a starting point to operationalize the type IV resilience. More specifically, quantifying type IV resilience requires that evidence is found of a structural break occurring much earlier than when the forming of a shock or a crisis hits and subsequently less impact from the crisis. The Duschl's approach would need to be adjusted to accommodate variables shifted in time.

## Conclusion

This paper explicitly introduces the concept of forward-looking, or anticipatory (type IV) regional economic resilience and emphasizes that it should be investigated with tight links to structural dynamics. First insights from the Polish NUTS-3 regions suggest that structural changes undertaken before the shock might have a negative effect on economic resistance. However, there could be a positive impact of structural adjustments to recoverability, *i.e.* the second "part" of resilience.

We believe that there is immense research potential for empirical studies on type IV resilience, although its operationalization admittedly requires further work on developing adequate toolbox. In any case, the evolutionary approach seems best suited for investigating this phenomenon, since interplays between agents at the local level are probably crucial for developing forward-looking perspective of local and regional economic systems and insurance mechanisms against possible adverse, exogenous shocks.

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