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# The Economic Resilience of the Austrian Agriculture since the EU Accession

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**Abstract:** Ensuring sustainable and economically viable agriculture requires economic resilience before, throughout, and after a shock. This paper studies the economic resilience of Austrian agriculture within the period of 1995 to 2019. However, methods for tracking changes in economic resilience have so far seen only limited application in agriculture. The index for the analysis and measurement of economic resilience is based on four areas: financial flexibility, stability in following the development path, diversification of activities, and diversification of export markets. As results show, Austrian agriculture is of interest because of the very high level of economic resilience, ranging from 0.83 to 0.92 in the period researched, thereby displaying a high capacity to absorb shocks. Generally, these results indicate that Austrian agriculture is forgiving of shocks and thus very economically resilient. These results provide context for developing generalizations on economic resilience in agriculture and its fundamental function for producing effective food security within a sustainable transition path. Some concluding suggestions propose possible future areas of research.

**Keywords:** economic resilience; agricultural sector; index; Austria

## 1. Introduction

Due to changes in economic and political conditions, societal demands, and technological innovations, the Austrian agricultural sector has been exposed to fundamental changes in the last decades. The most fundamental change was the accession to the European Union (EU), i.e., its markets and competition were affected by the Common Agricultural Policy (CAP). The share of the agricultural sector in the Austrian economy has been steadily declining. The share of agriculture in the total gross value added of the economy currently fluctuates around 1%, whereas, in 1995, it was 1.9%, and in 1976, it was 4.5% (Quendler et al. 2016, p. 303). Agriculture plays an important role for Austria's economy, going far beyond the production of food, in that it has a positive impact on other industries. The Austrian agricultural sector also continues to exhibit its important historic environmental, social, political, and societal significance. Austrian agriculture is exposed to fluctuations in demand, e.g., based on government interventionism (e.g., export bans to Russia), seasonality, weather conditions (e.g., droughts and floods), price fluctuations, and diseases at regional and global level (e.g., swine or bird fever and COVID-19), as well as technological innovation. Therefore, from the economic point of view, the agricultural sector must be sustainable not only under average conditions in the long run, but it also must be resilient during times of extreme shocks.

In anticipation of future times of extreme shocks, we add lack of resilience as an important constraint to agricultural sustainability. In 2015, van Wyk (2015) advocated for a paradigm shift from an emphasis on sustainability to be supplanted by resilience in the ongoing process of transition. For

the OECD (2017), "economic resilience" has become a guiding principle in the context of economic research. This is based on the idea that resilience is of particular importance to an imbalanced or unstable economic system. We contend that resilience is not an alternative to sustainability, but, instead, is an essential aspect or characteristic of sustainability. Resilience is defined as the ability of an economy to withstand shocks and reduce the probability of further deep shocks or at least to mitigate the effects of a shock (Morkūnas et al. 2018). The concept of economic resilience may offer a potential framework to overcome shocks and to enable sectoral development in a sustainable way. Moreover, it provides a new perspective on the agricultural sector by building economic resilience and adaptive capacity within the system. The focus is not on the attempt to control the sector and the system for stable optimal production and short-term economic gain. It is alleged that the ability with which individuals, companies, sectors, policy, NGOs, and international trading bodies function, withstand shocks, and return to a stable state after major negative impacts of external shocks is essential for a long-run transition to sustainability (Bailey and De Propris 2014; Quendler 2017). An economically resilient agricultural sector is essential, as it contributes to the ongoing viability of the economy and the wider community (cf., McManus 2008). In this sense, economic resilience reflects the financial strength and stability of the sector, including the economic vitality and diversity of the system in which it operates, the supply chain that it rests on, and the markets that it serves (cf., Found and Rich 2006; UNDP 2015, p. 4).

There has been an increasing number of analyses (country, region, province, city, local labor market, neighborhood, etc.) on how shocks effect economic resilience (cf., Hallegatte 2014; Modica and Reggiani 2015). They suggest ways to combat a shock, touch on how the economic system in general could react in the long-term, and discuss the role of the state, i.e., policy. To explain the resilience of the agricultural sector, the literature has examined the relationship between economic resilience based on gross value added, intermediate consumption, financial capital deviations in income, export orientation, and diversification (Andersen et al. 2014; Angeon and Bates 2015; Hallegatte 2015; Gößling-Reisemann 2016; Noy and Yonson 2016; Rose and Krausmann 2013; Swamy 2019).

In this context, the question of what constitutes the economic resilience of an agricultural sector and how is it assessed or measured is currently coming to the fore. This paper is guided by the research question of how Austrian agriculture has performed after the accession to EU in terms of economic resilience. In order to assess the economic resilience of Austrian agriculture, an index which measures resilience of the agricultural sector was calculated. The data were taken from the Economic Accounts for Agriculture (EAA) (Statistics Austria 2020a), Austrian foreign trade (Statistics Austria 2020b) and OECD.Stat (OECD 2020) for the statistical analysis and econometric modeling. This paper expands on previous work on economic resilience by Morkūnas et al. (2018). It is one of the first papers devoted to investigating economic resilience in the Austrian agricultural sector. This paper is more theoretical in nature, although it gives some insights to policy makers to strengthen support policy in order to avoid the shocks of 2008 and 2013. However, it was recognized at the outset that the subject is complex and multifaceted and, thus, that this paper would probably touch on many areas worthy of future separate research beyond its scope. This notwithstanding, this paper is intended as a contribution to increase understanding of economic resilience. Moreover, it contributes toward the development of a unified model of an economically resilient agricultural sector, to help embrace and manage change effectively (Bontoux and Bengtsson 2015; cf., EC 2019) within a transition to a more sustainable EU economy.

In the following section, the paper first explores definitions of economic resilience and gives an overview of indicators of economic resilience in agriculture. Section 3 outlines the method employed, summarizes the data collected, and shows the rationale of their selection. Section 4 presents the results for Austrian agriculture for the period 1995 to 2019 and provides insights into the reasons for its dynamics. Section 5 concludes with a look at further research needs and a word of caution relating to the interpretation of results. This paper complements the research on economic resilience of agriculture (e.g., Lin 2011; Pant et al. 2014; Webb et al. 2017; Wairiu 2017; Birthal and Hazrana 2019)

and may help to frame our overall understanding of evolutionary resilient pathways and sustainable transitions in the agricultural sector.

## 2. Theoretical Background

The resilience[1] concept has a long tradition in some disciplines (especially in psychology and ecology, and economics). In sectoral research, economic resilience is relatively new; it has been a key subject of research for the last decade. This section discusses the term "shock", within the concepts of transition and sustainable development, addresses the concept of economic resilience, and outlines its application in agriculture through a literature review.

### *2.1. Shocks and Sustainable Transition*

Nothing challenges an agricultural sector like a shock. Zseleczky and Yosef (2014, p. 1) defines shocks as "external short-term deviations from long-term trends, deviations that have substantial negative effects on people's current state of well-being, level of assets, livelihoods, or safety, or their ability to withstand future shocks". They identified five types of shock: conflicts (state-based, non-state, and one-sided violence), natural disasters (droughts, floods, hurricanes or cyclones, and earthquakes), climate change, food and price volatility, and health crises.

In highly volatile and uncertain times, a sector is frequently confronted with such extreme and, most of the time, unexpected or unforeseen shocks. These shocks can profoundly change the economic equilibrium or homeostasis of the sector. In the context, these changes or a series of changes may severely compromise the operation or disrupt the economic performance and well-being of the sector (cf., Rose and Krausmann 2013). These changes can be idiosyncratic in nature, e.g., financial crises, diseases, society crises, or the impacts of extreme weather conditions. On the other hand, they can also be structural, i.e., affecting the whole sector or only a branch of a sector (e.g., dairy), through policy reforms. A resilient agricultural sector withstands shocks, such as volatile markets and erratic weather events, and adapts to changing circumstances and societal requirements, as well as general demographic trends (Meuwissen 2018). With regard to the management of shocks, the CAP includes changes of intervention prices and risk management measures over time, but also deals with the provision of ad hoc disaster aid (Meuwissen 2017, p. 6). The European Commission considers improving the resilience of the agricultural sector in order to achieve the objectives of the CAP (Meuwissen 2018).

Within the evolutionary economy, researchers, in particular, have asserted that resistance to and recovery from shocks may be a consequence of its previous growth path (Martin and Sunley 2015). This path coins a transition process. Ideally, the sector in transition has to be resistant to external and internal shocks in the short-term and have the ability to refocus on a sustainable transition after the shock—even after the passage of decades (or centuries) (cf., Olsson et al. 2014). The transition toward more sustainable economies and sectors is a central challenge of our time. As sustainability is the more comprehensive concept, resilience represents a necessary but not sufficient condition for sustainability. In the sustainability science discourse (cf., van Wyk 2015; OECD 2017), transitions have purposely been associated with Sustainable Development Goals (SDGs) (Markard et al. 2016). Several of the goals are directly related to building resilience to extreme shocks in relation to economic, social, environmental, and also cultural issues (UN 2018). Thereby, sustainability transitions can be defined

[1] The resilience of a sector is not to be equated with its vulnerability. "Vulnerability" is the broader term. Vulnerability encompasses the extent to which a system is prone to crisis (Rose 2004); thus, it is minimized through successful crisis-prevention measures. Furthermore, lower moving economic, ecological, social, and demographic stressors create vulnerability, which in turn can have long-term consequences by reinforcing pre-existing vulnerabilities. By contrast, the degree to which resilience has been achieved can be assessed only with respect to a crisis. A system in which crisis-prevention measures have been successfully carried out reduces its vulnerability. However, it does not necessarily thereby improve its resilience (in the case in which the now-less-probable crisis disruptive change nevertheless takes place). Note that it is not the increase in shocks that creates vulnerability, but rather the decline in coping and adaptation mechanism for facing and surviving (cf., Kirby 2006).

as "long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption" (Markard et al. 2012, p. 956; Bontoux and Bengtsson 2015; cf., Bontoux and Bengtsson 2015, EC 2019). In order to meet the post-2015 development goals, cf. 2030 Agenda for Sustainable Development one global target of the Sendai Framework is a reduction in economic losses in relation to global GDP (UNSDIR 2015, p. 12). In this context, Ranger and Surminski (2013, p. 3f) have proposed to reduce economic losses by 20% and to develop an operational framework for monitoring resilience, using economic indicators. Beyond focusing on economic indicators, a clear comprehensive metric system should also include social, environmental, and governance systems as a prerequisite, in development efforts at all levels of the SDGs (Bhamra 2015). There appears to be a lack of studies explicitly discussing the role of economic resilience in the sustainable transition of specific sectors. According to Sondermann (2017) "economic resilience is essential to better withstand adverse shocks and reduce the economic costs associated with them". Furthermore, there is a potential for conflict between economic efficiency or productivity and sustainable transition, e.g., an increase in gross domestic product (GDP) can, and often does, conflict with building social and ecological resilience (cf., Greenham et al. 2013).

### *2.2. Defining Economic Resilience*

Today, all economic fields have generally adopted the concept of resilience. Given the breadth of the disciplinary origins and despite the growing importance of the idea of economic resilience, the conceptual framing and clarity of the notion of economic resilience remains the subject of considerable academic debate (Boschma 2014; Martin and Sunley 2015; Bristow and Healy 2018). Furthermore, the concept has been approached in many different ways by many different economists. Martin (2012) describes how resilience is embedded in the broader economic literature as a fuzzy concept (Markusen 1999), whereas Swanstrom (2008) thinks of resilience as more than a metaphor but less than a theory, or, in other words, as a conceptual framework.

There is much ambiguity and difference of view as to the precise meaning of the notion and interpretation of economic resilience (Table 1), how it should be measured, whether resilience is a positive or negative attribute, and what it implies for policy intervention (Hill et al. 2008). According to Simmie and Martin (2010), the focus of economic resilience seems, on the one hand, to be an analysis of the speed with which a system returns to its pre-shock condition (cf., engineering resilience), and on the other hand, the capacity of a system to reach new possible equilibria (cf., ecological resilience). In this research on economic resilience, we focus on the capacity of a system to absorb external shocks and use any new possibilities (cf. Duval et al. 2007; Hill et al. 2008; Briguglio et al. 2009; Martin 2012; Tan et al. 2017; Morkūnas et al. 2018) that shocks provide to achieve a continuing transition to sustainability. It is aimed at measuring the potential of the sector researched to stay on an earlier predetermined development path or to exploit possibilities arising. It does not, however, use the speed of recovery as a measure of resilience.

Economic resilience is undoubtedly of interest in the current era of globalization, regional democratization, instability, and uncertainty, where small or extreme shocks can induce new unpredictable dynamics in economic systems because of the high level of network connectivity among all their subsystems. In sum, the equilibrium or stability notions, as well as the uncertainty and unpredictability of current economic phenomena in an economy, not only reinforce the importance of the concept of economic resilience but also call for a greater emphasis on the investigation of economic resilience in economics, especially in agriculture.

**Table 1.** Selected definitions of economic resilience over time.

| Year | Author | Definition—Economic Resilience |
|---|---|---|
| 2007 | Duval et al. | "may be loosely defined as the ability to maintain output close to potential in the aftermath of shocks. Hence, it comprises at least two dimensions: the extent to which shocks are dampened and the speed with which economies revert to normal following a shock" (p. 6) |

| | | |
|---|---|---|
| 2008 | Hill et al. * | "the ability to recover successfully from shocks to its economy that either throw it off its growth path or have the potential to throw it off its growth path" (p. 4) |
| 2009 | Briguglio et al. * | "refers to the policy-induced ability of an economy to recover from or adjust to the negative impacts of adverse exogenous shocks and to benefit from positive shocks. The term is used in two senses in this paper, respectively relating to the ability to: (i) recover quickly from a shock; and (ii) withstand the effect of a shock" (p. 5) |
| 2012 | Martin | "the capacity of an […] economy reconfigure, that is adapt, its structure (firms, industries, technologies and institutions) so as to maintain an acceptable growth path in output, employment and wealth over time" (p. 10) |
| 2017 | Tan et al. | "should be conceptualized as (1) the long-term capacity … to develop new growth paths such as new industries or technological breakthroughs; and (2) the capacity to resist and recover from short-term shocks; and (3) the relationship between the two meanings of resilience, that is, how shocks affect the capacity to develop new growth paths" (Carpenter et al. 2005; Simmie and Martin 2010; Davoudi et al. 2009; Boschma 2014). (p. 472) |
| 2018 | Morkūnas et al. | "of a state, region, economic sector or other type of economic system can be defined as the ability to maintain a pre-existing state (usually assumed to be an equilibrium state) or return to it very quickly, typically, acquiring new abilities, after being affected by some type of exogenous shock" (p. 323)* |
| | | There are authors (Barthel and Isendahl 2013; Tidball and Stedman 2013; Farley and Voinov 2016) who research resilience as an ability of the economic system being able to avoid being pulled out of its previous equilibrium state by an exogenous shock. This could be achieved in two ways: having the ability to avoid external perturbations (by producing goods or services that are unlikely to be subject of negative external demand shock, etc.) or maintaining the capacity to withstand the impending external shock with little or no negative impact (by producing a wide range of goods sold in different markets, or having broadly diversified economic activities, the possible external shock has little adverse effect). (p. 323) |
| | | Authors such as Tonts et al. (2014), Williams and Vorley (2014), and Boschma (2015) "perceive economic resilience from the path-dependence perspective. The concept of path-dependence, sometimes called a 'historical lock-in', assumes that an economic system has more than one equilibrium and that not all of it is efficient enough (regardless of the fact that the static or dynamic state of resilience is being researched). Due to the gamut of the decisions and actions taken during a period of time, an economic system can find itself 'locked into' a degree or growth path that is not optimal (Hill et al. 2008; Modica and Reggiani 2015). It offers a notion of economic resilience in which resilience is understood as a capacity of an economic system to avoid being locked into such a suboptimal equilibrium or, if it became, to transform to a more efficient equilibrium quickly and spatially" (p. 323) |

Source: own work. Note: * This attitude toward economic resilience can be called static economic resilience or adaptive economic resilience. In this scenario, an economic system, as an entity, takes no action to avoid being thrown out of the equilibrium state and relies on the flexibility to minimize the negative consequences of the impending exogenous shock (Morkūnas et al. 2018, p. 322).

> Furthermore, the system, either in anticipation or as a reaction, undergoes a reorganization of form and/or function in order to minimize the impact of a destabilization (Martin 2012, p. 6).

It is quite evident that the definition of resilience has become more concrete over time as shown in Table 1. Looking at these definitions, we see there are various factors which contribute to the potential for a system to be resilient. Taken from the definitions, these factors include the choice of product or service, the diversity of product and service, the diversity of the market (cf., second definition by Morkūnas et al. 2018 in Table 1) and the inflexibility of a system (cf., third definition by Morkūnas et al. 2018 in Table 1). It is also clear that these factors involve both the supply and the demand sides of any sector. Correspondingly, measuring resilience should include indicators geared to all aspects of these definitions and should realize that a level of resilience is only achieved through a combination of these factors. Since it is impossible to predict entirely the type and nature of any shock, especially in the case of agriculture, any indicator set chosen can serve only as a proxy for an assumed level of resilience.

### *2.3. Measuring Economic Resilience in Agriculture: A Selection of Indicators*

The literature on measuring economic resilience can be divided into three streams: studies based on a qualitative research design (Williams et al. 2013), papers which use a mix of qualitative and quantitative data (Vugrin et al. 2011; Evenhuis 2020), and papers based on purely quantitative approaches, which, in turn, can be divided into investigations that (i) typically use some artificial proxy indices for measuring economic resilience (Faggian et al. 2018), (ii) draw conclusions from a trend analysis (Sensier et al. 2016), or (iii) create indices for measuring this fuzzy concept (Briguglio et al. 2009; Rose 2017). We follow the latter approach by selecting the most suitable indicators for assessment of the economic resilience level of a state's agricultural sector. It should be noted that we selected indicators which help to measure and promote a system's economic resilience, without regard for the implications for its stagnation (Mühlemeier et al. 2017).

Xu et al. (2011), measuring economic resilience of the US economy, proposed to investigate the link between general output and intermediate consumption as one of the indicators of economic resilience. The relationship between revenues and intermediate consumption in defining economic resilience was explored also by Hallegatte (2015). Intermediate consumption and financial capital are among the variables comprising the Dormady et al. (2019) economic-resilience measuring index. This ratio between output levels and intermediate consumption was also exploited to measure resilience in agriculture. Andersen et al. (2014) employ this ratio in assessing the resilience level of agricultural sectors of selected Latin American countries.

The ability to follow a predetermined development path is considered as one of the features of a resilient economic system (Wink 2014). In the economic-resilience concept, a main focus is on the stability of financial flows (Masik and Rzyski 2014). Deviations in income levels as one of the measurements of economic resilience are mentioned by Angeon and Bates (2015), Noy and Yonson (2016), Swamy (2019). The absences of extreme fluctuations and significant deviations from the predetermined development path are also viewed as main indicators of resilience in agricultural systems (Elgersma et al. 2018). Cabell and Oelofse (2012), while researching agroecosystems' resilience, pointed out the reasonable profit which should be generated in resilient agricultural systems. This dimension is of utmost importance when investigating agricultural resilience, as agriculture is a unique and susceptible ecosystem, combining people, machinery, land, and climate, where the latter two play a major role in generating output (Čiegis 2009). Increasingly high profits in agriculture, compared to other sectors, may be followed by overinvestment, which in turn, leads to overexploitation of production capacity, land degradation (Webb et al. 2017; Wairiu 2017), decreasing quality of life in rural regions (Volkov et al. 2019a), and lowering the long-term resilience level (Kosmas et al. 2016). Unreasonably low profit may lead to a migration of skilled workers to other sectors of the economy (Giannakis and Bruggeman 2017) and insufficient investment in machinery and land conservation, which in turn affect yields harvested, decreasing the economic viability and resilience of farms (Ringwood et al. 2019). This unusual economic situation where extremely high

profit is not considered an absolute positive factor motivates us to include an indicator measuring deviation of income levels between agriculture and the whole economy into our research.

Doorn (2017) stresses the importance of a vulnerability facet in defining and measuring resilience. For this purpose, an agricultural sector is faced with shocks, carrying various vulnerability facets, e.g., extreme weather conditions, price fluctuations, export customer monopolization, etc. The dependence on a few main customers is seen as a main factor in increasing vulnerability values by Svensson (2004). This was augmented by Gößling-Reisemann (2016), who emphasized the focal position of diversification in building resilience capacity. Trade related diversification indicators are significantly more important in defining the economic resilience of agriculture, as compared to other economic sectors (Pant et al. 2014). The diversification of export customers is important in defining agricultural economic resilience on a micro level also. The nature of export markets is one of revealed focal indicators of farms resilience in Blesh and Wittman (2015) study. Seufert et al. (2019) indicates the risks to agricultural production arising from the lack of diversification in customers' portfolio. Diversification of clients is among the most important economic resilience measurement indicators in the Michel-Villarreal et al. (2019) study on agri-food systems.

The high diversification of activities is seen as a prerequisite for flexibility in absorbing the arising possibilities (Broekaert et al. 2016). This, in turn, is considered to be one of the focal points in building adaptive economic resilience (Yu et al. 2018). The diversification of economic activities is also considered fundamental in building passive economic resilience (Dinh and Pearson 2015), which acts as a disturbance-absorption mechanism by dampening the external disruptive changes through the ability to more easily reallocate resources from less profitable to more profitable activities/products/services. Although it requires high entrepreneurship levels of researched economic sector to fully exploit the potential of diversification in building economic resilience (Kitsos and Bishop 2018), industrial diversity is widely accepted as an indispensable component of sectoral economic resilience (Rose and Krausmann 2013; Williams and Vorley 2014; Di Caro 2017). This is typical also at a microeconomic level (Graveline and Gremont 2017). The general diversification of activities is considered necessary for enhancing the economic component of resilience by Psycharis et al. (2014) and Sharifi and Yamagata (2016). This feature is also characteristic of resilience in the agricultural sector. The diversification of crop varieties as a component of agricultural resilience was researched by Lin (2011), Birthal and Hazrana (2019). This argument is augmented by Seo (2010), who showed the increase in resilience indicators of integrated farms compared to specialized entities. De Roest et al. (2018) showed the vulnerability of regions growing only a few crop varieties, thus confirming the relevance of diversification in a macro-economic perspective of economic resilience. Kremen et al. (2012) exploited this view in a micro-economic approach, suggesting diversification of activities on the farm level, in order to enhance the latter's resilience. Makate et al. (2016) findings support this scientific view, substantiating the inclusion of an indicator on the diversification of crops cultivated in our study. Due to the abovementioned increased scientific focus on diversification in researching the resilience concept, we included two different types of diversification into our economic resilience index of agricultural sector—namely diversification of agricultural activities and diversification of export markets served.

We distinguish between the diversification of export customers served and diversification in agricultural activities because of their different nature and limiting constraints. The increasing export diversification can be achieved by improved management techniques and sales personnel's skills (Shaver 2011) and has quite low external constraints due to Austria's favorable position as an EU Member enjoying advantageous international trade terms. It appears more difficult to increase the diversification of agricultural activities, as limitations, such as climate conditions, soil quality, etc., exist.

## 3. Materials and Methods

Based on the literature on economic resilience, this section describes, in more detail, a quantitative research methodology that can be used to operationalize the concept and assess the determinants of economic resilience of the agricultural sector. It is hypothesized that elements of

resilience in the agricultural sector can be found in the following areas: *financial flexibility, stability in following the development path, diversification of activities,* and *diversification of export markets.*

First of all, we calculated the values for individual indicators, from which the index $(ER, 7)$ is being composed.

*Financial flexibility* ($C_{ai}$) is about the costs of additional revenues, expressed as a ratio between general output ($G_O$) and intermediate consumption ($I_C$), as follows:

$$X_1: C_{ai} = G_O/I_C \quad (1)$$

where $G_O$ is the general output, and $I_C$ is the intermediate consumption (Morkūnas et al. 2018).

The *stability in following the development path* ($R_{in}$) (Perrings 1994) can be expressed as the ability of a sector to provide a reasonable income compared to the whole economy ($R_{in}$), as defined by Morkūnas et al. (2018). It is a composite indicator that is given by (2):

$$X_2: R_{in} = \frac{\frac{Pgc}{Cgc}}{\frac{Pga}{Cga}} * 100\% \quad (2)$$

where $P_{gc}$ is the production (gross value added) growth in a country, $C_{gc}$ is the average wage growth in a country, $P_{ga}$ is the production (gross value added) growth in agriculture, and $C_{ga}$ is the average wage growth in agriculture.

In calculating this indicator, we follow Balk (2009). We consider a range between [−10% and 10%] as healthy and desirable, providing required resources (educated labor force, investment etc.) at a sufficient level, without any implications to overexploitation of land or preconditions for diminishing outputs. We consider intervals between [−20% and −10%] and between [10% and 20%] to be acceptable; ranges from [−35% to −20%] and from [20% to 35%], we consider barely acceptable; other ranges are treated as unacceptable from the point of agricultural resilience. If the calculated $R_{in}$ indicator's value falls into the desirable range, it gets 100% of the indicators weight in economic resilience index calculation for the respective year (i.e., 0.25); if it is an acceptable interval, it receives 67% of the allocated weight (i.e., 0.1675); if the calculated value is in a range which is barely acceptable, it gets 40% of the possible score (i.e., 0.1); and if it is in an unacceptable range, it get 0%.

*The diversification of activities ($D_A$)* is an adapted composite indicator (Carter 1998; Barnes et al. 2015) which comprises 65% by the number of agricultural activities covering no less than 2.5% and no more than 25% of the whole agricultural output (maximizing indicator) ($D_B$) and by 35% by the number of agricultural activities comprising more than 25% of agricultural output (minimizing indicator $D_S$). It is expressed as follows:

$$X_3: D_A = 0.65D_B + 0.35D_S \quad (3)$$

where $D_B$ and $D_S$ are expressed as follows:

$$D_B = N_{sm}/N_{Al}$$

$$D_S = N_L/N_{Al}$$

where $N_{sm}$ is the number of agricultural activities covering no less than 2.5% and no more than 25% of the whole agricultural output; $N_{al}$ is the number of all agricultural activities; and $N_L$ is the number of agricultural activities comprising more than 25% of agricultural output.

The higher importance of a number of various diversified agricultural activities in agricultural sector compared to a more specialized model is defined by the fact that small and medium enterprises are the backbone of every economic sector (Asheim et al. 2003; Farah and Supartika 2016), displaying higher flexibility and adaptability—one of some prerequisites for increasing resilience.

*The diversification of export markets ($D_{em}$)* is also a composite indicator which equally comprises the number of export markets ($N_{em}$, maximizing indicator) and the number of risky markets (minimizing indicator), as defined by (Morkūnas et al. 2018). We define risky markets as those which comprise more than 10% of overall exports. It is calculated as follows:

$$X_4: D_{em} = (N_{em} + R_m)/2 \quad (4)$$

where $N_{em}$ is the total number of countries where agricultural and food products of Austrian origin are exported $R_m = EX_r/EX_t$. Here, $EX_r$ is the value of the products exported to these markets, and $EX_t$ is the number markets products exported to.

We do not assess the political or legal situation of the export markets in this model. We consider all export countries as foreign markets, not paying attention to if they belong to some international economic/trade blocks (e.g., EU, NAFTA, Mercosur, etc.) or not, as a resilience measuring index is more important during a crisis time. Moreover, as the COVID-19 pandemic showed that, during crisis, even the countries belonging to the closest economic cooperation groups (EU) may impose various restrictions to international movements of goods for a period of time.

The complete set of indicators is presented in Table 2. The indicators over the period 1995 to 2019 are shown in Table 3.

**Table 2.** Indicators used in an assessment of economic resilience of Austrian agriculture.

| No. | Indicator | Character | Interpretation |
|---|---|---|---|
| 1 | Financial flexibility ($X_1$) | maximizing | bigger is better |
| 2 | Stability in following the development path ($X_2$) | Zero objective | 0 is the best |
| 3 | Diversification of activities ($X_3$) | | |
| | 3.1. Number of agricultural activities comprising less than 2.5% | maximizing | bigger is better |
| | 3.2. Number of agricultural activities comprising more than 25% | minimizing | smaller is better |
| 4 | Diversification of export markets ($X_4$) | | |
| | 4.1. Number of export markets | maximizing | bigger is better |
| | 4.2. Number of risky markets | minimizing | smaller is better |

Source: own work. Note: We used data from the following sources. The data to calculate the financial flexibility ($G_O$, $I_C$) and diversification of activities for the period 1995 to 2019 were extracted from the Economic Accounts for Agriculture (EAA) dataset maintained by Statistics Austria (2020a). This EAA dataset provides parameters and indicators for assessing the economic situation of the agricultural sector (Statistics Austria 2020d). The data for the calculation of the stability in following the development path for agriculture ($P_{ga}$, $C_{ga}$) comes from the EAA (Statistics Austria 2020a) and for the economy ($P_{gc}$, $C_{gc}$) as a whole from OECD Stat. (OECD 2020). To quantify the diversification of export markets ($N_{em}$, $EX_r$, $EX_t$) we rely on the Austrian foreign trade data (Statistics Austria 2020b).

**Table 3.** Indicators used for computing economic resilience (ER).

| Indicators | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Volatility of revenues | 0.95 | 0.97 | 0.94 | 0.94 | 0.94 | 0.96 | 0.97 | 0.94 | 0.94 | 0.96 | 0.90 | 0.93 | 0.96 | 0.92 | 0.80 | 0.89 | 0.91 | 0.89 | 0.84 | 0.86 | 0.87 | 0.90 | 0.93 | 0.98 | 0.99 |
| Stability in following development path | 0.80 | 0.73 | 0.78 | 0.82 | 0.78 | 0.74 | 0.69 | 0.72 | 0.71 | 0.64 | 0.77 | 0.74 | 0.66 | 0.72 | 0.56 | 0.72 | 0.70 | 0.71 | 0.63 | 0.80 | 0.83 | 0.76 | 0.65 | 0.64 | 0.70 |
| Diversification of activities | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99 | 0.96 |
| Diversification of export markets | 0.74 | 0.78 | 0.81 | 0.76 | 0.79 | 0.78 | 0.82 | 0.86 | 0.87 | 0.87 | 0.88 | 0.93 | 0.94 | 0.96 | 0.96 | 0.95 | 0.99 | 1.00 | 0.97 | 0.98 | 0.98 | 0.98 | 1.00 | 0.98 | 0.99 |

Source: own work.

We allocate equal weights to all researched indicators ($\omega_{ni}$ = 0.25), as we construct an index of various multidimensional indicators, whose values are fluctuating in time and are incomparable to each other. The SAW (Simple Additive Weighting) method was used in order to calculate the index. SAW is a very well-known and commonly used method (Hwang and Yoon 1981; Deni et al. 2013). It is praised for its simplicity in application and very high accuracy of results, which show no significant changes in values and ranks compared to other frequently used MCDMs, such as TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) (Yeh 2002), WP (Weighted Product) (Zhou and Ang 2009), CPI (Composite Performance Index) (Karlitasari and Suhartini 2017), etc. In this case a determination of equal weights is recommended (Šimanskienė et al. 2011). This is also supported also by Huggins (2003), who stated that different weights only marginally affect the final values and ranks of researched items but may lead to accidental errors in calculations (Thompson 2011). The select indicators were normalized (OECD 2008) for the calculation of the economic resilience (*ER*) index. The normalization procedure formula by Hwang and Yoon (1981) was applied:

$$\bar{r_{ij}} = \frac{r_{ij}}{\max\limits_{j} r_{ij}} \tag{5}$$

The conversion of minimizing indicator (number of agricultural activities comprising more than 25% of agricultural output and number of risky markets) to maximizing was done by using the following formula (Hwang and Yoon 1981):

$$\bar{r_{ij}} = \frac{\min\limits_{j} r_{ij}}{r_{ij}} \tag{6}$$

where $r_{ij}$ is the value of the *i*th indicator for the *j*-object (in this case, year), $\max\limits_{j} r_{ij}$ is the maximum value of the *i*th indicator of all the alternatives (years), and $\min\limits_{j} r_{ij}$ is the lowest value of the *i*th indicator.

The economic resilience index of agriculture (*ER)* can be described as a sum of the normalized values weighted for all four indicators and should lie between 0 and 1. *ER* is calculated for each year by using the following formula:

$$ER = \sum_{\mathrm{i=1}}^{\mathrm{m}} \omega_{ni} \tilde{\mathrm{r}}_{\mathrm{ij}} \tag{7}$$

In order to ensure the robustness of our results, we conducted a sensitivity analysis. Although there are lots of sensitivity analysis techniques suitable for the SAW method (Memariani et al. 2009; Simanaviciene and Ustinovichius 2010; Alinezhad et al. 2014), we have chosen a variance-based sensitivity analysis technique proposed by Saltelli et al. (2004) which is based on Sobol method. In this case, two sensitivity measures are being taken into account, the first-order sensitivity index, $S_i$, and the total-sensitivity index, $S_{Ti}$. They are defined by (8) and (9):

$$S_i = \frac{V_{x_i}\left\{E_{x_{-i}}(d|X_i\right\}}{V(d)} \tag{8}$$

where *I* is the number of inputs.

$$S_{Ti} = \frac{V(d) - V_{x_{-i}}\left\{E_{X_i}(d|X_{-i}\right\}}{V(d)} \tag{9}$$

where *I* is the number of inputs.

The results of sensitivity analysis are presented in Table 4. These results show almost negligible values of the third and fourth indicators (namely diversification of activities and diversification of export markets). The first two indicators (financial flexibility and stability in following the development path) show an existing although small possible influence in the potential deviation of index measuring the economic resilience of Austrian agriculture. Such small values of first-order and total-sensitivity indices (Zhou and Ang 2009) allow us to consider the results of our model sufficiently

robust. These results go along with Zavadskas et al.'s (2007) findings about the significant insensitivity of the SAW method to the modifications in criteria weights.

**Table 4.** Sobol's first-order and total-sensitivity indices.

| Input Factor | Standard Deviation | $S_i$ | $S_{Ti}$ | $S_{Ti} - S_i$ |
|---|---|---|---|---|
| Indicator 1 ($X_1$) | 0.2413 | 0.04 | 0.11 | 0.07 |
| Indicator 2 ($X_2$) | 0.2247 | 0.21 | 0.49 | 0.28 |
| Indicator 3 ($X_3$) | 0.2208 | 0.00 | 0.07 | 0.07 |
| Indicator 4 ($X_4$) | 0.2192 | 0.00 | 0.03 | 0.03 |
| **Sum** | | 0.25 | 0.7 | 0.45 |

Source: own work.

## 4. Results and Discussion

The evolution of economic resilience index values of the Austrian agriculture is shown in Figure 1.

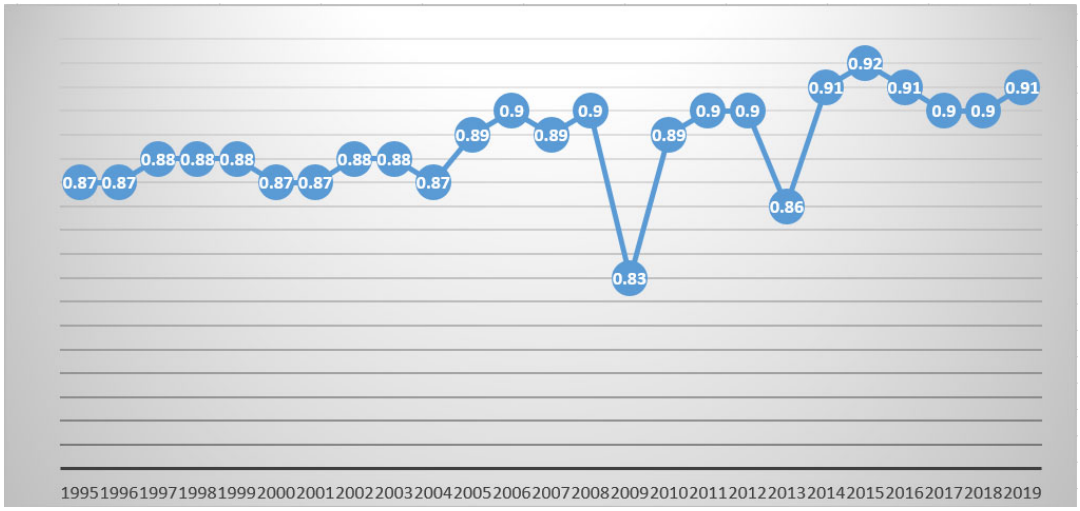


**Figure 1.** Values of agricultural sector's economic resilience index from 1995 to 2019, Austria. Source: own work.

By analyzing the results of economic resilience of Austrian agriculture, we can observe its very high values throughout the whole period, ranging from 0.83 to 0.92. It indicates the maturity and very high development level of the economic sector researched (Wang 2019). The overall trend shows a slight but steady increase in the values of the economic resilience index, confirming the positive transition, despite some deviations. There are two extreme negative fluctuations and also some light ones. These fluctuations show the degree of vulnerability in the case of shocks and the latter's impact on the level of economic resilience.

The first extremum is in the year 2009. It can be attributed to the world's financial crisis. It should be noted that this demand shock does not really affect the indicators. When measuring the values of resilience of Austrian agriculture, which still demonstrates outstanding results, the significant decrease in the economic resilience index is due to changes in the second indicator, showing deviations from the overall development path. Moreover, the other sectors of the Austrian economy showed in the year 2009 a significant drop in output, cf., 6.60% in secondary and 0.11% in tertiary sectors (Statistics Austria 2020c). Although agriculture retained its very high-resilience results, a gap occurred between the development paths of agriculture and the other economic sectors which, if it lasted longer, could significantly affect the Austrian agriculture due to overinvestment or overexploitation and so on. Thus, from a resilience point of view, it is not a desirable situation,

although, by researching it from the resilience assessment perspective, we could ascertain very satisfying results.

The second significant drop in economic resilience can be observed in 2013. Austrian agriculture was strongly confronted with more unfavorable weather conditions and price developments than the rest of the economy. A long winter, followed by a rainy spring, local flood damage in early summer, and extreme heat and drought in summer had a corresponding impact on the production volume of crop production. At the same time, producer prices for some crops fell due to the world record harvest of maize and the higher global wheat harvest (Statistics Austria 2014).

The small fluctuations in other index values are mainly caused by the deviations in the first component of resilience measuring index—financial flexibility. The changes in prices for agricultural products and varying yields directly affect index values, although these changes are insignificant. Even with these minor drawbacks, the Austrian agriculture sector manages to display a positive trend. This path indicates marginal but steady improvement of overall efficiency of farming activities in Austrian agriculture, which, in turn, is being reflected in the resilience index. The quite slow rate of improvement may be attributed to the fact that even in an EU accession year the values of the resilience index and economic efficiency level of Austrian agriculture were quite high. Based on these results, it is hard to show significant positive changes following shocks.

Another characteristic which can be observed when analyzing the economic resilience of Austrian agriculture is a "bounce–forward" effect (Hynes et al. 2020). Austrian agriculture not only recovers very fast from external shocks but also shows a better end result than in years prior to crises, further indicating a general improvement in overall resilience. This characteristic can be explained by the fact that Austrian agriculture is mainly characterized by a small-scale agriculture. Small-scale agriculture is more flexible and adaptable (Mishra 2016), compared to bigger ones. This may lead to better exploiting of possibilities in the case of shocks. Furthermore, the high diversification of export markets served and number of types of agricultural activities cultivated are quite constant over time. This level of diversification and the big proportion of mixed farms help farmers switch from less profitable to more prospective agricultural markets within the shortest time. These characteristics of Austrian agriculture contribute to the reduction of the effects of negative shocks, which is referred to as "shock-absorption" by Briguglio et al. (2006).

It should be noted that it is important not to set some predetermined deadline by which the agricultural sector should have been recovered after a shock. In light of the current development, it is important to maintain the production and market position, as competition levels between agricultural producers, in particular, EU regions, may differ significantly (Volkov et al. 2019b). In this context, the EU is encouraging shorter supply chains (Canfora 2016).

## 5. Conclusions

The economic resilience of Austrian agriculture frequently arouses public interest. This paper deals with conceptual and methodological aspects associated with economic resilience and its measurement for the agricultural sector. The index developed covers four areas of economic resilience, namely financial flexibility, stability in following the development path, diversification of activities, and diversification of export markets. Each of these areas contains variables which are considered suitable to gauge the extent to which the agricultural sector is conducive to absorbing and counteracting the consequences of shocks.

The results give insights into the economic resilience of Austrian agriculture and its transition over time. Austrian agriculture has been performing at a very high level of economic resilience and exhibits a very good level of transition in terms of economic resilience, despite a couple of fluctuations. The results also show that Austrian agriculture is capable of absorbing external shocks and, therefore, serves as a stabilizing factor in the national economy and improves food security. In general, our results show that the resilience level of Austrian agriculture is in line with the resilience level of the whole Austrian economy (FM Global 2020), thus confirming the balance and sustainability of the Austrian economy.

However, the paper has some limitations. Firstly, the index developed in this paper is very preliminary, and the work should be considered as still at an early stage of development. The index calculation is limited by the number and the selection of variables and data. Other variables related to the agricultural sector that could characterize economic resilience should be explored, as well. The results, therefore, should be interpreted with caution. Moreover, the computed economic resilience measuring index appears to be quite a multifaceted tool for measuring the economic resilience capacity of the agricultural sector. It is, however, limited in that it is more suited to measuring static economic resilience, which, in general, only indicates a potential for recovery. It does not provide predictions for the recovery time, which is a characteristic that can be attributed to a dynamic resilience concept. Secondly, the analysis in this paper is based on long-term economic observation since 1995, including the two major shocks in the years 2009 and 2013. The impacts of these shocks on Austrian agriculture are only included in the fluctuations of the national economy but do not reflect any focus on the influence of agricultural policy measures. Thirdly, the paper did not take Austrian spatial inequality at the sub-national level or farm level, or even with other countries into consideration. The ways a region or a farm are affected may differ significantly from country to country. Having said that, the discourse of economical resilience should go beyond asking how economically resilient Austrian agriculture is. There are also other dimensions of sustainability, such as social and environmental integrity. Furthermore, it may be helpful to learn more about the role of farmers within the local, regional and national context, so as to generate targeted policies which include resilience.

However, as the calculations are based on national sector data, additional research is needed to draw further conclusions about the resilience of agriculture. This may include in-depth analyses on the following: (i) further areas and indicators, e.g., social and environmental ones; (ii) the regional and farm level, including stakeholders' and farmers' behavior; (iii) the identification of the ways of coping with and adopting aftershocks by extracting success factors; (iv) trans-national comparisons; and (v) the creation of an economic resilience index for other sectors of the economy.

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## References

Alinezhad, Alireza, Sarrafha Keyvan, and Abbas Amini. 2014. Sensitivity analysis of SAW technique: The impact of changing the decision making matrix elements on the final ranking of alternatives. *Iranian Journal of Operations Research* 5: 82–94.

Andersen, Lykke E., Clemens Breisinger, Daniel Mason-D'Croz, Luis Carlos Jemio, Claudia Ringler, Richard D. Robertson, Dorte Verner, and Manfred Wiebelt. 2014. Agriculture, Incomes, and Gender in Latin America by 2050: An Assessment of Climate Change Impacts and Household Resilience for Brazil, Mexico, and Peru. *IFPRI Discussion Paper* 1390: 72. Available online: https://ssrn.com/abstract=2539588 (accessed on 28 August 2020).

Angeon, Valérie, and Bates Samuel. 2015. Reviewing Composite Vulnerability and Resilience Indexes: A Sustainable Approach and Application. *World Development* 72: 140–62.

Asheim, Bjorn Terje, Arne Isaksen, Claire Nauwelaers, and Franz Tödtling, eds. 2003. *Regional Innovation Policy for Small & Medium Enterprises*. Cheltenham: Edward Elgar Publishing.

Bailey, David, and Lisa De Propris. 2014. Recession, recovery and resilience? *Regional Studies* 48: 1757–60. doi:10.1080/00343404.2014.967082.

Balk, Bert M. 2009. On the relation between gross output–and value added–based productivity measures: The importance of the Domar factor. *Macroeconomic Dynamics* 13: 241–67.

Barnes, Andrew P., Helena Hansson, Gordana Manevska-Tasevska, Shailesh S. Shrestha, and Steven G. Thomson. 2015. The influence of diversification on long-term viability of the agricultural sector. *Land Use Policy* 49: 404–12.

Barthel, Stephan, and Christian Isendahl. 2013. Urban gardens, agriculture, and water management: Sources of resilience for long-term food security in cities. *Ecological Economics* 86: 224–34. doi:10.1016/j.ecolecon.2012.06.018.

Bhamra, Anshul S. 2015. Resilience Framework for Measuring Development. Brief for GSDR 2015. Available online: https://sustainabledevelopment.un.org/content/documents/642997-Bhamra-Resilience%20Framework%20For%20Measuring%20Development.pdf (accessed on 6 August 2020).

Birthal, Pratap S., and Jaweriah Hazrana. 2019. Crop diversification and resilience of agriculture to climatic shocks: Evidence from India. *Agricultural Systems* 173: 345–54.

Blesh, Jennifer, and Hannah Wittman. 2015. Brasilience: Assessing resilience in land reform settlements in the Brazilian Cerrado. *Human Ecology* 43: 531–46.

Bontoux, Laurent, and Daniel Bengtsson. 2015. *2035 Paths towards a Sustainable EU Economy. Sustainable Transitions and the Potential of Eco-Innovation for Jobs and Economic Development in EU Eco-Industries 2035*. EUR 27376 EN. Luxembourg: Publications Office of the European Union, doi:10.2760/80294.

Boschma, Ron 2014. Towards an evolutionary perspective on regional resilience. *Regional Studies* 49: 733–51. doi:10.1080/00343404.2014.959481.

Briguglio, Lino, Gordon Cordina, Stephanie Bugeja, and Nadia Farrugia. 2006. *Conceptualizing and Measuring Economic Resilience*. Mimeo, Department of Economics, University of Malta. Available online: https://www.researchgate.net/publication/229039198 (accessed on 28 July 2020).

Briguglio, Lino, Gordon Cordina, Nadia Farrugia, and Stephanie Vella. 2009. Economic vulnerability and resilience: Concepts and measurements. *Oxford Development Studies* 37(3): 229–247. doi:10.1080/13600810903089893.

Bristow, Gillian, and Adrian Healy. 2018. *Economic Crisis and the Resilience of Regions: A European Study*. New Horizons in Regional Science series. Cheltenham: Edward Elgar Publishing.

Broekaert, Wouter Andries Petra, and Koenraad Debackere. 2016. Innovation processes in family firms: The relevance of organizational flexibility. *Small Business Economics* 47: 771–85.

Cabell, Josuha F., and Myles Oelofse. 2012. An indicator framework for assessing agroecosystem resilience. *Ecology and Society* 17: 18. doi:10.5751/ES-04666-170118.

Canfora, Irene. 2016. Is the short food supply chain an efficient solution for sustainability in food market. *Agriculture and Agricultural Science Procedia* 8: 402–7.

Carpenter, Stephen R., Frances Westley, and Monica G., Turner. 2005. Surrogates for resilience of social-ecological systems. *Ecosystems* 8: 941–944. doi: 10.1007/s10021-005-0170-y.

Carter, Sara. 1998. Portfolio entrepreneurship in the farm sector: Indigenous growth in rural areas? *Entrepreneurship & Regional Development* 10: 17–32.

Čiegis, Remigijus. 2009. Darnaus žemės ūkio plėtra Lietuvoje. V*adybos Mokslas ir Studijos-Kaimo Verslų ir jų Infrastruktūros Plėtrai* 1: 30–37.

Davoudi, Simin, Elizabeth Brooks, and Abid Mehmood. 2013. Evolutionary resilience and strategies for climate adaptation. *Planning Practice & Re-search* 28: 307–322. doi:10.1080/02697459.2013.787695.

De Roest, Kees, Paolo Ferrari, and Karlheinz Knickel. 2018. Specialisation and economies of scale or diversification and economies of scope? Assessing different agricultural development pathways. *Journal of Rural Studies* 59: 222–31.

Deni, Widayanti, Oka Sudana, and Arya Sasmita. 2013. Analysis and implementation fuzzy multi-attribute decision making SAW method for selection of high achieving students in faculty level. *International Journal of Computer Science Issues (IJCSI)* 10: 674.

Di Caro, Paolo. 2017. Testing and explaining economic resilience with an application to Italian regions. *Papers in Regional Science* 96: 93–113.

Dinh, Huong, and Leonie Pearson. 2015. Specifying Community Economic Resilience—A Framework for Measurement. Paper presented at the 59th AARES Annual Conference, Rotorua, New Zealand, February 10–13.

Doorn, Neelke. 2017. Resilience indicators: Opportunities for including distributive justice concerns in disaster management. *Journal of Risk Research* 20: 711–31.

Dormady, Noah, Alfredo Roa-Henriquez, and Adam Rose. 2019. Economic resilience of the firm: A production theory approach. *International Journal of Production Economics* 208: 446–60.

Duval, Romain, Jørgen Elmeskov, and Lukas Vogel. 2007. Structural Policies and Economic Resilience to Shocks. OECD Economics Department Working Papers 567. Available online: https://www.oecd-ilibrary.org/economics/structural-policies-and-economic-resilience-to-shocks_140152385131 (accessed on 3 August 2020).

EC. 2019. Towards a Sustainable Europe by 2030. Reflection Paper. Available online: https://op.europa.eu/en/publication-detail/-/publication/3b096b37-300a-11e9-8d04-01aa75ed71a1/language-en/format-PDF (accessed on 4 August 2020).

Elgersma, Gerryt G., Gerben de Jong, René van der Linde, and Herman A. Mulder. 2018. Fluctuations in milk yield are heritable and can be used as a resilience indicator to breed healthy cows. *Journal of Dairy Science* 101: 1240–50.

Evenhuis, Emil. 2020. New directions in researching regional economic resilience and adaptation. In *Handbook on Regional Economic Resilience*. Cheltenham: Edward Elgar Publishing.

Faggian, Alessandra, Roberta Gemmiti, Timothy Jaquet, and Isabella Santini. 2018. Regional economic resilience: The experience of the Italian local labor systems. *The Annals of Regional Science* 60: 393–410.

Farah, Margaretha, and Nina Supartika. 2016. Factors affecting profitability of small medium enterprises (SMEs) firm listed in Indonesia Stock Exchange. *Journal of Economics, Business and Management* 4: 132–37.

Farley, Joshua, and Alexey Voinov. 2016. Economics, socio-ecological resilience and ecosystem services. *Journal of Environmental Management* 183: 389–98. doi:10.1016/j.jenvman.2016.07.065.

FM Global. 2020. *Resilience Index*. Available online: https://www.fmglobal.com/research-and-resources/tools-and-resources/resilienceindex/explore-the-data/?&cr=AUT&sn=ex (accessed on 31 July 2020).

Found, Pauline, and Nick Rich. 2006. *Making It All 'Add Up': A Systems Approach to Economic Sustainability*. Cardiff Logistics and Operations Management Working Papers. Cardiff: Cardiff Business School.

Giannakis, Elias, and Adriana Bruggeman. 2017. Determinants of regional resilience to economic crisis: A European perspective. *European Planning Studies* 25: 1394–415.

Gößling-Reisemann, Stefan. 2016. Resilience–Preparing Energy Systems for the Unexpected. An Edited Collection of Authored Pieces Comparing, Contrasting, and Integrating Risk and Resilience with an Emphasis on Ways to Measure Resilience. Available online: https://beta.irgc.org/wp-content/uploads/2016/08/G%C3%B6ssling-Reisemann-Resilience-Preparing-Energy-Systems-for-the-Unexpected-2.pdf (accessed on 30 July 2020).

Graveline, Nina, and Marine Gremont. 2017. Measuring and understanding the microeconomic resilience of businesses to lifeline service interruptions due to natural disasters. *International Journal of Disaster Risk Reduction* 24: 526–38.

Greenham, Tony, Elizabeth Cox, and Josh Ryan-Collins. 2013. Mapping Economic Resilience. Available online: https://www.friendsprovidentfoundation.org/wp-content/uploads/2017/11/nef-Mapping-Economic-Resilience-1-report.pdf (accessed on 30 July 2020).

Hallegatte, Stephane. 2014. Economic Resilience: Definition and Measurement. *Policy Research Working Paper Series* No. 6852. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2432352 (accessed on 29 July 2020).

Hallegatte, Stephane. 2015. The Indirect Cost of Natural Disasters and an Economic Definition of Macroeconomic Resilience. *World Bank Policy Research Working Paper Series* No. 7357. Available online: https://openknowledge.worldbank.org/bitstream/handle/10986/22238/The0indirect0c0oeconomic0resilience.pdf?sequence=1&isAllowed=y (accessed on 29 July 2020).

Hill, Edward W., Howard Wial, and Harold Wolman. 2008. *Exploring Regional Economic Resilience*. Working paper 2008-04. Berkeley: Institute of Urban and Regional Development, University of California.

Huggins, Robert. 2003. Creating a UK Competitiveness Index: Regional and Local Benchmarking. *Regional Studies* 37: 89–96. doi:10.1080/0034340022000033420.

Hwang, Ching-La, and Kwangsun Yoon. 1981. *Multiple Attribute Decision Making-Methods and Applications, A State-of-the-Art Survey*. Berlin, Heidelberg and New York: Springer.

Hynes, William, Benjamin Trump, Patrick Love, and Igor Linkov. 2020. Bouncing forward: A resilience approach to dealing with COVID-19 and future systemic shocks. *Environment Systems and Decisions* 40: 174–84.

Karlitasari, Lita, and Dini Suhartini. 2017. Comparison of simple additive weighting (SAW) and composite performance index (CPI) methods in employee remuneration determination. In *IOP Conference Series: Materials Science and Engineering*. Bristol: IOP Publishing, vol. 166, p. 012020.

Kirby, Peadar. 2006. *Vulnerability and Violence. The Impact of Globalization*. London and Ann Arbor: Pluto Press.

Kitsos, Anastasios, and Paul Bishop. 2018. Economic resilience in Great Britain: The crisis impact and its determining factors for local authority districts. *The Annals of Regional Science* 60: 329–47.

Kosmas, Costas, Mina Karamesouti, Kate Kounalaki, Vassilis Detsis, Penny Vassiliou, and Luca Salvati. 2016. Land degradation and long-term changes in agro-pastoral systems: An empirical analysis of ecological resilience in Asteroussia-Crete (Greece). *Catena* 147: 196–204.

Kremen, Claire, Alastair Iles, and Christopher Bacon. 2012. Diversified farming systems: An agroecological, systems-based alternative to modern industrial agriculture. *Ecology and Society* 17: 4.

Lin, Brenda B. 2011. Resilience in agriculture through crop diversification: Adaptive management for environmental change. *BioScience* 61: 183–93.

Makate, Clifton, Rongchang Wang, Marshall Makate, and Nelson Mango. 2016. Crop diversification and livelihoods of smallholder farmers in Zimbabwe: Adaptive management for environmental change. *SpringerPlus* 51: 1135.

Markard, Jochen, Rob Raven, and Bernhard Truffer. 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy* 41: 955–67. doi:10.1016/j.respol.2012.02.013.

Markard, J, Marco Suter, and Karin Ingold. 2016. Socio-technical transitions and policy change—Advocacy coalitions in Swiss energy policy. *Environmental Innovation and Societal Transitions* 18: 215–37. doi:10.1016/j.eist.2015.05.003.

Markusen, Ann. 1999. Fuzzy Concepts, Scanty Evidence, Policy Distance: The Case for Rigour and Policy Relevance in Critical Regional Studies. *Regional Studies* 33: 869–84.

Martin, Ron. 2012. Regional economic resilience, hysteresis and recessionary shocks. *Journal of Economic Geography* 12: 1–32.

Martin, Ron, and Peter Sunley. 2015. On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography* 15: 1–42. doi:10.1093/jeg/lbu015.

Masik, Grzegorz, and Stanisław Rzyski. 2014. Resilience of Pomorskie region to economic crisis. Bulletin of Geography. *Socio-Economic Series* 25: 129–41.

McManus, Sonja T. 2008. *Organisational Resilience in New Zealand*. Christchurch: University of Canterbury.

Memariani, Azizollah, Abbas Amini, and Alireza Alinezhad. 2009. Sensitivity analysis of simple additive weighting method (SAW): The results of change in the weight of one attribute on the final ranking of alternatives. *Journal of Industrial Engineering* 4: 13–18.

Meuwissen, Miranda. 2017. Report on Resilience Framework for EU Agriculture. Work Performed by P1 (WU) in Cooperation with All Partners. SUREFarm—Sustainable Resilient EU Farming Systems. Available online: https://www.surefarmproject.eu/wordpress/wp-content/uploads/2018/02/SURE-Farm_Deliverable-D1.1-Resilience-Framework.pdf (accessed on 29 July 2020).

Meuwissen, Miranda. 2018. Why the CAP should widen its approach to resilience. *Policy Brief June*. Available online: https://www.surefarmproject.eu/wordpress/wp-content/uploads/2018/06/Policy-Brief-1-final.pdf (accessed on 29 July 2020).

Michel-Villarreal, Rosario, Eliseo Vilalta-Perdomo, Martin Hingley, and Maurozio Canavari. 2019. Evaluating economic resilience for sustainable agri-food systems: The case of Mexico. *Strategic Change* 28: 279–88.

Mishra, Ruchi. 2016. A comparative evaluation of manufacturing flexibility adoption in SMEs and large firms in India. *Journal of Manufacturing Technology Management* 27: 730–62.

Modica, Marco, and Aura Reggiani. 2015. Spatial economic resilience: Overview and perspectives. *Networks and Spatial Economics 15*: 211–33. doi:10.1007/s11067-014-9261-7.

Morkūnas, Mangirdas, A. Artiom Volkov, and Pasquale Pazienza. 2018. How Resistant is the Agricultural Sector? Economic Resilience Exploited. *Economics and Sociology* 11: 321–32. doi:10.14254/2071-789X.2018/11-3/19.

Mühlemeier, Susan, Claudia R. Binder, and Romano Wyss. 2017. It's an Endurance Race: An Indicator-Based Resilience Analysis of the Energy Transition in the Allgäu Region, Bavaria. *GAIA-Ecological Perspectives for Science and Society* 26: 199–206.

Noy, Ilan, and Rio Yonson. 2016. A Survey of the Theory and Measurement of Economic Vulnerability and Resilience to Natural Hazards. Available online: http://hdl.handle.net/10063/4978 (accessed on 6 August 2020).

OECD. 2008. *Handbook on Constructing Composite Indicators.* Paris: OECD Publishing. Available online: http://www.oecd-ilibrary.org/economics/handbook-on-constructing-composite-indicators_533411815016 (accessed on 28 July 2020).

OECD. 2017. *Economic Resilience*. Available online: www.oecd.org/eco/economic-resilience.htm (accessed on 28 July 2020).

OECD. 2020. OECD.Stat Productivity. Available online: https://stats.oecd.org/Index.aspx?DataSetCode=PDBI_I4 (accessed on 28 July 2020).

Olsson, Per, Victor Galaz, and Wiebren. J. Boonstra. 2014. Sustainability transformations: A resilience perspective. *Ecology and Society* 19: 1. doi:10.5751/ES-06799-190401.

Pant, Raghav, Kash Barker, and Christopher W. Zobel. 2014. Static and dynamic metrics of economic resilience for interdependent infrastructure and industry sectors. *Reliability Engineering & System Safety* 125: 92–102.

Perrings, Charles. 1994. Ecological Resilience in the Sustainability of Economic Development. *Discussion Papers in Environmental Economics and Environmental Management Number 9405*. Heslington: The University of York. doi:10.22004/ag.econ.263925.

Psycharis, Yannis, Kallioras, Dimitris, and Panagiotis Pantazis. 2014. Economic crisis and regional resilience: Detecting the 'geographical footprint' of economic crisis in Greece. *Regional Science Policy & Practice* 6: 121–41.

Quendler, Erika. 2017. Organisational resilience: Building business value in a changing world. *Journal for International Business and Entrepreneurship Development* 10: 101–19.

Quendler, E., Christina Mayer, and Karl M. Ortner. 2016. Economic Transformation of Austrian Agriculture Since EU Accession. In *Global Perspectives on Trade Integration and Economies in Transition*. Edited by Erokhin Vasily. Hershey: IGI Global, chp. 15, doi:10.4018/978-1-5225-0451-1.ch015.

Ranger, Nicola, and Swenja Surminski. 2013. Disaster Resilience and Post-2015 Development Goals: The Options for Economics Targets and Indicators. Policy Paper. Available online: https://www.researchgate.net/profile/Swenja_Surminski/publication/257919978_Ranger_N_and_Surminski_S_April_2013_Disaster_resilience_and_post-2015_development_goals_the_options_for_economics_targets_and_indicators_Policy_paper_Centre_for_Climate_Change_Economics_and_Policy_Lee/links/5704dc3708ae74a08e24d467.pdf (accessed on 28 July 2020).

Ringwood, Lauryn, Philip Watson, and Paul A. Lewin. 2019. A quantitative method for measuring regional economic resilience to the great recession. *Growth and Change* 50: 381–402.

Rose, Adam. 2004. Defining and Measuring Economic Resilience to Disasters. *Disaster Prevention and Management* 13: 307–14.

Rose, Adam. 2017. Construction of an Economic Resilience Index. In *Disaster Resilience: An Integrated Approach*. Springfield: Charles C Thomas Publisher, pp. 55–78.

Rose, Aadam, and Elisabeth Krausmann. 2013. An economic framework for the development of a resilience index for business recovery. *International Journal of Disaster Risk Reduction* 5: 73–83.

Saltelli, Andrea, Stefano Tarantola, Francesca Campolongo, and Marco Ratto. 2004. *Sensitivity analysis in practice: a guide to assessing scientific models. A Guide to Assessing Scientific Models*. New York: Wiley, vol. 1.

Sensier, Marianne, Gillian Bristow, and Adrian Healy. 2016. Measuring regional economic resilience across Europe: Operationalizing a complex concept. *Spatial Economic Analysis* 11: 128–51. doi:10.1080/17421772.2016.1129435.

Seo, S. Niggol. 2010. Is an integrated farm more resilient against climate change? A micro-econometric analysis of portfolio diversification in African agriculture. *Food Policy* 35: 32–40.

Seufert, Verena, Zia Mehrabi, Doreen Gabriel, and Tim G. Benton. 2019. Current and Potential Contributions of Organic Agriculture to Diversification of the Food Production System. In *Agroecosystem diversity: reconciling contemporary agriculture and environmental quality*. Cambridge: Elsevier, Academic Press, pp. 435–52.

Sharifi, Ayyoob, and Yoshiki Yamagata. 2016. Urban resilience assessment: Multiple dimensions, criteria, and indicators. In *Urban Resilience*. Cham: Springer, pp. 259–76.

Shaver, Myles J. 2011. The benefits of geographic sales diversification: How exporting facilitates capital investment. *Strategic Management Journal 32*: 1046–60.

Simanaviciene, Ruta, and Leonas Ustinovichius. 2010. Sensitivity analysis for multiple criteria decision making methods: TOPSIS and SAW. *Procedia-Social and Behavioral Sciences* 2: 7743–44.

Šimanskienė Ligita, Remigijus Čiegis, and Jolita Ramanauskienė. 2011. Klaipėdos apskrities darnaus vystymosi vertinimas = The assessment of sustainable development of Klaipeda county. *Tiltai 1*. Available online: http://etalpykla.lituanistikadb.lt/fedora/objects/LT-LDB-0001:J.04~2011~1367174723376/datastreams/DS.002.0.01.ARTIC/content (accessed on 6 August 2020).

Simmie, James, and Ron Martin. 2010. The economic resilience of regions: Towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society* 3: 27–43.

Sondermann, David. *2017. Towards More Resilient Economies: The Role of Well-Functioning Economic Structures*. CEPS Working Document. No 2017/03. Available online: https://www.ceps.eu/wp-content/uploads/2017/01/WD%202017_03%20DSondermann%20ResilientEconomies.pdf (accessed on 6 August 2020).

Statistics Austria. 2014. *Entwicklung des landwirtschaftlichen Einkommens im Jahr 2013*. Vienna: Statistics Austria.

Statistics Austria. 2020a. *Economics Accounts for Agriculture*. Database Query from the 23rd of March 2020. Vienna: Statistics Austria.

Statistics Austria. 2020b. *Austrian Foreign Trade*. Vienna: Statistics Austria.

Statistics Austria. 2020c. *Gross Domestic Product Per Economic Sectors, Current Prices.* Vienna. Available online: https://www.statistik.at/web_en/statistics/Economy/national_accounts/gross_domestic_product/annual_data/index.html (accessed on 28 July 2020).

Statistics Austria. 2020d. *Landwirtschaftliche Gesamtrechnung*. Ergebnisse für 2019. Stand Juli 2020. Vienna: Statistics Austria.

Svensson, Goran. 2004. Vulnerability in business relationships: The gap between dependence and trust. *Journal of Business & Industrial Marketing* 19: 469–83. doi:10.1108/08858620410564418.

Swamy, Vighneswara. 2019. Financial inclusion and the resilience of poor households. *The Journal of Developing Areas* 53: 4.

Swanstrom, Todd. 2008. Regional Resilience: A critical examination of the ecological framework. Paper presented at the Urban Affairs Association Annual Meeting, Baltimore, MD, USA, April 25. Berkeley: Institute of Urban and Regional Development.

Tan, Juntao, Pingyu Zhang, Kevin Lo, Jing Li, and Shiwei Liu. 2017. Conceptualizing and measuring economic resilience of resource-based cities: Case study of Northeast China. *Chinese Geographical Science* 27: 471–81. doi:10.1007/s11769-017-0878-6.

Thompson, Samuel B. 2011. Simple formulas for standard errors that cluster by both firm and time. *Journal of financial Economics* 99: 1–10.

Tidball, Keith, and Richard Stedman. 2013. Positive dependency and virtuous cycles: From resource dependence to resilience in urban social-ecological systems. *Ecological Economics* 86: 292–99. doi:10.1016/j.ecolecon.2012.10.004.

Tonts, Matthew, Paul Plummer, and Neil Argent. 2014. Path dependence, resilience and the evolution of new rural economies: Perspectives from rural Western Australia. *Journal of Rural Studies* 36: 362–75.

UN. 2018. Building Resilience to Multiple Shocks Affecting People and Sustainable Development. Note by the UNCTAD Secretariat. United Nations Conference on Trade and Development. Available online: https://unctad.org/meetings/en/SessionalDocuments/tdb65_1_d5_en.pdf (accessed on 28 July 2020).

UNDP. 2015. *Development Advocate Nepal October 2015 to March 2016*. Available online: http://www.undp.org/content/dam/nepal/docs/reports/development_advocate/Development%20Advocate-Final%20Draft%2010.pdf (accessed on 28 July 2020).

UNSDIR. 2015. *Disaster Risk Reduction and Resilience in the 2030 Agenda for Sustainable Development.* Reflection Paper Prepared by the UN Office for Disaster Risk Reduction. Available online: https://www.unisdr.org/files/46052_disasterriskreductioninthe2030agend.pdf (accessed on 6 August 2020).

Wyk, Llewellyn V. 2015. From Sustainability to Resilience: A Paradigm Shift. Available online: https://researchspace.csir.co.za/dspace/bitstream/handle/10204/8305/Van%20Wyk1_2015.pdf?sequence=1&isAllowed=y (accessed on 28 July 2020).

Volkov, Artiom, Tomas Balezentis, Mangirdas Morkunas, and Dalia Streimikiene. 2019b. Who Benefits from CAP? The Way the Direct Payments System Impacts Socioeconomic Sustainability of Small Farms. *Sustainability* 11: 2112.

Volkov, Artiom, Tomas Balezentis, Mangirdas Morkunas, and Dalia Streimikiene. 2019a. In a Search for Equity: Do Direct Payments under the Common Agricultural Policy Induce Convergence in the European Union? *Sustainability* 11: 3462.

Vugrin, Eric D., Darke E. Warren, and Mark A. Ehlen. 2011. A resilience assessment framework for infrastructure and economic systems: Quantitative and qualitative resilience analysis of petrochemical supply chains to a hurricane. *Process Safety Progress* 30: 280–90.

Wairiu, Morgan. 2017. Land degradation and sustainable land management practices in Pacific Island Countries. *Regional Environmental Change* 17: 1053–64.

Wang, Kyungsoon. 2019. Housing market resilience: Neighbourhood and metropolitan factors explaining resilience before and after the US housing crisis. *Urban Studies* 56: 2688–708.

Webb, Nicholas P., Nadine A. Marshall, Linday C. Stringer, Mark S. Reed, Adrian Chappell, and Jeffrey E. Herrick. 2017. Land degradation and climate change: Building climate resilience in agriculture. *Frontiers in Ecology and the Environment 15*: 450–59.

Williams, Nick, and Tim Vorley. 2014. Economic resilience and entrepreneurship: Lessons from the Sheffield City Region. *Entrepreneurship & Regional Development* 26: 257–81. doi:10.1080/08985626.2014.894129.

Williams, Nick, Tim Vorley, and Panayiotis H. Ketikidis. 2013. Economic resilience and entrepreneurship: A case study of the Thessaloniki City Region. *Local Economy* 28: 399–415.

Wink, Rüdiger. 2014. Regional economic resilience: European experiences and policy issues. *Raumforschung und Raumordnung* 72: 85–91.

Xu, Ming, Brad R. Allenby, and John C. Crittenden. 2011. Interconnectedness and resilience of the US economy. *Advances in Complex Systems* 14: 649–72.

Yeh, Chung-Hsing. 2002. A problem-based selection of multi-attribute decision-making methods. *International Transactions in Operational Research* 9: 169–81.

Yu, Haochao, Yan Liu, Chengliang Liu, and Fei Fan. 2018. Spatiotemporal variation and inequality in China's economic resilience across cities and urban agglomerations. *Sustainability* 10: 4754.

Zavadskas, Edmundas K., Zenonas Turskis, Titas Dejus, and Milda Viteikiene. 2007. Sensitivity analysis of a simple additive weight method. *International Journal of Management and Decision Making* 8: 555–74.

Zhou, Peng, and Beng W. Ang. 2009. Comparing MCDA aggregation methods in constructing composite indicators using the Shannon-Spearman measure. *Social Indicators Research* 94: 83–96.

Zseleczky, Laura and Sivan Yosef. 2014. *Are Shocks Really Increasing? A Selective Review of the Global Frequency, Severity, Scope and Impact of Five Types of Shocks*. 2020 Conference Paper 5. Washington, DC: IFPRI. Available online: https://www.fsnnetwork.org/sites/default/files/2020resilienceconfpaper05.pdf (accessed on 1 August 2020).