

OECD-FLA

Measurement of Resilience using Farm-Level Data - Conceptual Ideas

23/04/21



<https://www.forbes.com/sites/johnbaldoni/2020/03/26/readers-redundancy-can-be-your-key-to-resilience/?h=46831274327>

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I - project aim

- aim of this project is to **identify quantifiable indicators** and **feasible measurement techniques** to produce empirical evidence on agricultural resilience
- state and development of the **resilience capacities** at different system levels (i.e. farm and/or sectoral level)
- beside the aspect of quantification also the availability of appropriate data and information therefore has to be considered
- a preliminary exploration on how to analyse the interactions between resilience, productivity and sustainability, and on the role of policies to enhance resilience

- **diversification**

- crop level genetic diversity, farm level crop mix, on-farm income sources, off-farm income, on-farm/off-farm income mix etc.

- **availability and access to financial resources**

- assets, financial savings or other short-term transfer payments to regain quantity and quality of production assets and/or adjust consumption behavior
- productive assets in the form of tangible assets that can be liquidated in short-term as e.g. land, livestock, machinery, materials etc.
- formal or informal safety net programs as e.g. direct cash transfers, cash-for-work programmes or informal safety nets are further listed for a developing context
- income averaging tax code based possibilities or tax deferral measures are listed for developed countries

- **social capital**

- bonding capital (e.g. trust in the direct community or social group)
- bridging capital (i.e. regional or cross-group horizontal linkages to access information etc.)
- linking capital (i.e. vertical linkages with public authorities to leverage information etc.)

- **acces to accurate and timely information**
 - uptake and investment in advanced digital technologies to enhance data collection, analysis and management capabilities (e.g. metereological sensor techniques, decision support software, or financial and production management enabling benchmarking systems)
- **availability and use of market based risk management tools**
 - as e.g. insurances, non-traditional financing, access to efficient banking systems, more specialised mechanisms (as e.g. futures or forward contracting) as well as value chain development and integration
- **policy measures**
 - ex ante policy measures: information provision and facilitation of planning but also include investments in specific technologies and complementing provision of infrastructure (as e.g. information towards more effective risk management, planning and coordination of disaster response, investment in disaster prevention, and measures related to a risk-minimizing system environment)
 - ex post policy measures: disaster response organisation and related information provision as well as the provision of financial support

- **human and social capital is essential**
 - increasing the flexibility of the system in the long run and therefore strengthening also the capacity to absorb
 - many measures and indicators can not be clearly distinguished from those that aim to increase absorption capacities
 - adaptation is often referred to responses with respect to long term environmental trends, in particular related to climate change
- **quality of human capital**
 - on-farm human capital has to be enabled/incentivised to optimise production operations with the aim of (also) maximising the system's flexibility (as e.g. continuous learning, iterative management, on-farm innovation and experimentation)
- **networks as a core component of social capital**
 - social networks (bonding capital) foster the exchange of knowledge and experience related to on-farm innovations among farmers and may increase the probability of resource pooling to develop new income generating opportunities
 - external networks (bridging capital) are crucial to expand the information and resource pool (as e.g. links between producers and researchers, or producer associations and R&D engaged industry and university departments are highly relevant)
 - overall mix of social capital related components is crucial

- **market based | private sector measures**

- insurances, technology investments at larger scale, and supply chain pressure towards more sustainable and high value oriented practices (e.g. via certification)
- a role for governments to support the agricultural systems' shift to more flexible decision-making and operations is highlighted

- **policy measures**

- to address various obstacles particularly in the areas of information and research
- offer extension and capacity building to improve human capital
- provide infrastructure that allows farmers to undertake adaptive actions
- ensure that market signals incentivising adaptive measures are not distorted by competing policy frameworks that lock producers into maladaptive production systems

- **proactive transformation can be distinguished from forced, or reactive, transformation**
- **intangible human capital**
 - employ a forward-looking decision-making process that incorporates management flexibility and on-farm experimentation
 - a row of smaller accommodations and adaptations with respect to business strategy have to be considered (as e.g. a flexible business plan)
 - attitudes and beliefs are to be mentioned as psychological drivers to be adapted
- **networks as one type of social capital are crucial for transformative oriented farmers**
 - the mix of networks is regarded as important key
 - smaller social networks of family but larger knowledge and information networks enabling the transformative oriented farmer to experiment and flexibly decide without being constrained by social norms of peer groups
- **private sector activities are regarded as playing a substantial role**
 - incentives for farmers to transform given by collaborative funding of new technologies, higher prices and better contracts as well as actively co-ordinating transformational change along the value chain
- **policy measures**
 - the provision or improvement of data to inform flexible decision-making efforts
 - the engagement in collaborative planning processes to identify barriers and facilitate transformative actions
 - the provision of financial resources to allow producers to make transformative changes

II - indicators | summary based on literature review

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Indicator	Targeted Capacity/ies	Target Scale	Data
scope economies	absorption	farm / sector	financial farm accounts
scale economies	absorp/adaptation	farm / sector	financial farm accounts
diversification	absorption	farm / sector	financial farm accounts
flexibility	absorption	farm / sector	financial farm accounts
herfindahl index (on-farm sources)	absorption	farm / sector	financial farm accounts
off-farm income	absorption	farm / sector	financial farm accounts
assets (productive assets)	absorption	farm / sector	financial farm accounts
equity/debt ratio	absorption	farm / sector	financial farm accounts
savings	absorption	farm / sector	financial farm accounts
tax deferral options	absorption	sector	
trust in community/group (social bonding capital)	absorption	farm	survey
regional/cross-group linkages (social bridging capital)	absorption	farm	survey
investment in digital technologies	absorption	farm / sector	survey
insurance expenses	absorption	farm / sector	financial farm accounts

Indicator	Targeted Capacity/ies	Target Scale	Data
extension services	absorption	farm	financial farm accounts / survey
infrastructure endowment	absorption	regional	official statistics
risk tools	absorption	farm / sector	
financial support (disaster response etc.)	absorption	farm / sector	
investment in disaster prevention	absorption	sector	
labor educational level	adaptation	farm / sector	
management trainings	adaptation	farm / sector	
labor training	adaptation	farm / sector	
memberships/linkages networks (social bonding capital)	adaptation	farm / sector	
linkages external networks (social bridging capital)	adaptation	farm / sector	
mix of bonding/bridging capital	adaptation / transformation	farm / sector	
certification	adaptation	farm / sector	
planing software use	transformation	farm/ sector	
cooperation in technology financing (horizontal/vertical)	transformation	farm/ sector	
contracts	transformation	farm/ sector	
exit support (extension/financial)	transformation	farm/ sector	

III - level of analysis | target scale

- farm level approach preferable..
 - resilience relevant decisions are made at farm level
 - policies target individual farms and resilience components
 - previous farm level work and available estimates
- sector level approach complementary..
 - entire farming systems might differ in their resilience behaviour
 - policy effects are considered at system/sectoral level over space and time
 - synergies/trade-offs between resilience components at system/sector level

IV - identification of disturbances/shocks

- various external disturbances/shocks and their impact on resilience related capacities will be empirically investigated based on indicators measured, e.g.
 - millenium droughts Australia,
 - financial crises EU,
 - floodings in UK,
 - corona lock-down etc.
- diversity of potential target sources for risk will be considered
- a particular emphasis on climatic hazards (droughts, floods...)
- also exploring other sources of risks
 - such as animal or plant diseases,
 - market shocks as e.g. reflected by significant price collapses or bubbles, or demand shocks

V - measurement | empirical methods

Quantitative Method	Focus	Indicators
Descriptive Distributional Statistics	Static description of distributions	All (static), per farm type, sector, country
Panel Regression	Static analysis of drivers across space and time, events' impact	All (dynamic), per farm type, sector, country
Estimation of Statistical Distributional Development (mean/stddev/var/skew/kurt) & graphical illustrations	Dynamic analysis of distributions and drivers	All (dynamic), per farm type, sector, country
First Difference Estimation	Dynamic analysis of distributions and drivers accounting for autocorrelation	Key indicators
Heckman Selection Estimation	Dynamic analysis accounting for potential selection bias	Key indicators
SURE Estimation	Dynamic analysis accounting for simultaneity of indicators change	Key indicators
Methods of Moment based Estimation (DPD)	Dynamic analysis accounting for autocorrelation and potential endogeneity	Key indicators
Profit Framework Estimation	Measuring distributional moments as risk proxies, Links to Indicators	Key Indicators
Distance Function/Frontier based Trade-off Analysis	Potential trade-offs with productivity and sustainability	Key indicators, Productivity Measure, Sustainability Indicators
Markov Chain Analysis	Dynamics of Shares, Convergence of system	Shares of Indicators (>< threshold), transition probabilities between states
Treatment Effects Analysis, DID & PSM	Effects of shocks and policies on indicators and dynamics	Indicators dynamics, various
Time Series Regressions	Cointegration of indicators, shocks' effects	Key indicators, e.g. productivity and resilience time series

VI - strategy for analysis | overview

1. static approach

- exploration of different dimensions of resilience using indicators and statistical proxies for each component (i.e. distributional moments etc.)
- some of the statistics are measured based on information for several years (e.g. length of recovery)

2. dynamic approach

- estimating resilience directly from the dynamics of farm adjustment after well-defined shocks
- requires identification of disturbances/shocks and definition of the treatment group and the control group not subject to the same adverse event
- differentiated impact of the shocks in different municipalities (across space etc.)
- use of datasets from other sources such as meteorological statistical services

3. composite approach - index of resilience covering all characteristics (components' indicators)

4. drivers of different resilience performance components and composite index

- econometric methods depending on indicator(s) distribution and data availability

VI - strategy for analysis | summary (scoping paper)

	Static Approach	Dynamic Approach	Composite Approach
General Method	Descriptive statistics on the different characteristics of resilience.	Descriptive statistics and DiD (difference-in-difference) estimation (or similar treatment effects technique) with two groups of farms: one with treatment (shock) and one without	Principal component analysis and Latent Class Regression to cluster farms on different resilience profiles
<i>Farm level</i>	Use of proxy variables for each characteristic across productivity classes	Use of proxies and DiD estimations	
Preparedness	On farm investment, scope of diversification...	DiD: On farm investment, scope of diversification...	
Absorption / Recovery	Variability of income Length of recovery...	Descriptive: Impact on income / profits Length of recovery to trend DiD: income variability...	Principal components analysis to define an index that combines most of the information across characteristics
Adaptation / Transformation	Changes in productivity and in productivity classes Technical change...	Descriptive: Impact on income / profits Length of recovery to trend DiD: increase in productivity or change in productivity class, technical change...	Latent Class Regression analysis to estimate drivers and dynamics in indicators for different farm classes/groups
Drivers of Resilience Performance Farm Level	Drivers analysis on all indicators, including policy drivers. Various regression models as e.g. multinomial regression or heckman selection probit regression (depending on indicator).		
<i>Sector level</i>	Comparing sectors in one or more countries Sectoral averages / Markov analysis	Comparing sectors in one or more countries (averages) Markov analysis: Change in the matrix of probabilities after shock	
Preparedness			
Absorption / Recovery	Descriptive: Change in the share of farmers in the most productive class Other characteristic of the dynamic adjustment Recovery & adaptation as medium term	Descriptive: Impact on income / profits Length of recovery to trend Markov: indicator shares	Principal components analysis to define an index that combines most of the information across characteristics
Adaptation / Transformation	Transformation as long term	Change in the share of farms in the most productive class in the steady state Change in the speed of adjustment implied by Markov DiD	
Drivers of Resilience Performance Sector Level	Drivers analysis on all indicators, including policy drivers		

VI - exemplary analysis

“the resilience of crop farms in Italy versus resilience of crop farms in Australia”

(focus: resilience towards extreme natural events; data: Italian FADN, Australian farm accounts panel data)

step I - static farm: indicators farm investment, diversification (herfindahl), off-farm income share, productivity change, class switches, technical change

[1] descriptive stats (mean, min/max, stdev, var, kurt, skew)

step II - dynamic farm: extreme natural events (drought shocks) as “treatments”

[2] building matched samples by psm (It_d, It_nd | Aus_d, Aus_nd)

[3] treatment effects analysis by did based on drought shocks and resilience indicators as outcome variables (from [1])

step III - dynamic sector: Markov analysis and drought shocks as “treatments”

[4] Markov shares (probability matrices)

[5] treatment effects analysis by did based on drought shocks, matched samples (from [2]) and resilience Markov shares as outcome variables (from [4])

step IV - composite: resilience index, farm clusters based on resilience profiles

[6] principal components analysis and latent class regression based on [1]

VI - strategy for analysis | next steps

- request for discussion and collaboration, circulation of draft plan for analysis
- first proposal for country case studies
 - intensive versus extensive production systems
(e.g. DK pigs vs. Nor mixed farms, e.g. Italy crops vs. Aus crops)
 - production system(s) over various countries
(e.g. dairy UK, F and DK; e.g. crops Italy, UK, Aus)
- suggestions for external disturbances / shocks to be considered
 - climatic extreme events / natural disasters
 - animal/plant pests
 - market/financial shocks

Thank you.



<https://www.myamericannurse.com/building-personal-resilience/>

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