Relative Measurement of Economic Security

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1. Relative Economic Security measures

In the existing literature, few measures of Economic Insecurity have been proposed and there is some debate on how to measure such a multi-faced phenomenon. A fundamental contribution to the literature has been given by Bossert and D'Ambrosio (2013) with their insecurity indicator, continuing with the collaboration of Clark and Lepinteur in 2019. Their indicator's latest version is based on a weighted summation of absolute changes between the individual resource levels observed in consecutive years (Bossert et al. 2019). With this work, we give our contribution by proposing relative versions of the individual economic insecurity indicator they proposed. We rather suggest considering relative change between resources stock, instead of the absolute variation, as we think that individuals are more likely to judge changes in their economic status in relative terms, being also used to relative salary increases. Therefore, we think relative changes may allow us to capture the real perceived individual insecurity better. Moreover, indices based on relative changes have the advantages of being independent of the order of magnitude of the phenomenon considered and of the units of measurement, thus favouring the comparison between individuals and countries adopting different currencies.
In this work, two different indicators are proposed and compared with the one used in Bossert et al. (2019), from now on we will be referring to this indicator as AI (Absolute Indicator). The first one considers the relative pair differences with respect to the further period. Considering $\mathbb{R}^{(T)}$as the $(T+1)$-dimensional Euclidean space with component labeled $(-T, \dots, 0)$, where 0 is the current period and $-T$ is the furthest period in the past and acknowledging that $x = (x_{-T,}, \dots, x_0) \in \mathbb{R}^{(T)}{}_{++}$ is an individual income stream and that the economic security is evaluated only considering x. It is formulated as follows:

$$RI^T(x) = g_0 \sum_{\substack{t\in(1,\dots,T)\\ x_{-(t-1)}-x_{-t}>0}} \delta^{t-1}\frac{x_{-(t-1)}-x_{-t}}{x_{-t}} + l_0 \sum_{\substack{t\in(1,\dots,T)\\ x_{-(t-1)}-x_{-t}<0}} \delta^{t-1}\frac{x_{-(t-1)}-x_{-t}}{x_{-t}} \quad (1)$$

where δ is the inter-temporal weighting parameter, l_0 and g_0 are weights assigned respectively to losses and gains, $RI^T(x)$ is a function $RI^T(x)$: $\mathbb{R}^{(T)}{}_{++} \to \mathbb{R}^{(T)}$ for each $t \in \mathbb{N}$, therefore $RI^T(x) = \langle RI^T\rangle_{T\in\mathbb{N}}$ is a measure of individual economic security, from now RI (Relative Indicator).
The second indicator we propose is a Logarithmic Relative Indicator (LRI), where the relative change is obtained by applying the logarithm (Tornqvist et al., 1985) to the ratio between resources levels in two subsequent points in time.
The $LRI^T(x) = \langle LRI^T\rangle_{T\in\mathbb{N}}$ is formulated as follows:

$$LRI^T(x) = g_0 \sum_{\substack{t\in(1,\dots,T)\\ x_{-(t-1)}-x_{-t}>0}} \delta^{t-1}\ln\left(\frac{x_{-(t-1)}}{x_{-t}}\right) + l_0 \sum_{\substack{t\in(1,\dots,T)\\ x_{-(t-1)}-x_{-t}<0}} \delta^{t-1}\ln\left(\frac{x_{-(t-1)}}{x_{-t}}\right) \quad (2)$$

In this indicator the relative pair differences are expressed as logarithm of the ratio and the relative difference is considered with respect to the logarithmic mean $L(x_{-t}, x_{-(t-1)})$ Törnqvist et al. (1985):

$$\ln\left(\frac{x_{-(t-1)}}{x_{-t}}\right) = \frac{x_{-(t-1)}-x_{-t}}{L(x_{-t}, x_{-(t-1)})}$$

Where $L(x_{-t}, x_{-(t-1)})$ is defined as:

$$L(x_{-t}, x_{-(t-1)}) = \begin{cases} \dfrac{x_{-(t-1)}-x_{-t}}{\ln x_{-(t-1)}/x_{-t}}, & for \quad x_{-(t-1)} \neq x_{-t} \\ x_{-t}, & for \quad x_{-(t-1)} = x_{-t} \end{cases}$$

We prove that the two relative indicators satisfy some important properties. They both fulfil some properties considered also by Bossert et al. (2019), in particular, Gain-loss monotonicity, Homogeneity, Quasilinearity and Stationarity. Moreover, LRI satisfied further useful properties (that are instead not satisfied by RI): Proximity monotonicity and Simmetry (Tornqvist et al., 1985).

2. Application to EU-SILC Data

To highlight the advantages offered by the indicators proposed, we carry out an exploratory study based on information produced by the EU-SILC (2019) survey, the database widely used to study poverty, inequality and social exclusion in EU member countries. We considered four different

panels: from 2012 to 2016, from 2013 to 2017, from 2014 to 2018 and from 2015 to 2019. The variable used in the analysis is the equivalent disposable income at an individual level and income values have been discounted to remove inflation. Streams of four years with three delays have been considered and economic security "scores" have been computed for all three indicators and all individuals in the four panels. Following Bossert et al. (2019), we use $\delta = 0.9$, $l_0 = 1$ and $g_0 = 15/16$. The AI is transformed into a security indicator by multiplying the scores times (-1) to carry out the comparison.

LRI provides scores much more coherent with AI than RI. The correlation between LRI and AI is, for example, 0.6 in 2019, while the correlation between RI and AI is only 0.04 in the same year. Also, the trends observed over time for LRI and AI appear consistent with each other, on median and average, and inconsistent with the RI trend. Hence LRI appears preferable to the RI as it satisfies more properties and is more coherent with AI, which has been already largely considered and applied in the literature.

We notice that LRI and AI lead to some differences in the individual scores calculated for the individuals in the sample. If we divide the individual scores into four quartile classes, we notice that 15% of the observations belong to different quartiles according to the two indicators. Most of the observations belonging to different classes (55%) exchange from the third to the fourth class: differences regard above all high positive scores, that for the absolute indicator are close to median while for the relative indicator are close to the maximum and vice-versa.

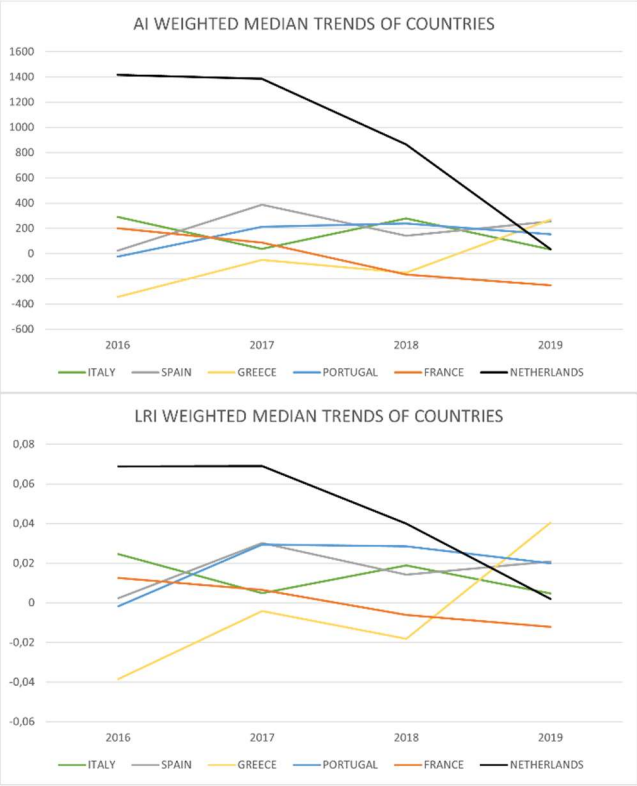

Figure 1: Comparison between security indicators trends among different European countries.

Finally, we use both LRI and AI to compare economic security in some European countries: Spain, Italy, Portugal, Greece, France, and the Netherlands. Despite the basic consistency between the

two indicators, the analysis reveals some significant differences between the evaluation in absolute terms and the one in relative terms, which deserve further study. Figure 1 shows, as an example, results obtained on the weighted median. The trends look comparable, but Spain and Portugal's trends diverge according to AI from 2016 to 2017 while they converge according to LRI in the same interval. Moreover, the countries trends change rank order in two out of four years considered (2018 and 2019).

References

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