



A Relative Measure of Economic Insecurity and the Nexus with Job Change

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Abstract

Economic insecurity is attracting growing attention in the social well-being literature. However, there is still debate about its definition and measurement which deserve further and in depth study. Assuming that economic insecurity relates to the forward-looking perception of future outcomes based on past experience, we suggest a class of relative indices measuring the individual feeling of economic insecurity by considering relative past resource fluctuations. The innovation we implement in this context consists in considering relative changes, supposing that individuals evaluate each fluctuation based on their previous resource level. We take advantage of the measures suggested to study how economic insecurity may affect job mobility. Obtained results show that economic insecurity has a significant impact on the probability of changing jobs, and that its effect differs by gender and working experience.

Keywords Economic insecurity · Logarithmic relative index · Job mobility · Panel surveys

JEL Classification D63 · I32 · J63

1 Introduction

The recent Covid-19 pandemic brought economic uncertainty to many households (Cagiano et al., 2020). The contemporary literature is giving growing attention to the measure of this uncertainty and its effect on the economic behavior of individuals and on the whole economic system (Baker et al., 2020). One aspect of economic uncertainty is economic insecurity, which attracted the interest of authors even before the arrival of the pandemic.

The purpose of this paper is twofold. First, focusing on the objective measurement of economic insecurity, we embrace the approach proposed by Bossert and D'Ambrosio

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(2013) and Bossert et al. (2022) and we suggest a new version of their class of indices. Our second aim is to deepen the ability of the proposed indices to capture the economic insecurity perceived by the individuals. To this purpose we empirically validate their capacity to represent the perception of economic insecurity that affects individuals' behavior in the labor market.

The measures suggested by Bossert et al. (2022) work with past resource flow fluctuations and provide individual insecurity scores by considering absolute (in the sense of translation-invariant) pair differences of past resource levels. These measures assign a higher level of insecurity to individuals who are unable to recover after experiencing a loss in resources.

In this work, we suggest a relative version (in the sense of scale-invariant) of their class of indices, by considering pair ratios of past resource levels. The proposal moves from some considerations that we think are particularly relevant for the objective of measuring economic insecurity. First, two individuals experiencing the same loss in resources in the same period, do perceive a different level of insecurity if they start from different resource levels. For example, a 10,000 euro loss of income between two consecutive years will have a greater effect on an individual whose initial income was 30,000 euros than on an individual whose initial income was 300,000 euros. In other words, given the same absolute change, the relative change is larger in magnitude if the initial value is at a lower level than if it is higher.

Moreover, individuals are more likely to judge changes in their economic status in relative terms, as they are used to doing with wage and salary increases, tax brackets and interest earned from investments, all expressed in relative terms. Finally, indices based on relative changes have the advantage of being independent of the order of magnitude of the phenomenon considered and the unit of measurement, thus favouring the comparison between individuals and between countries adopting different currencies or having a different purchasing power.

In the second part of the work, an index of the class proposed is used to study the possible effect of economic insecurity on the probability of changing jobs. Among the vast literature on the determinants of employee job mobility, we focus on organizational changes, defined as a voluntary change of the employing firm (Feldman & Ng, 2007).

To our purposes we use data taken from the German Socio-Economic Panel (SOEP) for the period 2006–2020. Firstly, the use of a longitudinal survey with many available waves allows us to compare the results obtained from the indices we propose, and the ones suggested by Bossert et al. (2022), both sectionally and over time. Secondly, this survey enables us to estimate panel data models for the decision of changing job, which include unobserved individual effects that may represent, for example, the desire for new stimuli, the desire to acquire new skills and face new challenges, the prospect of professional growth, the recognition of the work done and the skills acquired, and other personality traits (Costa & McCrae, 1992; Judge & Bono, 2001).

Moreover, the case of Germany is of particular interest to our purposes. Germany represents the world's fourth-largest economy and the German labor market is one of the most flourishing in the EU (Rinne & Zimmermann, 2013), especially after the labor market reforms of 2003–05, the so-called Hartz-reforms. These reforms reduced both the long-term and the short-term unemployment rates (Spermann, 2015), which were structural and persistent throughout the 1990s and the early 2000s (Krebs & Scheffel, 2013). Since the long-term unemployment rate is considered as an index of the difficulty associated with labor market mobility (OECD, 1997), we think that this context can

encourage the possibility of voluntary job-to-job transition, pushing insecure workers to shift to a more secure job.

Results obtained suggest that: the proposed indices and those by Bossert et al. (2022) capture different aspects of economic insecurity, as reflected by the diverse insecurity scores. Further, individuals' economic insecurity increases the probability of changing job, and the estimated models show a better fit to the data when economic insecurity is measured by the proposed index compared to the one by Bossert et al. (2022).

The remaining part of the paper is organized as follows. The next section briefly provides a background focused on the definition and measurement of economic insecurity, the use of relative measures and the determinants of job change. In Sect. 3 the class of relative economic insecurity indices proposed is described and its analytical properties are derived. Section 4 describes the data and reports the results of a comparison between one of the relative indices belonging to the class proposed and the absolute counterpart suggested by Bossert et al. (2022). In Sect. 5 the results of the analysis of the effect of economic insecurity on the probability of changing job is presented and in Sect. 6 conclusions can be found together with some future research directions.

2 Background

2.1 Economic Insecurity

In the literature there is no collective and community-accepted definition of economic insecurity. Authors do agree that it is a phenomenon related to the forward-looking perception of future outcomes and the uncertainty that this perception generates (Rohde et al., 2022).

Economic insecurity therefore refers to the state of stress or anxiety that individuals may feel regarding their future economic condition. Anxiety and stress are necessarily subjective conceptions. Anxious individuals may perceive economic losses and related risks differently from non-anxious individuals. Rohde et al. (2022) stress that the concept of economic insecurity sits halfway between economics and psychology. They argue that economic insecurity aims at studying the effects of economic circumstances on psychology, in contrast to the "behavioral economics" literature, where the impact of psychological processes on economic outcomes is considered.

Based on the above considerations, economic insecurity has been defined in several ways in the literature. Osberg (1998, p. 23) delves into the meaning of the term "insecurity" and proposes a first definition of economic insecurity as the "anxiety produced by a lack of economic safety, i.e. by an inability to obtain protection against subjectively significant potential economic losses". Later Stiglitz et al., (2009, p. 198) define it as the "uncertainty about the material conditions that may prevail in the future". More recently, Bossert and D' Ambrosio (2013, p. 1018) define economic insecurity as "the anxiety produced by the possible exposure to adverse economic events and by the anticipation of the difficulty to recover from them."

As argued by Bossert and D'Ambrosio (2013), the proposed definitions involve past, present and future. The focus is on the current individuals' confidence about their capacity to handle an economic loss in the future. The individuals' past experiences influence their current self-confidence on their ability to face adverse economic events in the future. The individuals' economic status at the present time also plays a role in

determining such self-confidence: the better their economic condition, the less worried they will be about the future.

Moreover, all the mentioned definitions of economic insecurity focus on worries about the future. Therefore, unlike poverty and inequality, that refer to the current time and depend on what has happened in the past, economic insecurity is an inherently forward-looking concept (Osberg, 2021).

As a follow up to the discussion about the definition, there has been even more discussion in the literature about how economic insecurity should be measured (Osberg, 2015; Rohde & Tang, 2018). Some approaches concentrate on the aggregate level, such as the International Labor Organization's (ILO) indicator (Rohde & Tang, 2018) or the Osberg and Sharpe (2014) approach. Other authors proposed to measure economic insecurity at an individual level.

As discussed by Rohde and Tang (2018), the individual level involves more limitations and assumptions than the aggregate case. For instance, individual measures disregard personal factors, such as individual temperaments, which would theoretically be relevant to the analysis. Moreover, individuals are also assumed to consider the realized risk as a proxy for the future risk, and economic insecurity being proportional to objective risk (Rohde & Tang, 2018). Nevertheless, individual measures offer undoubtedly many possibilities for analyzing the relationship between economic insecurity and several individual behaviors and conditions as, for example, voting (Bossert et al., 2022; Rebecchi and Rohde, 2023; Watson et al., 2022), mental health (Rohde et al., 2015), suicide rates, (Reeves et al., 2014) and obesity (Smith et al., 2013).

Moreover, individual approaches suggested in the literature may be divided in objective and subjective indicators. The latter usually work with answers to subjective survey questions on the feeling of insecurity. Several authors study the relationship between the subjective feeling of insecurity and, for example, subjective well-being (De Witte, 1999), marriage probability (Clark et al., 2023) and fertility (Clark & Lepinteur, 2022). On the other hand, objective measures of economic insecurity usually focus on backwards-looking techniques able to predict a certain value of a forward-looking perception of insecurity.

There are a variety of approaches capturing objective measurement. They assume that past monetary gains and losses effect the individuals' confidence at the present time. They consider information about individual economic conditions to derive subjective forecast of how well individuals can handle losses in the future. This information is hence used as proxy to predict the stresses and anxiety to which individuals may be exposed (Rohde et al., 2015).

Some authors moving from the multifaceted nature of insecurity, suggest identifying various dimensions of insecurity and then to summarize them, for example, using a Principal Component Analysis (Ranci et al., 2021; Rohde et al., 2015). Hacker et al. (2014) consider specific conditions that can occur in the life of individuals, and synthesize such conditions through an indicator variable. Other authors exploit certain characteristics of the individual flows of a resource (income, wealth or consumption), thus abstracting from other causes of economic insecurity not captured by such monetary resource. Rohde et al. (2014), for example, classify those individuals whose resource stream varies more from a determined benchmark as more insecure. Bossert and D'Ambrosio (2013) and Bossert et al. (2022) suggest an axiomatic approach to derive an appropriate class of indices, based on a stream of past values of a resource, that satisfy a set of desirable properties.

2.2 Relative Indices

When studying changes over time of an economic phenomenon, we have basically two options, to use absolute changes or relative changes. These two types of change provide different information about the evolution of a phenomena. Therefore, they may be more or less useful depending on the purpose of the research. Relative changes allow the comparison of values, taking into account the order of magnitude of the phenomenon by dividing by the starting value. Hence, they are preferable when we want to obtain results that are directly comparable (between individuals, regions, sectors of activity, etc.) (Clark et al., 2008).

The idea of considering relative indices is new in the economic insecurity literature, while it is not new in the economic literature, where the advantages of relative differences over absolute differences have been largely highlighted (Clark et al., 2008; Törnqvist et al., 1985; Vartia, 1976). Relative changes have also been widely used for measuring price changes or productivity, and in estimating various relationships between economic quantities (Caliendo et al., 2018; Leser, 1983; Törnqvist et al., 1985).

Focusing on the well-being literature, some authors consider the relativization with respect to a certain reference group in the society (Verme, 2013). Other authors as, for example, Kahneman and Tversky (1979), stress the importance of the relative comparison of individuals' present status with their past or future position.

Important applied research has been carried out in this latter direction. Clark et al. (2008) investigate the role of relative income in the utility function to explain the Easterlin paradox by using *internal* reference points as future or past self-comparisons. McBride (2001) considers the so-called *psychological* norm to study the effect of relative income on the perception of well-being, which is when individuals use their personal past as a reference group. Ceriani and Gagliarano (2015), propose an index to measure relative deprivation, that compares the individuals' current condition with both their past conditions and the others' current conditions.

Unlike these authors, we propose dynamic indices based on the relative temporal comparisons. In particular, as will be described in the next section, given a certain number of past observations available, the indices are based on a sequence of ratios between temporally consecutive values.

2.3 Economic Insecurity and Job Changes

The literature on potential factors that motivate employees' job mobility focuses mostly on structural and occupational labor market factors, organizational policies and individual personality traits (Feldman & Ng, 2007). Structural and occupational labor market factors are among the reasons driving individuals to change jobs (DiPrete, 1993; Hachen Jr, 1992). Indeed, in flourishing economies it is more frequent to change organization, job or occupation than in the poorer ones. From an organizational perspective, the main determinants considered in the literature are: wage levels, the structure of pensions and insurance benefits and organizational socialization practices. Past research suggests that higher wages attract workers (Hammida, 2004; Topel & Ward, 1992), insurance benefits and the structure of pensions positively influence job mobility patterns especially in late career workers (Kim & Feldman, 2000), and organizational socialization practices can drastically influence employee's organizational embeddedness (Allen, 2006).

The relationship between job insecurity and turnover intentions has been already investigated by many authors in the literature, such as Arnold and Feldman (1982), Clark (1998), De Witte et al. (2015) and Bajrami et al. (2021). Böckerman et al. (2011) examine the effect of job insecurity on employees' well-being.

In this work, we move away from the previous literature by using an index of the class that we propose to study how the perception of economic insecurity, caused by resource flows fluctuations, can yield anxiety and can drive the decision of changing job. To the best of our knowledge, the impact of wage fluctuations on job transactions and organizational changes has never been previously investigated. Our assumption is that insecure workers with fluctuating earnings, may prefer to move to a job that can guarantee a more stable salary and financial stability. We think that by including a measure of economic insecurity among the determinants of employee mobility we can add some useful insights into this phenomenon. Changing jobs, voluntarily or out of necessity, is undoubtedly an extremely relevant event in the life of a large number of people and brings with it significant aspects. Apart from the economic reason, it seems that one of the main drivers that push people to change job concerns the possibility of finding greater stability and a better balance between private and work life (Origo & Pagani, 2009).

3 Relative Economic Insecurity Indices

3.1 The Class of Indices

The class of indices proposed by Bossert and D'Ambrosio (2013) is a landmark in the field of measuring economic insecurity. They derive a formula, in the framework of an axiomatic approach, based on the weighted sum of two weighted summations, one for monetary losses and the other for monetary gains, both evaluated over time.

For any $T \in \mathbb{N}$, $\mathbb{R}^{(T)}$ represents the $(T + 1)$ -dimensional Euclidean space with component labeled $(-T, \dots, 0)$, where 0 is the current point in time and $-T$ is the furthest point in time. A measure of individual economic insecurity is a sequence of functions $I = \langle I^T \rangle_{T \in \mathbb{N}}$ where for each $T \in \mathbb{N}$, $I^T : \mathbb{R}_{++}^{(T)} \rightarrow \mathbb{R}$ is a function that assigns an insecurity value to each individual resource stream $x = (x_{-T}, \dots, x_0) \in \mathbb{R}_{++}^{(T)}$.

A special case is the class of absolute (that is, translation-invariant) indices $I_A = \langle I_A^T \rangle_{T \in \mathbb{N}}$ introduced by Bossert et al. (2022). These measures are defined by:

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

for all $T \in \mathbb{N}$ and for all $x \in \mathbb{R}_{++}^{(T)}$, where the numbers $l_0, g_0 \in \mathbb{R}_{++}$ and δ are parameters. The class of indices is given by the weighted sum, with weights denoted by l_0 and g_0 , of temporally weighted losses and gains. Losses and gains are defined between two consecutive points in time. The weight given to losses, l_0 , must exceed the weight given to gains, g_0 , assuming that losses have a higher impact than gains on the individual perception of economic insecurity ("loss-priority condition").

Moreover, δ represents a discount factor that gives an increasingly low relevance to differences going back in time. Bossert et al. (2022) prove that δ must be in the interval $(0, g_0/l_0)$ to make the class of indices respect the mentioned "loss-priority condition".

Note that, indices in (1) measure economic insecurity, therefore each value of the stream is subtracted from the temporally previous one to obtain losses (negative differences) and gains (positive differences). The economic insecurity measure depends on how these differences combine.

The reason why we suggest a different version of this class of indices is driven by conceptual motivations. The main issue concerning these indices is given by the pair differences included in absolute terms, for the reasons discussed in Sect. 1. In particular, the relative change between resource levels should be used to capture the perceived individual insecurity instead of the absolute one, considering that two individuals who experience the same resource decrease (increase) in absolute value between two points in time, have a different perception of insecurity depending on the initial resource level.

We think that in the context of economic insecurity, by adopting a class of indices based on relative changes, it is possible to examine the measurement of the phenomenon from a different perspective. By including relative changes, the indices can capture some individual differences in the perception of economic insecurity that are not brought out by the previous class of measures. In this way we can compare the loss (or the gain) in resources of each individual between two points in time, measuring differently the personal evaluation of the change in resources that individuals experience.

Moreover, in the class of measures that we propose, relative changes are included in logarithmic terms, for the advantages offered by the logarithmic transformation. Because of its properties, a derivative of the logarithm of a variable with respect to time will provide the percentage change of that variable, thus rendering the logarithmic transformation very useful when measuring changes over time. Törnqvist et al. (1985), in their seminal work discuss several ways of applying the relative change and highlight the properties of the natural logarithm of the ratio of the two quantities. In particular, they emphasise the advantage in science as well as in everyday life of using the log change instead of the ordinary relative change, as log change is symmetric and additive. Obviously, results are sensitive to the choice of a transformation, as we see when comparing the results obtained from different measures (Sect. 4).

The logarithm has the limitation of not being able to be used in cases where the resource considered assumes non-positive values. However, there are resources that can reasonably be assumed to take on a positive value. This applies for example to individual income or wage (the resources used in this work), as well as to household consumption. The use of the logarithmic transformation should instead be carefully evaluated when using net wealth. Indeed, the use of net wealth is generally considered inadequate for some measures of inequality too, due to the possibility of taking negative values (Ferrante & Pacci, 2024).

Therefore, the class of indices we propose in this paper is given by the logarithmic relative (in the sense of scale-invariant) indices $I_R = \langle I_R^T \rangle_{T \in \mathbb{N}}$ defined by:

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

for all $T \in \mathbb{N}$ and for all $x \in \mathbb{R}_{++}^{(T)}$, where, for parameters l_0, g_0 and δ , the same conditions described for (1) are imposed ($l_0, g_0 \in \mathbb{R}_{++}$ and $\delta \in \left(0, \min \left\{ \frac{l_0}{g_0}, \frac{g_0}{l_0} \right\} \right)$). In Eq. (2) each resource value of the stream is divided by the next (reference base), providing a positive log ratio (loss) that contributes to increase the economic insecurity index $I_R^T(x)$, or a negative log ratio (gain) that contributes to decrease the index.

3.2 The Properties

The measures proposed satisfy the following properties: *Gain–Loss Monotonicity*, *Proximity Monotonicity*, *Quasilinearity*, *Stationarity*, *Scale Invariance*.¹ The first four properties are also satisfied by the indices suggested by Bossert et al. (2022), while the last property is related to relative change.

Property (Gain–loss Monotonicity). For all $t \in \mathbb{N}$, for all $p, q \in \mathbb{R}_{++}$, ($p > q$ to guarantee that $p - q \in \mathbb{R}_{++}$),

$$I^t(p + q, p1_t) > I^t(p, p1_t) > I^t(p - q, p1_t).$$

This property ensures that a stream of resources suffering a loss leads to a higher level of insecurity than the same stream which includes a gain in the same period.

The second property is about the timing of fluctuations. The idea is that fluctuations occurring further in the past should affect insecurity scores less than fluctuations closer to the present time. For example, if we have a “first up and then down” fluctuation in the stream x between time $-t$ and $-(t - 1)$ insecurity should be lower than that measured for the same fluctuation occurring between time $-(t - 1)$ and $-(t - 2)$.

Property (Proximity Monotonicity). For all $t \in \mathbb{N}$, for all $p, q \in \mathbb{R}_{++}$, ($p > q$ to guarantee that $p - q \in \mathbb{R}_{++}$),

$$\begin{aligned} I^{t+2}(p, p, p + q, p1_t) &> I^{t+2}(p, p + q, p, p1_t) > I^{t+2}(p, p, p, p1_t) > \\ I^{t+2}(p, p - q, p, p1_t) &> I^{t+2}(p, p, p - q, p1_t). \end{aligned}$$

The next two properties refer to the inter-temporal nature of the class of measures and are necessary when we need to aggregate diverse fluctuations over time.

Property (Quasilinearity). For all $T \in \mathbb{N} \setminus \{1\}$, there exists a function $F_{++}^T : \mathbb{R}^2 \rightarrow \mathbb{R}$, such that for all $x \in \mathbb{R}_{++}^{(T)}$,

$$I^T(x) = I^{T-1}(x_{-(T-1)}, \dots, x_0) + F^T(x_{-T}, x_{-(T-1)}).$$

This property concerns the possibility of decomposing the indices and states that if the further change is separated from the rest of the individual resource flows, the same result is obtained with respect to a certain function of the two quantities $F^T(x_{-T}, x_{-(T-1)})$.

Property (Stationarity). For all $r \in \mathbb{N}_0$, an increasing function $G^r : \mathbb{R} \rightarrow \mathbb{R}$ exists, such that for all $t \in \mathbb{N}_0$ and for all $p, p', s \in \mathbb{R}_{++}$,

$$I^{(t+2+r)}(p, p', s1_{t+1}, s1_r) = G^r(I^{t+2}(p, p', s1_{t+1})).$$

This property is relevant for indices that use geometric discounting to capture the passing of time. It ensures that if a stream made of $t + 2$ times is shifted r times in the past, a function making the $t + 2$ times stream equal to the shifted stream, always exists.

The next property is not satisfied by the Bossert et al. (2022) class of measures but is particularly relevant for the study of economic insecurity.

Property (Scale Invariance). For all $T \in \mathbb{N}$, for all $x \in \mathbb{R}_{++}^{(T)}$ and for all $b \in \mathbb{R}_{++}$:

¹ Mathematical proofs can be found in Appendix 1.

$$I^T(bx) = I^T(x).$$

This property ensures that if all the resource levels of a stream are multiplied by the same constant, the score remains unchanged. This property guarantees the possibility of evaluating the resources fluctuations, without being affected by any scalar transformation of the streams. As an example, when considering individual income streams there is no need to use the equivalence scale to compute the equivalent income because the individual score will not be affected by the scalar transformation.

4 Data and Comparison Between Relative and Absolute Indices

In this Section, we compare the indices I_R with the insecurity indices proposed by Bossert et al. (2022). We consider data from the German Socio-Economic Panel (SOEP), a well-known representative panel study that covers from 1984 to 2020 with approximately 11,000 private households. Respondents range from 16 to 91 years old and they are asked around 150 different questions about many topics, including: earnings, household composition, health, education and many more (Goebel et al., 2018). The dataset we use is an unbalanced panel of 56,213 individuals interviewed annually from 2006 to 2020.

The indices are calculated by setting $T = 3$, therefore insecurity scores are obtained for the period 2009–2020. Both indices of economic insecurity are computed with the same values for the parameters used by Bossert et al. (2022), that are: $g_0 = 15/16$, $l_0 = 1$ and $\delta = 0.9$. We used these values because, if we chose a lower value for δ , we would not give enough relevance to past fluctuations. Moreover, these choices are in line with the prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1991), and with previous empirical applications (Bossert et al., 2022).²

Individual economic insecurity scores are calculated by using the real household equivalent disposable income³ obtained based on the usual modified OECD scale (Grabka, 2022). The same score is assigned to all members of the same household.⁴

In Fig. 1 individuals are plotted according to insecurity scores obtained for 2020. Individual scores obtained from the absolute index I_A (Eq. 1) are reported on the X-axis, while scores obtained from the relative index I_R (Eq. 2) are reported on the Y-axis.

Dots are mostly allocated in the first and the third quadrants, thus highlighting the substantial coherence between the two indices. However, dots are somewhat spread in both the mentioned quadrants, and sometimes small scores (in absolute value) of the I_A are associated with high scores (in absolute value) of the I_R and vice-versa. In particular, the graph shows the presence of extremely insecure individuals according to the relative measure, but not based on the absolute one that, being built considering absolute fluctuations, fails in capturing high relative losses that can have a strong influence on the perception of insecurity. In other words, this result highlights that the two indices measure

² Results with different parameter values are available upon request. Small changes in the chosen values do not noticeably affect the results.

³ Since in this panel the households' size changes over time, it is not possible to apply the *Scale Invariance* because the equivalent scale changes over time according to the household size.

⁴ To compute the insecurity scores for the relative index, individuals with the equivalent disposable household income equal to 0 or negative are excluded. However, they represent only 4% of the observations.

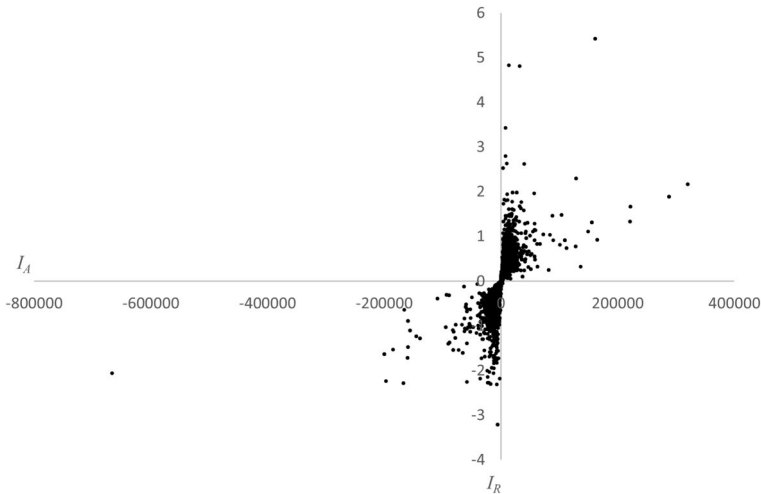


Fig. 1 Scatter-plot of individual economic insecurity scores in 2020, as defined in I_R and I_A . *Source:* Own elaboration on SOEP data

economic insecurity in different ways, capturing different aspects as they move from different conceptual premises.

To understand if these differences in the individual scores also lead to different interpretations of the phenomenon at an aggregated level, the weighted median and mean are calculated for each wave from 2009 to 2020 (Fig. 2). The two economic insecurity indices basically provide the same trend on median and on mean.

Among the overall decline in economic insecurity after the Great Recession, it is possible to detect two peaks where the insecurity slightly grows, in 2014 and from 2018 onwards. The first one might be due to the beginning of a program of structural reforms about taxation, research development, and the support to entrepreneurship that started in Germany in 2013 (Berger et al., 2018). The second one in 2018, might be related to the contraction of the real GDP growth which occurred in Germany from 2018 (Destatis, 2019).

However, the synthesis obtained with medians and means hides the heterogeneity of the scores highlighted in Fig. 1. In fact, when looking at the more extreme values of the distributions of insecurity scores (i.e. the 1st and 99th percentiles) the trends are quite diverse (bottom panel of Fig. 2). Even considering that the two ranges of values are different, we can observe opposite trends over many years. Moreover, I_R seems varies over time more than I_A with reference to positive outliers (99th percentile). This result is in line with the already observed presence of extremely insecure individuals according to the relative measure, but not based on the absolute one (Fig. 1).

This finding highlights that the two indices provide more similar results for individuals having more stable income streams, while they tend to produce more different results for individuals experiencing larger income fluctuations. To further investigate this issue, we measure the correlation between I_R and I_A for different levels of insecurity. We notice that for I_R values around zero - between -0.5 and 0.5 - the correlation between the two indices ranges from 0.50 to 0.72 in the considered waves, while for I_R values higher than 1 in absolute value, the correlation ranges between 0.04 and 0.25 in the considered waves.

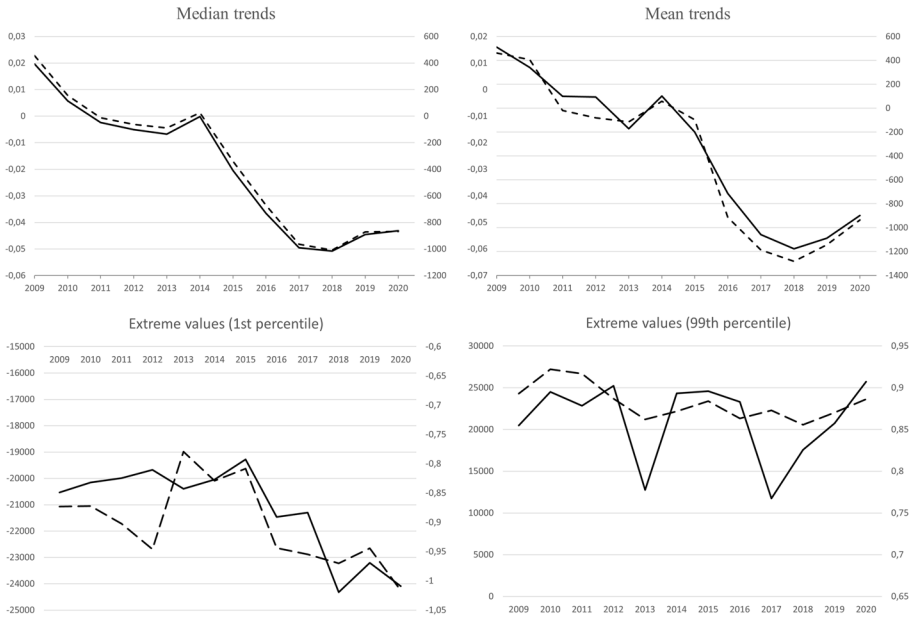


Fig. 2 Mean and other quantiles trends of insecurity scores from 2009 to 2020, as defined in I_R and I_A . The continuous line represents I_R while the dotted one represents I_A . *Source:* Own elaboration on SOEP data

5 Economic Insecurity and Job Change

To study the effect of economic insecurity on the choice of changing job, we restrict our analysis to working individuals from 2006 to 2020 (due to the 3-year lag needed to compute the I_R , the time span considered in the analysis is from 2009 to 2020) obtaining an unbalanced panel of 20,191 individuals and 93,125 observations. The outcome variable is a dummy equals to 1 if respondents have voluntarily changed their job moving to a different employer in the previous year; 0 otherwise. Therefore, our target variable is 1 if the respondents state: i) they changed jobs or started a new one since January 1st (previous year) and ii) they started a new job with a different employer. In the whole panel, 20% of the individuals have had at least one job change in all the time spans considered, while if we consider each different year this proportion is around 7%, but grows between 2009 and 2019 from 5 to 8% and falls by one percentage point in 2020.

For individuals who change their job because they are dismissed by their previous employer, the job change is not intentional. Considering the whole sample, among individuals who have changed job, 10% were dismissed earlier in the same year while, when considering all the waves, this percentage varies over years, peaking in 2010 (18%) and falling in 2017 (8%). Since we want to consider voluntary job changes, these individuals are excluded from our analysis.

Analyzing the individuals in the sample who change job according to our definition, we notice that most of them (57.7%) do not change their profession in terms of skills requested or related duties (if they are white/blue collar in a specific status in terms of skills required, they remain in the same status). The remaining 42.3% of individuals are divided almost equally between those who change occupation in terms of tasks to do (white collar, blue

collar, civil servant or apprentice 35%), individuals who stay in the same occupation but improve their status within the occupation (33%) or worsen it (32%).

Among those who change occupation, the majority switch from blue collar to white collar (42%). Likewise, more than half of the individuals changing job (58.3%) switch to a job where they work more hours. Considering the size of the employing firm, 38% of workers prefer to move to a bigger firm while only 28% move to a smaller one. This last result is probably related to the attraction of higher salaries, typically offered by bigger firms (Brown & Medoff, 1989; Gibson & Stillman, 2009).

To measure economic insecurity, an index of the class suggested is used. The index is computed by considering a lag of 3 periods and the same values for the parameters discussed in Sect. 3. The resource considered in this section for the computation of the index is the real “individual wage or salary from main job of individuals”.⁵

We want to evaluate the economic insecurity related to the main occupation and its effect on job change intentions, therefore we find it more adequate to consider the individual wage as the relevant resource rather than the equivalent disposable income. However, the real equivalent disposable household income of the previous year is used as a control in our model to account for the households’ whole economic conditions.

The other individual controls included in the analysis are chosen according to the literature on this phenomenon (Bossert et al., 2022; D’Ambrosio et al., 2018). They are: the age of the individual in classes (21–29, 30–39, 40–49, 50–59 and 60–76), gender (dummy variable equal to 1 for males), marital status (dummy variable equal to 1 if the respondent is married), self-rated health status (ordinal categorical variable assuming the following values: 1 - “bad”, 2 - “poor”, 3 - “satisfactory”, 4 - “good” and 5 - “very good”), years of education, the number of children in the household, and the number of annual working hours. Other psychological and personality aspects, that are considered relevant in the literature, such as personality traits or risk aversion, are captured by the individual specific effects included in the model.

Table 1 shows some descriptive statistics computed considering all the waves. We notice that the sample is equally divided by male and female, 66% of the individuals are married, and respondents are spread among the 5 age classes considered with more than the 60% of the respondents between 40 and 59 years old. The average self-rated health status is 3.5. The insecurity index takes values between -5.17 and 7.18 .

5.1 The Model

To study the possible effect of economic insecurity on the probability of changing job, a linear probability model is considered. The linear model is usually preferred in this field due to the possibility of using the fixed effect approach for dealing with unobserved time invariant individual effects (as in D’Ambrosio et al., 2018). The alternative would be to assume random specific effects, but this approach is usually inadequate for this type of data, because the independence among the unobserved effects and all the covariates of the model is difficult. We check this possibility using the Hausman test, which compares the fixed effects model and the random effects model. The null hypothesis is rejected at 5% level, thus suggesting the use of the fixed effects approach.

⁵ This variable represents wage or salary from main job of individuals in the household that are 16 years of age and older (Grabka, 2022).

Table 1 Descriptive statistics

| | Mean | SD | Min | Max |
|---------------------------------|----------|----------|------------|-----------|
| Insecurity index (I_R) | -0.08 | 0.51 | -5.17 | 7.18 |
| Insecurity index (I_A) | -1,420.2 | 11,894.3 | -908,937.6 | 457,716.1 |
| Equivalent disposable HH income | 27,324.3 | 16,015.1 | 1,323.5 | 1,050,209 |
| Years of education | 12.62 | 3.31 | 7 | 18 |
| Number of children | 0.78 | 1.04 | 0 | 11 |
| Annual working hours | 1,921.28 | 689.89 | 0 | 6,711 |
| Self rated health status | 3.49 | 0.86 | 1 | 5 |
| Age | 46.42 | 10.51 | 20 | 76 |
| | % | | | |
| Job mobility | 7% | | | |
| Female | 50% | | | |
| Married | 66% | | | |
| Age categories: | | | | |
| From 21 to 29 | 7% | | | |
| From 30 to 39 | 19% | | | |
| From 40 to 49 | 32% | | | |
| From 50 to 59 | 30% | | | |
| From 60 to 76 | 12% | | | |
| N. of observations | 93,125 | | | |
| N. of individuals | 20,191 | | | |

Source: Own elaboration on SOEP data

Moreover, we also check the possibility of using a random effects model by using the Mundlak approach (Mundlak, 1978) as suggested by Greene (2018, Sect. 17.7). This approach consists of adding the vector containing the inter-temporal means of all the time varying covariates in the model with the individual random effects, and then performing a Wald test on the intertemporal means coefficients. If the coefficients are significantly diverse from 0, the fixed effects model should be preferred to the random effects one. In our case this approach also suggests using the individual fixed effects model.

As widely discussed in the literature, probit and logit models for panel data may bring serious bias when dealing with fixed effects approach, due to the “incidental parameter problem” (Chamberlain, 1980; Neyman & Scott, 1948). A solution to this bias is proposed in Chamberlain (1980) where the conditional logit model is suggested. By conditioning on the sum of the outcomes it is possible to tackle the “incidental parameter problem” and to estimate the coefficients. Nevertheless, marginal effects cannot be computed with this approach, with consequent limits for the interpretation of the coefficients (Greene, 2018).

Therefore, in addition to the linear model we estimate a conditional logit model with fixed effects, as a robustness analysis, for checking the sign and the significance of the coefficients. If results are coherent with the conditional logit model, we interpret the magnitude of the coefficients produced by the linear probability model (LPM).

We specify the following regression model with two-way effects:

Table 2 Job change and economic insecurity: parameter estimates in LPM and C. Logit models

| | LPM Estimate (SE) | C. Logit Estimate (SE) |
|-------------------------|----------------------|---------------------------|
| I_R | 0.019*** (0.004) | 0.162*** (0.040) |
| $\ln(\text{HH income})$ | -0.007 (0.008) | -0.127 (0.108) |
| Year 2020 | -0.029*** (0.006) | -0.558*** (0.140) |
| N. of observations | 70,111 | 70,111 |
| N. of individuals | 15,095 | 15,095 |

Source: Own elaboration on SOEP data

Dependent variable: probability of changing job (time t). All covariates considered at time $t-1$

Coefficient estimates of all the other covariates are available in Tables 6, 7 and 8 in Appendix 2

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

$$\text{JobChange}_{i,t} = \beta_0 + \beta_1 I_{R_{i,t-1}} + \beta_2 \ln(\text{HHincome})_{i,t-1} + \beta_3 X_{i,t-1} + \alpha_i + \omega_t + \gamma_{i,t} + \varepsilon_{i,t} \quad (3)$$

All the auxiliary variables are included with a lag of 1 year, assuming that individuals decide to change job at year t on the basis of what happened the previous year. The dependent variable is the dummy created as discussed above considered at time t , β_0 is the constant term, $I_{R_{i,t-1}}$ is the relative insecurity index and $\ln(\text{HHincome})_{i,t-1}$ is the logarithm of the real equivalent disposable household income. Vector $X_{i,t-1}$ contains all the other controls, α_i represent the individual unobserved effects, ω_t the years effects, $\gamma_{i,t}$ the regional effects (the länder of residence of the individual) and $\varepsilon_{i,t}$ the error terms.

5.2 Results

Estimated model parameters are presented in Table 2, while estimated controls coefficients, time effects and regional effects are available in Tables 6, 7 and 8 in Appendix 2. In the first column, results from the linear probability model are shown, while results from the conditional logit model are reported in the second column.

Economic insecurity has a positive significant effect at 1% level in both models. Therefore, controlling for all the other individual characteristics, more economically insecure respondents are more likely to change their job. According to OLS estimates, if I_R increases by 1, the probability of changing job increases by about 0.02, ceteris paribus. The amount of such effect is comparable to those of other significant auxiliary variables as, for example, some age categories, the marital status and some year effects (see Appendix 2), that range in absolute value from 0.014 to 0.051. Considering that I_R ranges from -5.17 to 7.18, its effect on the probability of changing job appears relevant and highlights, ceteris paribus, a high difference in the probability of changing job between the least and the most insecure individuals.

Insecure individuals, who experienced negative earnings fluctuations without being able to recover, seem to prefer to change their job looking for a more stable earnings flow. We think that this result is strictly related to the characteristics of the German labor market, that is one of the most flourishing in the EU, both in terms of long-term and short-term unemployment (Krebs & Scheffel, 2013; Rinne & Zimmermann, 2013). In this market workers might find it easier to change job than in other countries where the job-to-job

transition is more contained. Germany has experienced a reduction of the unemployment rate over time until 2019, as shown in Fig. 3 (Appendix 2), where this rate is compared with the percentage of people who changed job according to the SOEP survey in the same period. The figure shows opposite trends for the two rates highlighting the favorable conditions of the German labor market in the period considered.

Moreover, it is interesting to notice how the logarithm of the real disposable household income is not meaningful in either model. Regarding the year fixed effects, only 2020 has a significant impact, with respect to the other years, and its effect is negative, i.e. the probability of changing job in this year is almost 0.03 lower than in the other years. This may be interpreted as a *job-keeping* effect of the pandemic on the employees' job-to-job transitions, which may be explained by the fall in the labor supply due to the pandemic. This result is coherent with the previous literature about the effects of a crisis on employee turnover intention, as in Wynen and Op de Beeck (2014) where a similar dynamic is found during the Great Recession. Furthermore, the number of children in the household and the annual working hours are significant determinants, while the education level is not significant (Table 6 in Appendix 2).

5.2.1 Comparison Between I_R and I_A

With the objective of understanding better the potential offered by an indicator of relative economic insecurity as a determinant in a model for the probability of changing jobs, we estimate the same model considering I_R and I_A as alternative auxiliary variables. Table 3 shows the estimates of the model coefficients obtained using both the conditional logit model with fixed effects (C. Logit) and the linear probability model with fixed effects (LPM). To compare the magnitude of the estimated coefficients of the LPM, we standardize the scores obtained from I_A (as in Bossert et al., 2022).

Results confirm the capability of both indicators to represent the perception of economic insecurity that leads individuals to change their occupation, as both indicators turn out to be significant and do have a positive impact on the probability of changing jobs. These results hold in all the models considered. According to the LPM estimates, the effect of I_R is three times larger than the estimated effect of I_A : ceteris paribus, if I_R increases by one, the probability of changing job increases by 0.019, while if standardized I_A increases by one, the probability increases by 0.006.

Furthermore, the goodness-of-fit measures, AIC and BIC, reported in the last rows of the table, highlight that models with I_R fit the data better. The p-value associated to the two economic insecurity indicators also shows a slightly higher significance of I_R with respect to I_A .

5.3 Heterogeneity Analysis

In Sect. 4.2 we find a significant relationship between the measure of economic insecurity proposed and the probability of changing job. In order to further deepen our analysis, we focus on specific sub-populations, to verify whether the observed relationship is also confirmed for such sub-populations. We are specifically interested in detecting possible differences between genders and age classes.

To study heterogeneity among ages, we split the sample into four age classes: from 18 to 29 where we have young workers, from 30 to 39 where workers have some

Table 3 Comparison between economic insecurity indicators: parameter estimates in models for the probability of changing job

| Covariate | LPM | | C.Logit | | LPM | | C.Logit | |
|-------------------------|-----------------------|-----------------|-----------------------|-----------------|----------------------|-----------------|-----------------------|-----------------|
| | Estimate (SE) | <i>p</i> -value | Estimate (SE) | <i>p</i> -value | Estimate (SE) | <i>p</i> -value | Estimate (SE) | <i>p</i> -value |
| I_R | 0.019*** (-0.004) | 0.000 | 0.162*** (-0.040) | 0.000 | | | | |
| I_A (std.) | | | | | 0.006*** (-0.002) | 0.001 | 0.084*** (-0.026) | 0.001 |
| ln(HH income) | -0.007 (-0.008) | 0.237 | -0.127 (0.108) | 0.389 | -0.008 (-0.008) | 0.316 | -0.11 (-0.110) | 0.302 |
| Year 2020 | -0.029*** (-0.006) | 0.000 | -0.027*** (-0.006) | 0.000 | -0.558*** (-0.14) | 0.000 | -0.550*** (-0.139) | 0.000 |
| N. of obser- vations | 70,111 | | 70,111 | | 70,111 | | 70,111 | |
| N. of indi- viduals | 15,095 | | 15,095 | | 15,095 | | 15,095 | |
| Log-likeli- hood | - | | -4,961.6725 | | - | | -4,964.2277 | |
| AIC | -36,748.932 | | 10,001.345 | | -36,700.718 | | 10,006.455 | |
| BIC | -36,391.777 | | 10,297.058 | | -36,343.563 | | 10,302.168 | |

Source: Own elaboration on SOEP data

Dependent variable: probability of changing job (time t). All covariates considered at time $t-1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

experience, from 40 to 49, which can be considered the class of workers in mid-career, and from 50 to 69, the with most experienced workers' class. For each different subsample the same model (Eq. 3) is run. Results obtained from the model estimated by gender are reported in Table 4, while those obtained from the model estimated by age class are available in Table 5.

Even if insecurity has a significant positive effect for both men and women, we can notice that magnitude differs. Indeed, the impact of insecurity on the probability of changing job is doubled for males (0.028) than for females (0.014). Despite the effects of economic insecurity on the probability of changing jobs being lower, there is a *job-keeping* effect if females are married, highlighted by the negative coefficient of the marital status.

This dynamic is in line with the past literature about gender inequalities in the labor market. Indeed, women tend to be more risk averse (Cortés et al., 2021) and less willing to compete in the labor market (Buser et al., 2014). These evidences can explain both the lower impact of the insecurity indicator and the negative coefficient of marital status that we find in our results. The same dynamic is not found for males, for whom being married is not a significant determinant.

Age classes are also significant for females, with a negative effect with respect to the excluded category, that is the first one (from 18 to 29 years old). Therefore, the probability of changing job is always lower for the higher age classes. The time effect is significant for both groups in 2020 and only for women in 2018 and 2019, showing a lower probability of changing job for women in these periods (compared to 2010).

Table 4 Comparison between genders: parameter estimates in the LPM

| Covariate | Male Estimate (SE) | Female Estimate (SE) |
|------------------------|-----------------------|-------------------------|
| I_R | 0.028*** (0.007) | 0.014*** (0.004) |
| ln(HH income) | -0.003 (0.012) | -0.010 (0.010) |
| Year 2018 | -0.002 (0.007) | -0.015** (0.008) |
| Year 2019 | -0.009 (0.008) | -0.021** (0.008) |
| Year 2020 | -0.026*** (0.008) | -0.033*** (0.009) |
| <i>Age categories:</i> | | |
| Age category (=2) | -0.031 (0.020) | -0.063*** (0.019) |
| Age category (=3) | -0.031 (0.022) | -0.070*** (0.022) |
| Age category (=4) | -0.032 (0.023) | -0.054** (0.024) |
| Age category (=5) | -0.037 (0.025) | -0.051** (0.026) |
| Married | -0.007 (0.010) | -0.024** (0.010) |
| N. of observations | 35,071 | 35,040 |
| N. of individuals | 7,458 | 7,637 |

Source: Own elaboration on SOEP data

Dependent variable: probability of changing job (time t). All covariates considered at time $t-1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

Table 5 Comparison between age classes: parameter estimates in the LPM

| Covariate | 16–29 Estimate (SE) | 30–39 Estimate (SE) | 40–49 Estimate (SE) | 50–69 Estimate (SE) |
|--------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| I_R | 0.009 (0.014) | -0.001 (0.007) | 0.035*** (0.007) | 0.022*** (0.006) |
| ln(HH income) | -0.033 (0.047) | -0.043* (0.023) | 0.006 (0.017) | 0.006 (0.009) |
| Year 2015 | -0.181*** (0.051) | -0.023 (0.017) | 0.004 (0.009) | -0.003 (0.005) |
| Year 2016 | -0.163*** (0.051) | -0.014 (0.019) | 0.003 (0.009) | -0.009* (0.005) |
| Year 2017 | -0.174*** (0.056) | -0.031 (0.020) | 0.005 (0.010) | -0.010* (0.005) |
| Year 2018 | -0.211*** (0.060) | -0.037* (0.021) | -0.006 (0.010) | -0.006 (0.005) |
| Year 2019 | -0.210*** (0.066) | -0.034 (0.023) | -0.003 (0.011) | -0.021*** (0.006) |
| Year 2020 | -0.201*** (0.069) | -0.085*** (0.023) | -0.023* (0.012) | -0.025*** (0.006) |
| N. of observations | 2,940 | 11,366 | 21,307 | 28,872 |
| N. of individuals | 1,368 | 3,881 | 6,276 | 6,839 |

Source: Own elaboration on SOEP data

Dependent variable: probability of changing job (time t). All covariates considered at time $t-1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

Results obtained by estimating the model for age classes show that the insecurity index is significant for all the classes apart from the youngest two. Economic insecurity does matter more when individuals have gained some working experience and it is more likely they have a family that needs more financial stability. For the youngest class, neither economic insecurity nor past income are significant determinants for the probability of changing job, while time effects are significant from 2015 to 2020, where they have a strong negative impact compared to the base year 2010.

It is possible to identify different underlying mechanisms behind this result. Firstly, it might be linked to the job market dynamics which, with respect to 2010, brought a decrease in the labor demand for young and untrained workers. This translated into a lower probability for them to find a valid alternative to decide to change job. This strong year's effect disappears in the other age classes, apart from the year 2020 which is the only one that is significant among all the age classes with a negative effect. As already discussed in Sect. 4.2, this dynamic can be interpreted as due to the Covid-19 pandemic, which blocked the economy and forced people to keep their job during 2020.

6 Conclusions

Past literature has stressed the importance of measuring different aspects of well-being also to help policymakers and drive economic policies. The present work belongs to the specific strand of literature, relevant to the empirical analysis of economic insecurity, which has focused on the measure of economic insecurity at an individual level (Rohde & Tang, 2018).

Embracing the approach proposed by Bossert et al. (2022), we contribute to the literature suggesting a new version of their class of indices, based on the consideration of the logarithmic transformation of relative changes in past resource levels. This idea aligns with the prospect theory (Kahneman & Tversky, 1979), since with the relative changes the magnitude of each consecutive change is evaluated considering the starting point. The class of indices proposed satisfies some important properties concerning the ordering of individual streams (*Gain–loss monotonicity*, *Proximity monotonicity*), the aggregation of fluctuations over time (*Stationarity*, *Quasilinearity*) and the invariance to certain individual stream transformations (*Scale invariance*).

The comparison with the Bossert et al. (2022) proposal highlights that, from an individual perspective, the two classes of measures capture some different aspects of economic insecurity. While on average they turn out to provide similar results, they provide different measurements for individual insecurity especially when considering highly fluctuating income flows.

The relative index obtained by using specific values for the parameters included in the class of indices suggested, is also used to evaluate the impact of economic insecurity on the probability of changing job. We assume that the anxiety produced by past fluctuations in income may push individuals to change jobs, looking for a more stable working condition.

Our results highlight three important findings. First, economic insecurity is positively related with the probability of changing job. Second, the index proposed is preferable than the Bossert et al. (2022) one, for capturing the economic uncertainty that contributes to such a decision. This result gives, on one side, further empirical evidence on the importance of the prospect theory principle in evaluating changes in the magnitude of economic outcomes; on the other side, it provides new insights in the study of economic insecurity. Third, the

heterogeneity analysis, carried out by gender and age classes, suggests that economic insecurity affects the decision to change jobs especially for male and older age classes.

The class of economic insecurity indices proposed in this paper represent a first proposal that may be further improved to capture the feeling of economic insecurity better. For example, a simulation study might be carried out to evaluate the sensitivity of the indices to different values of the parameters and different numbers of points in time involved in the formula. Moreover, the class of indices proposed may be useful to study the relationship between economic insecurity and other aspects of well-being, such as life satisfaction, poverty, or economic deprivation.

Appendix 1

Proofs

Property (Gain–loss Monotonicity). For all $t \in \mathbb{N}$, for all $p, q \in \mathbb{R}_{++}$, ($p > q$ to guarantee that $p - q \in \mathbb{R}_{++}$).

$$I^t(p + q, p1_t) > I^t(p, p1_t) > I^t(p - q, p1_t)$$

Proof. Considering the function $\ln\left(\frac{x_t}{x_{-(t-1)}}\right)$:

$$\ln\left(\frac{x_t}{x_{-(t-1)}}\right) \begin{cases} > 0 & \text{if } \frac{x_t}{x_{-(t-1)}} > 1 \\ = 0 & \text{if } \frac{x_t}{x_{-(t-1)}} = 1 \\ < 0 & \text{if } 0 < \frac{x_t}{x_{-(t-1)}} < 1. \end{cases}$$

Considering that $l_0, g_0 \in \mathbb{R}_{++}$, $t \in \mathbb{N}$, and $\delta \in \left(0, \min\left\{\frac{l_0}{g_0}; \frac{g_0}{l_0}\right\}\right)$, $l_0\delta^{t-1}$ and $g_0\delta^{t-1}$ are positive $\forall l_0, g_0 \in \mathbb{R}_{++}$. Hence:

$$\begin{aligned} I'_R(p + q, p1_t) &> 0. \\ I'_R(p, p1_t) &= 0. \\ I'_R(p - q, p1_t) &< 0. \end{aligned}$$

Therefore I'_R satisfies the property.

Property (Proximity Monotonicity). For all $t \in \mathbb{N}$, for all $p, q \in \mathbb{R}_{++}$, ($p > q$ to guarantee that $p - q \in \mathbb{R}_{++}$),

$$\begin{aligned} I^{t+2}(p, p, p + q, p1_t) &> I^{t+2}(p, p + q, p, p1_t) > I^{t+2}(p, p, p, p1_t) > \\ I^{t+2}(p, p - q, p, p1_t) &> I^{t+2}(p, p, p - q, p1_t). \end{aligned}$$

Proof. Replacing the I^{t+2} (Eq. 2) in the Proximity Monotonicity general condition, we obtain:

$$\begin{aligned} l_0\delta^{t-1}\ln\left(\frac{p+q}{p}\right) + g_0\delta^t\ln\left(\frac{p}{p+q}\right) &> l_0\delta^t\ln\left(\frac{p+q}{p}\right) + g_0\delta^{t+1}\ln\left(\frac{p}{p+q}\right) > 0 > \\ l_0\delta^{t+1}\ln\left(\frac{p}{p-q}\right) + g_0\delta^t\ln\left(\frac{p-q}{p}\right) &> l_0\delta^t\ln\left(\frac{p}{p-q}\right) + g_0\delta^{t-1}\ln\left(\frac{p-q}{p}\right). \end{aligned}$$

By the properties of the logarithm:

$$\begin{aligned} \ln\left(\frac{p+q}{p}\right)[l_0\delta^{t-1} - g_0\delta^t] &> \ln\left(\frac{p+q}{p}\right)[l_0\delta^t - g_0\delta^{t+1}] > 0 > \\ \ln\left(\frac{p-q}{p}\right)[g_0\delta^t - l_0\delta^{t+1}] &> \ln\left(\frac{p-q}{p}\right)[g_0\delta^{t-1} - l_0\delta^t]. \end{aligned}$$

The above inequalities may be also written as:

$$\begin{aligned} \ln\left(\frac{p+q}{p}\right)\delta^{t-1}[l_0 - g_0\delta] &> \ln\left(\frac{p+q}{p}\right)\delta^t[l_0 - g_0\delta] > 0 > \\ \ln\left(\frac{p-q}{p}\right)\delta^t[g_0 - l_0\delta] &> \ln\left(\frac{p-q}{p}\right)\delta^{t-1}[g_0 - l_0\delta]. \end{aligned}$$

This succession of inequalities are satisfied if $l_0, g_0 \in \mathbb{R}_{++}, t \in \mathbb{N}$ and $\delta \in \left(0, \min\left\{\frac{l_0}{g_0}, \frac{g_0}{l_0}\right\}\right)$, because:

- $[g_0 - l_0\delta]$ is positive for $\delta \in \left(0, \min\left\{\frac{l_0}{g_0}, \frac{g_0}{l_0}\right\}\right)$;
- $[l_0 - g_0\delta]$ is positive for $\delta \in \left(0, \min\left\{\frac{l_0}{g_0}, \frac{g_0}{l_0}\right\}\right)$;
- $\ln\left(\frac{p+q}{p}\right)$ is positive and $\ln\left(\frac{p-q}{p}\right)$ is negative;
- $|\delta^{t-1}| > |\delta^t|$ if $\delta \in \left(0, \min\left\{\frac{l_0}{g_0}, \frac{g_0}{l_0}\right\}\right)$.

It follows that the property is satisfied by I'_R .

Property (Quasilinearity). For all $T \in \mathbb{N} \setminus \{1\}$, there exists a function $F^T_{++} : \mathbb{R}^2 \rightarrow \mathbb{R}$, such that for all $x \in \mathbb{R}^T_{++}$,

$$I^T(x) = I^{T-1}(x_{-(T-1)}, \dots, x_0) + F^T(x_{-T}, x_{-(T-1)}).$$

Proof.

Considering the function $F^T_{++} : \mathbb{R}^2 \rightarrow \mathbb{R}$:

$$F^T(x, y) = \begin{cases} l_0\delta^{T-1}\ln\left(\frac{x}{y}\right) & \text{if } x \geq y \\ g_0\delta^{T-1}\ln\left(\frac{x}{y}\right) & \text{if } x < y, \end{cases}$$

the property is satisfied by I'_R .

Property (Stationarity). For all $r \in \mathbb{N}_0$, an increasing function $G^r : \mathbb{R} \rightarrow \mathbb{R}$ exists, such that for all $t \in \mathbb{N}_0$ and for all $p, p', s \in \mathbb{R}_{++}$,

$$I^{(t+2+r)}(p, p', s1_{t+1}, s1_r) = G^r(I^{t+2}(p, p', s1_{t+1})).$$

Proof. Considering the function $G^r : \mathbb{R} \rightarrow \mathbb{R}, G^r(y) = \delta^r y$, and replacing I'_R , in the general condition of Stationarity, we obtain:

$$I^{(t+2+r)}_R(p, p', s1_{t+1}, s1_r) = \delta^r \left(I^{(t+2)}_R(p, p', s1_{t+1}) \right).$$

Considering that $s1_r$ is a vector of constant values, the two streams lead to the same level of insecurity. It follows that the property is satisfied by I_R^t .

Property (Scale Invariance). *For all $T \in \mathbb{N}$, for all $x \in \mathbb{R}_{++}^{(T)}$ and for all $b \in \mathbb{R}_{++}$:*

$$I^T(bx) = I^T(x).$$

Proof. Scaling all values of $x \in \mathbb{R}_{++}^{(T)}$ by a fixed amount $b \in \mathbb{R}_{++}$ does not change the result of the function due to the definition of relative change. Therefore, this property is satisfied by I_R^t .

Appendix 2

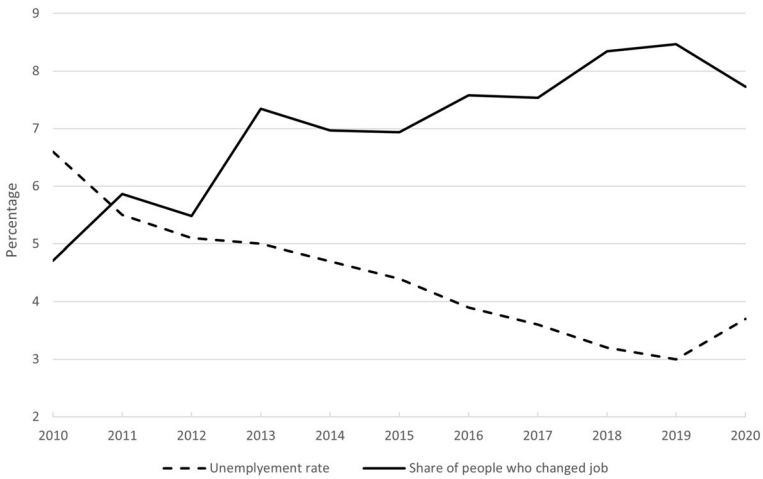


Fig. 3 Comparison between the unemployment rate and the share of people who changed job over time in Germany. *Source* Own elaboration on SOEP data

Table 6 Job change and economic insecurity: parameter estimates of the individual controls in LPM and C. Logit models

| Covariate | LPM | C. Logit |
|----------------------------------|-------------------|-------------------|
| | Estimate (SE) | Estimate (SE) |
| I_R | 0.019*** (0.004) | 0.162*** (0.040) |
| ln(HH income) | -0.007 (0.008) | -0.127 (0.108) |
| <i>Age categories:</i> | | |
| Age categories (=2) | -0.048*** (0.014) | -0.411*** (0.149) |
| Age categories (=3) | -0.051*** (0.015) | -0.448** (0.194) |
| Age categories (=4) | -0.043*** (0.017) | -0.313 (0.240) |
| Age categories (=5) | -0.044** (0.018) | -0.474 (0.318) |
| Married | -0.016** (0.007) | -0.224* (0.121) |
| <i>Self rated health status:</i> | | |
| Self rated health status (=2) | 0.011 (0.008) | 0.321 (0.232) |
| Self rated health status (=3) | -0.001 (0.009) | 0.063 (0.232) |
| Self rated health status (=4) | -0.006 (0.009) | -0.044 (0.233) |
| Self rated health status (=5) | 0.000 (0.010) | 0.076 (0.245) |
| Years of education | -0.013 (0.010) | -0.043 (0.090) |
| Number of children | -0.004 (0.003) | -0.073 (0.058) |
| Annual working hours | -0.000*** (0.000) | -0.000*** (0.000) |
| N. of observations | 70,111 | 70,111 |
| N. of individuals | 15,095 | 15,095 |

Source: Own elaboration on SOEP data

The dependent variable is the probability of changing job (time t). All covariates considered at time $t-1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

Table 7 Job change and economic insecurity: parameter estimates of the time controls in the LPM and C. Logit models

| Covariate | LPM | C. Logit |
|----------------------|-------------------|-------------------|
| | Estimate (SE) | Estimate (SE) |
| I_R | 0.019*** (0.004) | 0.162*** (0.040) |
| ln (HH income) | -0.007 (0.008) | -0.127 (0.108) |
| <i>Years effect:</i> | | |
| 2011 | 0.004 (0.003) | 0.091 (0.108) |
| 2012 | 0.004 (0.004) | 0.103 (0.112) |
| 2013 | 0.006 (0.004) | 0.177 (0.114) |
| 2014 | -0.000 (0.004) | 0.006 (0.114) |
| 2015 | -0.004 (0.005) | -0.057 (0.115) |
| 2016 | -0.004 (0.005) | -0.060 (0.118) |
| 2017 | -0.006 (0.005) | -0.118 (0.12) |
| 2018 | -0.008 (0.005) | -0.150 (0.126) |
| 2019 | -0.014** (0.006) | -0.278** (0.132) |
| 2020 | -0.029*** (0.006) | -0.558*** (0.140) |
| N. of observations | 70,111 | 70,111 |
| N. of individuals | 15,095 | 15,095 |

Source: Own elaboration on SOEP data

The dependent variable is the probability of changing job (time t). All covariates considered at time $t-1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

Table 8 Job change and economic insecurity: parameter estimates of the regional control in LPM and C. Logit models

| Covariate | LPM Estimate (SE) | C. Logit Estimate (SE) |
|--------------------------|----------------------|---------------------------|
| I_R | 0.019*** (0.004) | 0.162***(0.040) |
| ln (HH income) | -0.007 (0.008) | -0.127 (0.108) |
| <i>Regional effects:</i> | | |
| Hamburg | 0.039 (0.082) | 0.304 (0.570) |
| Niedersachsen | 0.007 (0.090) | -0.038 (0.791) |
| Bremen | 0.159 (0.170) | 14.593 (326.322) |
| Nordrhein-Westfalen | -0.079 (0.103) | -0.610 (0.743) |
| Hessen | -0.096 (0.106) | -0.866 (0.794) |
| Rheinland-Pfalz,Saarland | -0.023 (0.133) | -0.186 (0.930) |
| Baden-Wuerttemberg | 0.020 (0.109) | 0.058 (0.783) |
| Bayern | -0.047 (0.101) | -0.437 (0.844) |
| Saarland | 0.084 (0.364) | 0.641 (1.825) |
| Berlin | -0.007 (0.110) | 0.598 (0.947) |
| Brandenburg | -0.017 (0.107) | 0.718 (0.949) |
| Mecklenburg-Vorpommern | 0.130 (0.130) | 1.878* (1.067) |
| Sachsen | -0.096 (0.117) | -0.709 (0.949) |
| Sachsen-Anhalt | -0.194 (0.178) | -1.105 (1.413) |
| Thueringen | -0.186 (0.132) | -1.687 (1.109) |
| N. of observations | 70,111 | 70,111 |
| N. of individuals | 15,095 | 15,095 |

Source: Own elaboration on SOEP data

The dependent variable is the probability of changing job (time t). All covariates considered at time $t - 1$

* p -value < 0.1, ** p -value < 0.05, *** p -value < 0.01

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Declarations

Conflict of interest The authors have no conflict of interests to declare related to this publication.

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