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Measuring Economic Insecurity with Stata

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In this paper, we introduce and describe the economic_insecurity package in Stata, containing the economic_insecurity, ei_abs, and ei_rel commands. The commands calculate the measures according to the economic insecurity indices characterized in Bossert et al. (2023) and Bossert and Dâ€™Ambrosio (2024).

Keyword: economic insecurity, Stata, economic_insecurity, ei_abs, ei_rel

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Abstract

In this paper, we introduce and describe the `economic_insecurity` package in Stata, containing the `economic_insecurity`, `ei_abs`, and `ei_rel` commands. The commands calculate the measures according to the economic insecurity indices characterized in Bossert et al. (2023) and Bossert and D'Ambrosio (2024).

Keywords: economic insecurity, Stata, `economic_insecurity`, `ei_abs`, `ei_rel`.
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This article and its code are under review by the Stata Journal. The current version of the Stata package can be found at `https://github.com/FedericoFiorani/economic_insecurity`. The guidelines to use the package are in section 6. Please cite this paper when using the code. [1]

[1]Acknowledgments: We are grateful to Anthony Lepinteur for his support and feedback, to Philippe Van Kerm for his technical comments, and to Conchita D'Ambrosio for her initial input to this project. This research is supported by the Luxembourg National Research Fund (FNR) (PRIDE23/18689055).

1 Overview

Economic insecurity is the psychological state of anxiety experienced by individuals who perceive themselves as unable to meet future economic commitments due to actual or anticipated shocks affecting their economic stability.[2]

An expanding body of research recognizes that economic insecurity, distinct from poverty or income volatility (Bossert and D'Ambrosio, 2013), has important consequences for political preferences, social cohesion, and health outcomes (e.g., Bossert and D'Ambrosio, 2024; Guiso et al., 2024). However, scholars still lack consensus on how best to measure it, which variables to employ, and whether objective, backward-looking indicators adequately capture forward-looking subjective experiences.[3]

Nevertheless, attempts at axiomatization do exist. Bossert and D'Ambrosio (2013) develop an axiomatic framework for measuring economic insecurity, which is later refined in Bossert et al. (2023) and extended in relative terms in Bossert and D'Ambrosio (2024).. In their view, an outcome (wealth, income, or similar) reflects individuals' anxiety about the future, as fluctuations in the past generate insecurity about what lies ahead. The primitives are thus finite histories of wealth streams, with lengths that may vary across individuals. In practice, however, data constraints limit how far back these histories can be traced. We argue that this constraint is compounded by the lack of accessible, user-friendly software to compute economic insecurity consistently at both the individual and aggregate levels.

We provide a toolkit enabling the straightforward application of the axiomatized indices initially proposed by Bossert and D'Ambrosio (2013) as refined in Bossert et al. (2023) and further extended in Bossert and D'Ambrosio (2024) in Stata, and contributes to the growing literature in this field.[4] This paper outlines the theoretical framework underlying the indices, presents the full syntax of the package commands, and provides simulation results to illustrate the commands' features.

2 Measuring Economic Insecurity

We follow the notation in Bossert et al. (2023) and Bossert and D'Ambrosio (2024). We denote by $\mathbf{1}_m$ the vector of dimension $m \in N$ consisting entirely of ones. For any $T \in N$, let R^T represent the $(T+1)$-dimensional Euclidean space with components indexed by $(T, \ldots, 0)$. Here, 0 corresponds to the current period, while T indicates the number of past periods under consideration.

A remark on notation is in order. Throughout the paper, we denote by T the length of the observation window, for simplicity of exposition. Conceptually, however, the relevant time span may be individual-specific: different individuals may be observed for different numbers of periods and may enter the sample at different dates. More generally, the characterization applies to personal histories defined over the time span relevant for each individual. In empirical applications, however, the package is designed for datasets defined on a common time scale and unit of observation across individuals. Hence, while individuals may differ in the number of observed periods or in the starting date of their histories, the underlying temporal unit is assumed to be common in the sample. This is the empirically relevant case for the types of panel datasets

[2] Definitions include "the anxiety produced by a lack of economic safety, i.e. by an inability to obtain protection against subjectively significant potential economic losses" (Osberg, 1998), "the anxiety produced by the possible exposure to adverse economic events and by the anticipation of the difficulty to recover from them" (Bossert and D'Ambrosio, 2013), "the degree to which individuals are protected against hardship-causing economic losses" (Hacker et al., 2010), "the downward economic risks that individuals are unable to adequately insure against or avoid or ignore" (Osberg, 2015).

[3] For an exhaustive review of this literature, see (Richiardi and He, 2020).

[4] The package focuses exclusively on the axiomatized indices, which appear to be theoretically grounded and internally consistent.

used to compute the index, whereas situations in which one individual is observed, for example, in monthly data and another in yearly data are not the intended setting.

2.1 Absolute Index

Economic insecurity can be modelled as a function of an individual's wealth stream over time.

Let

$$x = (x_{-T}, \ldots, x_0) \in R^T$$

denote the sequence of resources, where x_0 represents current outcome and x_{-t} refers to the outcome t periods in the past. A measure of insecurity is thus a mapping

$$I_T : R^T \to R,$$

which assigns to each outcome stream x a real number indicating the level of economic insecurity. For the rest of this section, let $x \in R$ be the quantity of resources and $q \in R$ be a loss or gain in that quantity. The index is required to satisfy the following axioms:

Gain-Loss Monotonicity. The first condition guarantees that an increase in resources from the earliest period under consideration to the subsequent one leads to a lower level of insecurity compared to a scenario where no change occurs between these periods. For all $t \in N$, $x \in R$, and $q > 0$,

$$I_t(x + q, x\mathbf{1}_t) > I_t(x, x\mathbf{1}_t) > I_t(x - q, x\mathbf{1}_t).$$

By gain-loss monotonicity, the stream in the left figure entails greater insecurity than that in the middle, which itself exhibits more insecurity than the stream shown in the last on the right.

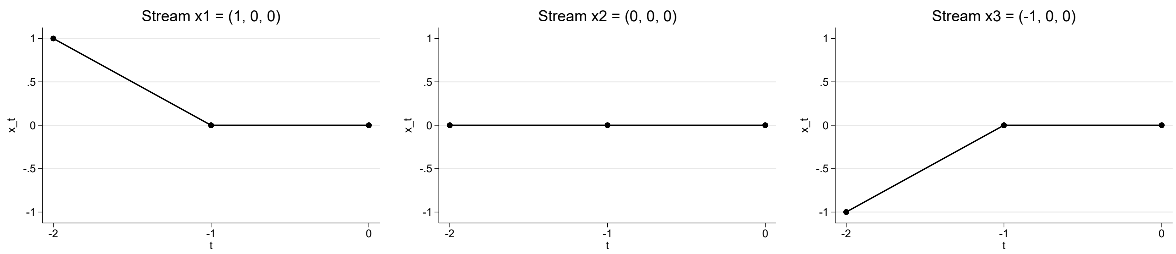


Figure 1: Gain-Loss Monotonicity: insecurity is highest with a loss, baseline with no change, and lowest with a gain.

Proximity Monotonicity. Recent fluctuations in wealth have a stronger effect on insecurity than distant ones. Thus, shocks closer to the present weigh more heavily in the index. For all $t \in N$, $x \in R$, and $q > 0$,

$$I_{t+2}(x, x, x + q, x\mathbf{1}_t) > I_{t+2}(x, x + q, x, x\mathbf{1}_t) > I_{t+2}(x, x, x, x\mathbf{1}_t) >$$

$$I_{t+2}(x, x - q, x, x\mathbf{1}_t) > I_{t+2}(x, x, x - q, x\mathbf{1}_t)$$

The panel below, from left to right, shows more and more insecurity.

Linear Homogeneity. The index is scale-sensitive: multiplying all wealth levels by a positive factor $b \in R_{++}$ scales insecurity by the same factor.

$$I_T(bx) = b\, I_T(x).$$

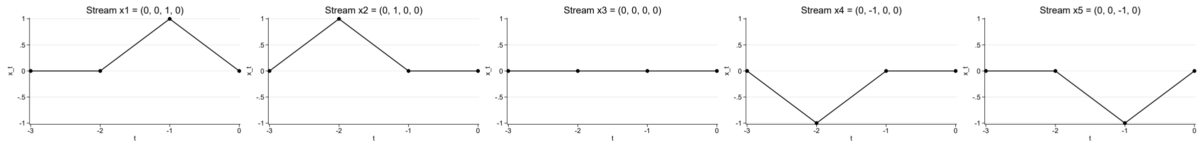


Figure 2: Proximity Monotonicity: up-then-down closer to the present raises insecurity more, while down-then-up closer to the present lowers it more.

Translation Invariance. Insecurity depends only on changes in wealth, not on absolute levels: adding a constant cR_{++} to all periods leaves the measure unchanged.

$$I_T(x + c\mathbf{1}_{T+1}) = I_T(x).$$

Quasilinearity. Insecurity over a long stream can be decomposed recursively into insecurity over a shorter stream plus an additional term depending only on the two earliest periods. For $T > 1$, there exists $F^T : R^2 \to R$ such that

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

Stationarity. The index is time-consistent: shifting the entire wealth stream r periods into the past yields an increasing transformation of the original insecurity. For all $r \in N_0$, there exists an increasing function $G_r : R \to R$ such that, for all $t \in N_0$ and for all $x, x', s \in R$,

$$I_{t+2+r}(x, x', s\mathbf{1}_{t+1}, s\mathbf{1}_r) = G_r\Big(I_{t+2}(x, x', s\mathbf{1}_{t+1})\Big).$$

Below we present the main results and absolute index equation as in Bossert et al. (2023) (p. 808).

Theorem 1 (Absolute Insecurity Index; Bossert et al., 2023). A measure of individual economic insecurity I satisfies gain-loss monotonicity, proximity monotonicity, linear homogeneity, translation invariance, quasilinearity, and stationarity if and only if there exist $\ell_0, g_0 \in R_{++}$ and

$$d \in \left(0, \min\left\{\frac{\ell_0}{g_0}, \frac{g_0}{\ell_0}\right\}\right)$$

such that, for all $T \in N$ and for all $x \in R^T$,

$$I_T(x) = \ell_0 \sum_{t \in \{1,\dots,T\} x_{-t} > x_{-(t-1)}} d^{t-1}\left(x_{-t} - x_{-(t-1)}\right) + g_0 \sum_{t \in \{1,\dots,T\} x_{-t} < x_{-(t-1)}} d^{t-1}\left(x_{-t} - x_{-(t-1)}\right). \tag{1}$$

where the relative importance of aggregate losses and gains is captured by the positive parameters ℓ_0 and g_0. It is important to note, however, that the discount factor d applied to losses must coincide with the one applied to gains. Moreover, the admissible values of d are restricted to lie below the smaller of the two ratios ℓ_0/g_0 and g_0/ℓ_0, which together with ℓ_0 and g_0 constitute the parameters of this class of insecurity measures.

2.2 Relative Index

The package also compute the relative version of the economic insecurity index (Bossert and D'Ambrosio, 2024). Below we summarize the axioms required for the index characterization. Let $T \in N$ and $I_T : R_{++}^{T+1} \to R$ assign an insecurity level to an income stream $x = (x_{-T}, x_{-(T-1)}, \dots, x_{-1}, x_0) \in R_{++}^{T+1}$.

Monotonicity. For all $T \in N$, for all $x \in R_{++}^{T+1}$, and for all $x'_{-T} \in R_{++}$, if $x'_{-T} > x_{-T}$, then

$$I_T(x'_{-T}, x_{-(T-1)}, \dots, x_0) \; > \; I_T(x_{-T}, x_{-(T-1)}, \dots, x_0).$$

Two streams that are identical from period $-(T-1)$ to 0 but differ in the earliest period are compared. A higher earliest income implies a smaller gain (or a larger loss) when moving to $-(T-1)$, which is taken to mean *more* insecurity.

Extension invariance. For all $T \in N$ and all $x \in R_{++}^{T+1}$,

$$I_{T+1}(x_{-T}, x) \; = \; I_T(x).$$

Extending a stream by introducing a period with the same income as x_{-T} adds neither a gain nor a loss, so insecurity should not change.

Temporal decomposability. For all $T \in N \setminus \{1\}$ there exists $\Theta : R_{++}^2 \to R$ such that, for all $x \in R_{++}^{T+1}$,

$$I_T(x_{-T}, \dots, x_0) \; = \; I_{T-1}(x_{-(T-1)}, \dots, x_0) \; + \; \Theta(x_{-T}, x_{-(T-1)}).$$

Total insecurity splits into the insecurity of the more recent T periods plus an additively separable term that depends only on the two most distant incomes.

Scale invariance. For all $T \in N$, all $x \in R_{++}^{T+1}$, and all $\lambda \in R_{++}$,

$$I_T(\lambda x) \; = \; I_T(x).$$

Multiplying all incomes by the same positive factor leaves insecurity unchanged (only relative movements matter). Below we present the main results and relative index equation as in Bossert and D'Ambrosio (2024) (eq. 1, p. 576).

Theorem 2 (Relative Insecurity Index Bossert and D'Ambrosio (2024)) A measure of insecurity $I = \{I_T : R_{++}^{T+1} \to R\}_{T \in N}$ satisfies monotonicity, extension invariance, temporal decomposability, and scale invariance if and only if there exists a sequence of increasing functions $\{f_t : R_{++} \to R\}_{t \in N}$ such that $f_t(1) = 0$ for all t and

$$I_T(\mathbf{x}) \; = \; \sum_{t=1}^{T} f_t\left(\frac{x_{-t}}{x_{-(t-1)}}\right), \qquad \forall T \in N, \; \forall \mathbf{x} \in R_{++}^{T+1}. \tag{2}$$

Since theorem 2 characterizes a family of relative indexes, here, based on the discussion as in Bossert and D'Ambrosio (2024) (p. 579), we propose the most complete specification of the relative economic insecurity. Motivated by weighting losses more heavily and allowing time dependence, set

$$f_t(y) \; = \; \delta^{\,t} \, g(y), \qquad \delta \in (0,1),$$

with the piecewise function $g : R_{++} \to R$ defined by

$$g(y) \; = \{ \, y - 1, if y < 1 \quad (loss), \ln y, if y \geq 1 \quad (gain).$$

Note that g is increasing on R_{++} and $g(1) = 0$, so $f_t(1) = 0$ for all t.

We can write the specified index as follows:

$$I_T(\mathbf{x}) \; = \; \underbrace{\sum_{t=1}^{T} \delta^t \left(\frac{x_{-t}}{x_{-(t-1)}} - 1\right)}_{\forall \frac{x_{-t}}{x_{-(t-1)}} < 1} + \underbrace{\sum_{t=1}^{T} \delta^t \, \ln\left(\frac{x_{-t}}{x_{-(t-1)}}\right)}_{\forall \frac{x_{-t}}{x_{-(t-1)}} > 1} \tag{3}$$

The choice $f_t(y) = \delta^t g(y)$ introduces two modelling ingredients: (i) a *time weight* δ^t with $\delta \in (0,1)$ that discounts more distant experiences (consistent with memory/recency effects), and (ii) a *different shape* g to make clear the degree of freedom in the function specification allowed by the characterization.

The piecewise g captures asymmetric reactions to losses vs. gains while preserving scale invariance: for $y < 1$ (a loss), $g(y) = y - 1$ penalizes proportionally to the relative shortfall, making losses bite linearly; for $y \geq 1$ (a gain), $g(y) = \ln y$ embodies diminishing sensitivity to larger percentage gains. g is increasing and satisfies $g(1) = 0$, so each step contributes zero when there is no change, positive for gains, and negative for losses, with the overall weight modulated by δ^t. This delivers a time-decomposable, scale-invariant, and loss-averse relative index consistent with the axioms.

2.3 Operationalization

Because economic insecurity is defined in terms of anxiety about the future, some clarification of the indices is in order. The proposed measures are backward-looking in their implementation, since they are computed from past realizations. However, this choice is motivated by the well-established idea that past economic experiences provide an informative proxy for concerns about future commitments (Bossert and D'Ambrosio, 2013; D'Ambrosio and Rohde, 2014). In this sense, the index is often interpreted as containing some forward-looking informational content, such as information about future economic vulnerability, however, this may be not true. Users engaged in empirical analyses that employ the insecurity index as a predictor of future outcomes should be aware that the index may partly capture temporary shocks rather than genuinely forward-looking economic vulnerability.

Moreover, generally, while economic insecurity is often understood as having an important psychological dimension, a direct measure based on subjective perceptions is typically unavailable in the data for which the index is intended. For this reason, the index relies on observed outcome histories and uses the weighting and discounting structure to reflect, in reduced form, the psychological salience of losses and their temporal profile (Dominitz and Manski, 1996).

With respect to the interpretation, the indices are real-valued: they take negative values when the outcome displays sufficiently large positive changes or repeated positive variations, positive values in the presence of adverse changes, and they are equal to zero when the outcome remains constant over time (or if opposite changes compensate). A zero value, however, should not be interpreted as full economic security in a broader sense; rather, it indicates the absence of measured insecurity, according to the dynamic pattern captured by the index. This is particularly important in applications, since an individual with a stable but very low level of income may receive a value of zero, even though such a situation may still be regarded as economically vulnerable.

One additional point is in order. The choice of the discount factor for the absolute index is linked by the admissibility condition:

$$d \in \left(0, \min\left\{\frac{\ell_0}{g_0}, \frac{g_0}{\ell_0}\right\}\right).$$

Whereas the relative index requires only that $\delta \in (0,1)$. We follow the former condition in both cases in order to guarantee the comparability of the indices. Users should be aware that stronger asymmetry between losses and gains reduces the admissible range for the discount factor. This constraint is therefore relevant for the empirical implementation of the index, since not all parameter combinations are feasible within the axiomatic framework. It follows that the choice of (ℓ_0, g_0, d) must be understood jointly, rather than as a sequence of separate calibrations.

3 The economic insecurity package

The package currently includes two egen functions that generate economic insecurity values at the individual level, and one command that aggregates them, with support for weights and survey designs.

3.1 egen functions

ei_abs generates absolute economic insecurity values at the individual level for each time period, as characterized in Bossert et al. (2023). ei_rel generates relative economic insecurity values at the individual level for each time period, as characterized in Bossert and D'Ambrosio (2024). The syntax is as follows [5]:

```
egen [type] newvar = ei_abs(varname) [if exp] [in range],
id(varname) time(varname) [loss(#) gain(#) discount(#) periods(#) gaps(string)]

egen [type] newvar = ei_rel(varname) [if exp] [in range],
id(varname) time(varname) [loss(#) gain(#) discount(#) periods(#) gaps(string)]
```

where the input variable must be numeric and may measure income, earnings, wealth, or another resource observed over time.

id(*varname/*) specifies the individual identifier in the panel dataset. id(*varname/*) is required unless the dataset has already been declared with tsset or xtset. If neither the option nor existing panel settings are available, the command halts and displays an error message.

time(*varname/*) specifies the time variable in the panel dataset, for example the year. time(*varname/*) is required unless the dataset has already been declared with tsset or xtset. If neither the option nor existing time settings are available, the command halts and displays an error message.

loss() specifies the weight applied to income losses. loss() is optional and requires a real number as input. The default value is 1.

gain() specifies the weight applied to income gains. gain() is optional and requires a real number as input. The default value is 0.9.

discount() specifies the discount factor for past times. discount() is optional and requires a real number as input. The default value is 0.5.

periods() specifies the time window, e.g., in years, over which economic insecurity is calculated. periods() is optional and requires an integer number as input. If not inserted, the default considers the maximum time span available for each individual in the dataset. The value suggested in Bossert and D'Ambrosio (2013) is 5 years.

gaps(*string*) specifies how the function handles missing observations. gaps(*string*) is optional and requires a string as input, either *ignore* or *break*. Under the *ignore/* option, the command calculates economic insecurity over all available periods and assumes that missing values imply no change in insecurity. Under the *break/* option, if a gap occurs and at least one time period is missing, the command treats the same individual before and after the gap as two separate individuals. We address this issue more in-depth in Section 3.3.

3.2 economic_insecurity command

The economic_insecurity command calculates the mean absolute and relative economic insecurity indices at the aggregate level, allowing for weights and survey designs. In particular it is

[5] id() and time() are required unless the dataset has already been declared with tsset or xtset. In that case, the function uses the panel and time settings already stored with the data.

obtained by first computing insecurity at the individual level over the relevant time periods and then summarizing these values across individuals, formally:

$$\bar{I} = \frac{1}{TN} \sum_{t=0}^{-T} \sum_{i=1}^{N} I_t^i(x), \qquad \forall i \in N, t \in T$$

where T is time periods considered for each individual, N is the total number of individuals considered, I is the insecurity for each individual i at time t computed from the input variable x. This computation has neither axiomatic nor normative meaning; it should be interpreted only as a statistical summary of economic insecurity aggregated across individuals, possibly combined with `if`/`in` conditions or to year- or group-level restrictions.

The syntax is as follows[6]:

```
economic_insecurity varname [if exp] [in range] [weight varname],
id(varname) time(varname) [loss(#) gain(#) discount(#) periods(#)
gaps(string) svy]
```

where the input variable must be numeric and may measure income, earnings, wealth, or another resource observed over time. In addition, `fweights`, `aweights`, `iweights`, and `pweights` are allowed; see [U] 11.1.6 weight.

`id(`*varname/*`)` specifies the individual identifier in the panel dataset. `id(`*varname/*`)` is required unless the dataset has already been declared with `tsset` or `xtset`. If neither the option nor existing panel settings are available, the command halts and displays an error message.

`time(`*varname/*`)` specifies the time variable in the panel dataset, for example the year. `time(`*varname/*`)` is required unless the dataset has already been declared with `tsset` or `xtset`. If neither the option nor existing time settings are available, the command halts and displays an error message.

`loss()` specifies the weight applied to income losses. `loss()` is optional and requires a real number as input. The default value is 1.

`gain()` specifies the weight applied to income gains. `gain()` is optional and requires a real number as input. The default value is 0.9.

`discount()` specifies the discount factor for past times. `discount()` is optional and requires a real number as input. The default value is 0.5.

`periods()` specifies the time window, e.g., in years, over which economic insecurity is calculated. `periods()` is optional and requires an integer number as input. If not inserted, the default considers the maximum time span available for each individual in the dataset. The value suggested in Bossert and D'Ambrosio (2013) is 5 years.

`gaps(`*string*`)` specifies how the command handles missing observations. `gaps(`*string*`)` is optional and requires a string as input, either *ignore* or *break*. Under the *ignore/* option, the command calculates economic insecurity over all available periods and assumes that missing values imply no change in insecurity. Under the *break/* option, if a gap occurs and at least one time period is missing, the command treats the same individual before and after the gap as two separate individuals. We address this issue more in-depth in Section 3.3.

`svy` specifies that the survey design previously set with `svyset` is applied in the calculation of the aggregate index.

3.2.1 Stored Results

`economic_insecurity` stores the following results in `e()`:

Scalars

[6] `id()` and `time()` are required unless the dataset has already been declared with `tsset` or `xtset`. In that case, the function uses the panel and time settings already stored with the data.

`e(N_tot)`: number of observations used in non-`svy` estimation;
`e(N_sample)`: number of survey-sample observations used in `svy` estimation;
`e(N_subsample)`: number of subpopulation observations used in `svy` estimation;
`e(N_pop)`: estimated population size in `svy` estimation;
`e(N_subpop)`: estimated subpopulation size in `svy` estimation;
`e(N_id)`: number of individuals;
`e(tmin)`: minimum time value in the estimation sample;
`e(tmax)`: maximum time value in the estimation sample;
`e(loss)`: loss-weight parameter;
`e(gain)`: gain-weight parameter;
`e(discount)`: discount factor;
`e(periods)`: number of periods used in the calculation window.

Macros
`e(cmd)`: `economic_insecurity`;
`e(cmdline)`: command as typed;
`e(depvar)`: outcome variable used in the calculation;
`e(id)`: panel identifier variable;
`e(time)`: time variable;
`e(gaps)`: gap-treatment option;
`e(estimator)`: estimation type (`unweighted index`, `weighted index`, or `svy`);
`e(wtype)`: weight type, if applicable;
`e(wvar)`: weight variable, if applicable;
`e(properties)`: `b V`.

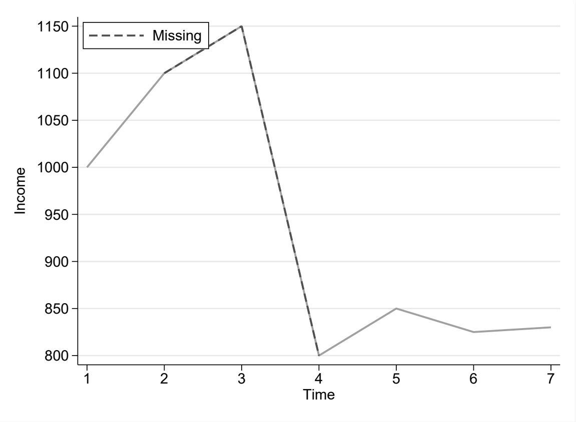
Matrices
`e(b)`: vector of estimated means for absolute and relative economic insecurity;
`e(V)`: variance-covariance matrix of the estimates;
`e(table)`: display table containing means, standard errors, and confidence intervals.

3.3 Missing Periods Treatment

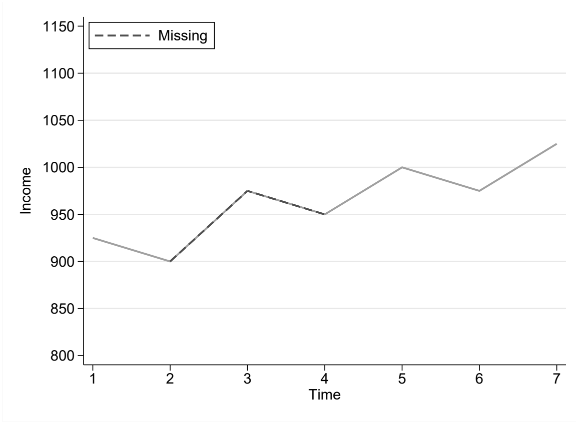
In the case where one or more periods are unavailable, the code provides users with two options. On the one hand, the more cautious choice is to impose a break in the measure as soon as the code identifies a missing time in the calculation window, and then restart from the next available time. On the other hand, by default, if an income value is missing, the code skips that observation in the computation of the index, as if that (missing) period made no contribution to the individual's insecurity. By applying this last solution, the Stata user implicitly assumes that any income losses and gains during the missing period offset each other (or there is no variation), leaving subsequent insecurity unchanged.

Both approaches have advantages. Users may prefer the first option when substantial upward or downward income variation during the missing periods is likely; see panel (a) of Figure 3. The second option may be preferable when the individual's insecurity is unlikely to be affected during the missing periods; see panel (b) of Figure 3.

A further practical issue concerns the behaviour of the indices in panels with frequent gaps. The two measures react differently because they are constructed from distinct transformations of income changes between consecutive observations. The absolute index is based on level differences in income, so it reflects the magnitude of the change in the same units as the income variable. By contrast, the relative index is based on income ratios and logarithmic transformations, which capture proportional rather than level changes. As a result, when panels contain gaps and some intermediate periods are not observed, the effective transition is measured between more distant observations. Because proportional transformations are non-linear, collapsing several smaller changes into a single larger observed change affects the relative index differently than



(a) Significant variation in economic insecurity.



(b) Negligible variation in economic insecurity.

Figure 3: Examples of individual income evolution over time with missing periods.

the absolute one, making the relative measure generally more sensitive to gappy panels. We examine this issue more in detail in the robustness section. Our validation exercise (Table 3) indicates that the relative index is more sensitive to panel incompleteness than the absolute index. Using the same dataset, we compare the baseline results with those obtained after randomly deleting 30% of the observations.

4 Application

To illustrate the output and the features of the `economic_insecurity` package, we use the National Longitudinal Survey of Young Women (US NLSW), 14-24 years old in 1968. The data, available from the Stata Press website, consists of 28,534 observations and 21 variables, covering demographics and occupational characteristics. To show how the package works, we consider only a subset of variables, including the individual identifier, the time variable, age, race, and the natural logarithm of wages. We produce all computations and figures in Stata.

For illustrative purposes, the empirical application uses the logarithm of the hourly wage rate. This choice is motivated by the fact that wages constitute, in most standard settings, the main source of income for individuals and therefore offer a natural and readily available proxy for economic resources. Whenever the data permit, wealth may provide an even more informative basis for measuring insecurity, since it offers a broader representation of an individual's financial situation and incorporates the available buffer against adverse economic shocks (Bossert and D'Ambrosio, 2013). More generally, the choice of variable may sometimes reverse country rankings (D'Ambrosio and Rohde, 2014; Rohde et al., 2015); the underlying variable should therefore be chosen in light of the specific application, the research question, and data availability.

In the application, we first load the dataset and report the aggregate values produced by the `economic_insecurity` command in the years from 1970 to 1985, while leaving all other optional parameters at their default values (Table 1).

The default values adopted in the package should therefore be understood as benchmark choices, selected to provide a transparent and practically convenient baseline for applied work. Our calibration follows the relevant literature and is guided by three considerations. First, the default parameters preserve the qualitative interpretation of the index emphasized in the theoretical framework, namely that adverse variations matter more than favorable ones and that more recent experiences are more salient than more distant ones. Second, the chosen values generate a parameterization that is neither extreme nor degenerate, and therefore offers a reasonable compromise between theoretical discipline and empirical usability. Third, using a common benchmark facilitates comparability across applications and makes the package easier to use for researchers who do not have strong prior grounds for choosing alternative values.[7]

```
. webuse nlswork, clear
(Young Women NLS, 14-24 years old in 1968)
{\smallskip}
. economic\_insecurity ln\_wage if inrange(year,70,85), id(idcode) time(year)
```

Table 1: Economic Insecurity Estimation

Sample

Outcome variable:	ln_wage
ID variable:	idcode
Time variable:	year
Observations:	21,491
Individuals:	4,260
Time span:	70–85
Weighting:	unweighted

Model parameters

Loss weight:	1
Gain weight:	0.9
Discount factor:	0.5
Periods:	21
Gap treatment:	ignore

Results

	Mean	St.Err.	CI_Low95%	CI_High95%
EI_Absolute	-0.0222	0.0012	-0.0245	-0.0199
EI_Relative	-0.0018	0.0045	-0.0106	0.0071

To proceed in more detail with the analysis of the above dataset in terms of economic insecurity. We use the functions `ei_abs` and `ei_rel` on the same range of the summary command. Table 2 shows a partial output. Figure 4 shows the average level of absolute and relative economic insecurity over time in the society.

```
. keep if inrange(year, 70, 85)
{\smallskip}
. egen abs\_insec = ei\_abs(ln\_wage), id(idcode) time(year)
{\smallskip}
. egen rel\_insec = ei\_rel(ln\_wage), id(idcode) time(year)


. collapse (mean) econ\_insec\_abs\_mean = abs\_insec ///
>          (mean) econ\_insec\_rel\_mean = rel\_insec, ///
>          by(year)
{\smallskip}
```

[7]These defaults are not meant to be universally optimal. Rather, they provide a natural starting point for implementation, especially in applications where there is no external information that would support a different calibration. For this reason, they should be interpreted as reference values, and it may be useful in applied work to complement the baseline specification with sensitivity analysis as to assess the robustness of the results to alternative admissible parameter choices.

Table 2: Excerpt of panel observations (idcode = 1)

idcode	year	age	race	ln_wage	w_samp	abs_insec	rel_insec
1	70	18	Black	1.451214	1.1282720	0	0
1	71	19	Black	1.028620	1.0276967	0.42259419	0.41083615
1	72	20	Black	1.589977	1.1236070	-0.29392476	-0.23008384
1	73	21	Black	1.780273	0.96025576	-0.31822829	-0.22808876
1	75	23	Black	1.777012	0.88849447	-0.07955707	-0.05702219
1	77	25	Black	1.778681	0.87621680	-0.01988927	-0.01425555
1	78	26	Black	2.493976	0.96856755	-0.65371042	-0.34513412
1	80	28	Black	2.551715	1.0299224	-0.16342760	-0.08628353
1	83	31	Black	2.420261	0.95735615	-0.02042845	-0.01078544
1	85	33	Black	2.614172	0.91235811	-0.00510711	-0.00269636

```
. twoway ///
>     (line econ\_insec\_abs\_mean year, ///
>         lpattern(solid) lwidth(medthick)) ///
>     (line econ\_insec\_rel\_mean year, ///
>         lpattern(dash) lwidth(medthick)), ///
>     title("Economic insecurity in the society") ///
>     ytitle("Average economic insecurity") ///
>     xtitle("Year") ///
>     legend(order(1 "Absolute" 2 "Relative") ///
>            pos(6) ring(0) cols(1)) ///
>     ylabel(, angle(horizontal))
```

The variable can also be used to study the insecurity by groups at a specified year. Figure 5 shows how the insecurity varies based on age and race in the year 1985.

```
. egen age\_groups = cut(age), at(0(5)100)
{\smallskip}
. graph bar (mean) abs\_insec (mean) rel\_insec if year == 85, ///
>     over(age\_groups, label(angle(45))) ///
>     over(race, label(labsize(small))) ///
>     title("Economic insecurity by age and race in 1985") ///
>     ytitle("Average economic insecurity") ///
>     legend(order(1 "Absolute" 2 "Relative"))
```

Until now, we have used only the default specifications for gain, loss, and discount parameters. Now, focusing on one individual only, we show what could change by setting the parameters. In particular, we can compare the trend of economic insecurity when the income losses are weighted more `loss(1.5)` and when the discount factor is higher `discount(0.89)` with respect to the default option. Figure 6 shows the trend in absolute insecurity and Figure 7 in relative insecurity.

```
. keep if idcode == 1
(21,481 observations deleted)
{\smallskip}
. egen abs\_insec1 = ei\_abs(ln\_wage), ///
>     id(idcode) time(year) gain(0.5) loss(1.5) discount(0.3)
{\smallskip}
. egen rel\_insec1 = ei\_rel(ln\_wage), ///
```

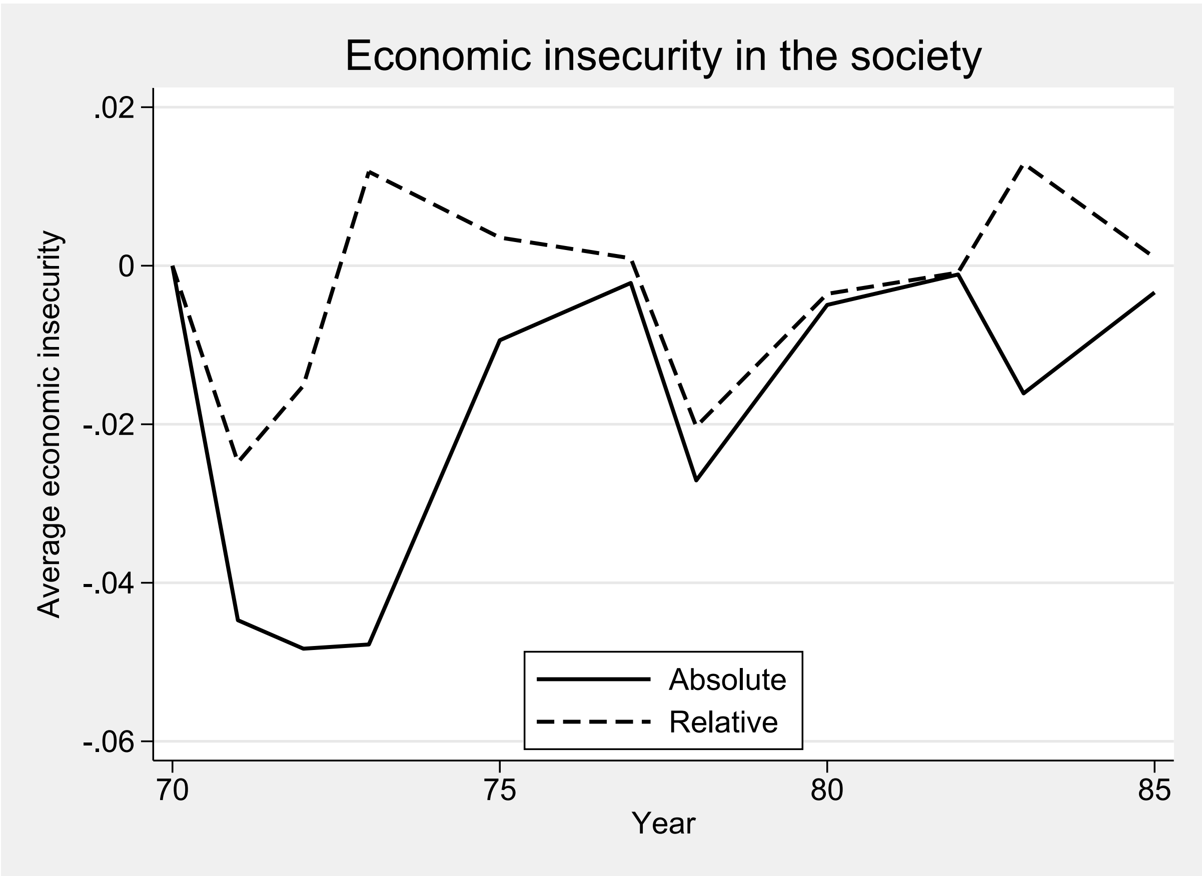


Figure 4: Average level of absolute and relative economic insecurity over time.

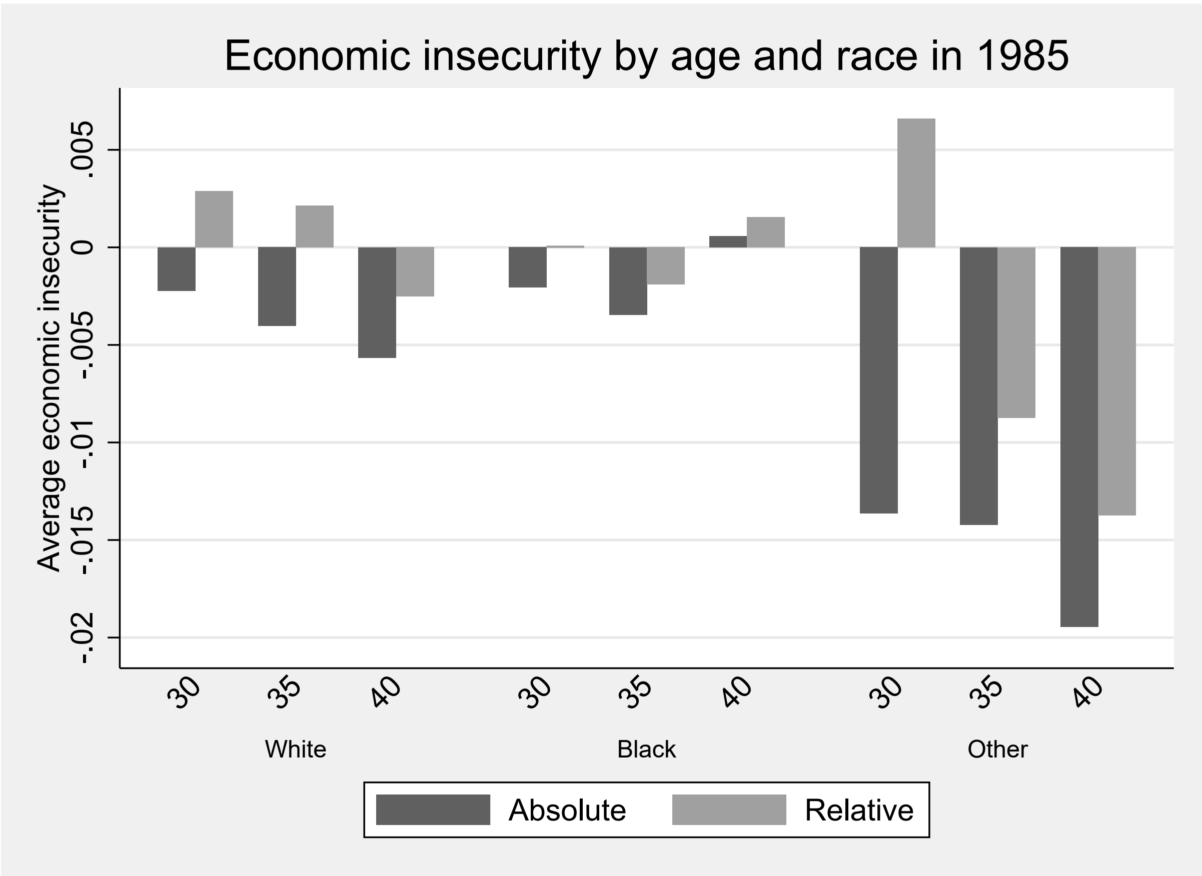


Figure 5: Absolute and relative Economic Insecurity by age and race.

```
>     id(idcode) time(year) gain(0.5) loss(1.5) discount(0.3)
{\smallskip}
. egen abs\_insec2 = ei\_abs(ln\_wage), ///
>     id(idcode) time(year) discount(0.89)
{\smallskip}
. egen rel\_insec2 = ei\_rel(ln\_wage), ///
>     id(idcode) time(year) discount(0.89)
{\smallskip}
. twoway ///
>     (line abs\_insec year, ///
>         lpattern(solid) lwidth(medthick)) ///
>     (line abs\_insec1 year, ///
>         lpattern(dash) lwidth(medthick)) ///
>     (line abs\_insec2 year, ///
>         lpattern(dot) lwidth(medthick)), ///
>     title("Absolute economic insecurity: specifications") ///
>     ytitle("Economic insecurity") ///
>     xtitle("Year") ///
>     legend(order(1 "Baseline" ///
>                  2 "High loss/low gain" ///
>                  3 "High discount") ///
>            size(medsmall))
```

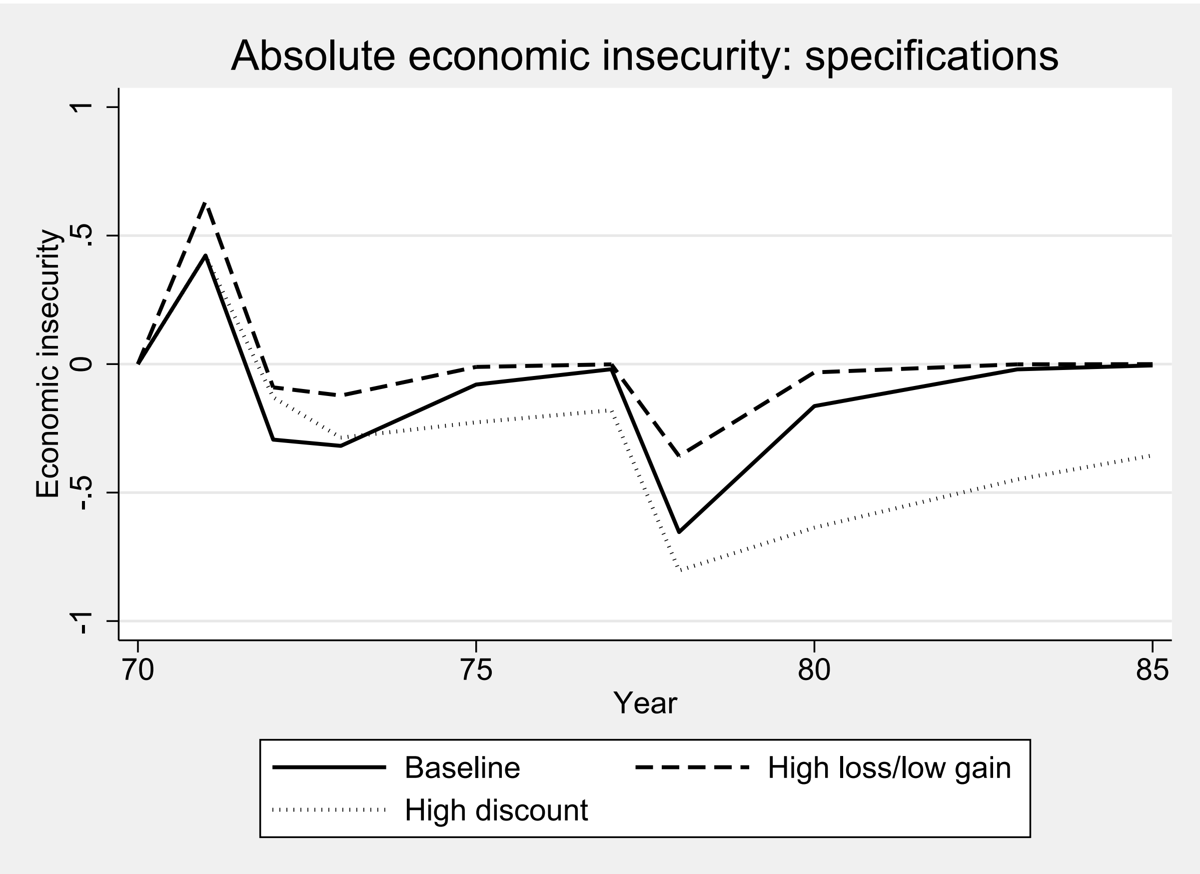


Figure 6: Absolute Economic Insecurity under different specifications.

```
twoway ///
```

```
(line rel_insec year, ///
    lpattern(solid) lwidth(medthick)) ///
(line rel_insec1 year, ///
    lpattern(dash) lwidth(medthick)) ///
(line rel_insec2 year, ///
    lpattern(dot) lwidth(medthick)), ///
title("Relative economic insecurity: specifications") ///
ytitle("Economic insecurity") ///
xtitle("Year") ///
legend(order(1 "Baseline" ///
             2 "High loss/low gain" ///
             3 "High discount") ///
       size(medsmall))
```

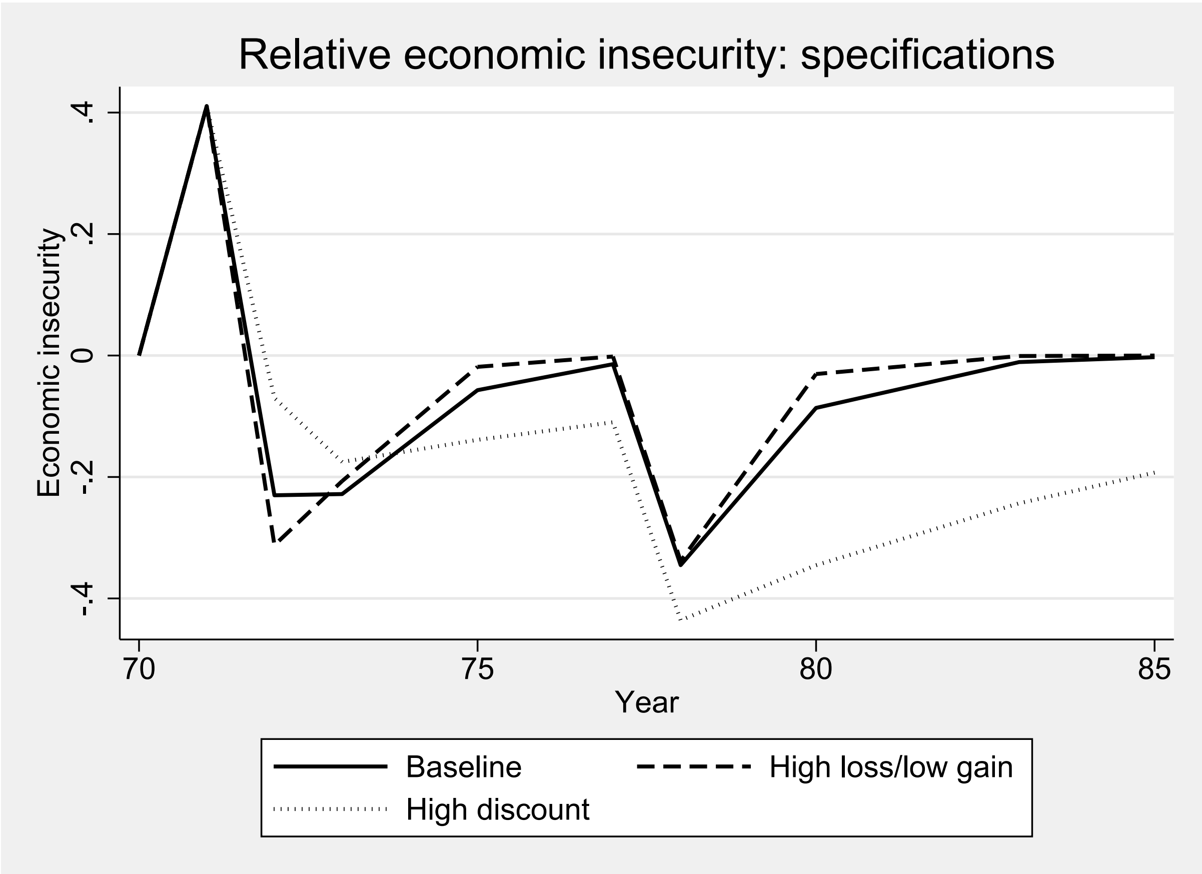


Figure 7: Relative Economic Insecurity under different specifications.

4.1 Robustness

Sensitivity to gappy panels The treatment of gaps deserves an explicit discussion because it can materially affect the estimated index, especially in panels with irregular spacing. In our construction, both the absolute and relative indexes are built from the same income variables. In that sense, the two measures are structurally affected in the same places. However, the relative index is typically more sensitive in magnitude, because it is based on ratios and logarithms rather than level differences. When income is low, even small observed changes can generate comparatively large relative movements, so any omission or distortion of cross-gap transitions tends to have a stronger effect on the relative measure than on the absolute one.

This issue is particularly relevant in long panels with irregular spacing. If gaps are effectively bridged, the method may combine observations that are far apart in calendar time, even if discounted, as if they were adjacent in the income process, which can overstate or misrepresent insecurity. The problem is more pronounced for the relative index, since proportional changes over long unobserved intervals can be large even when absolute changes are modest. By contrast, the absolute index is also affected by gap-bridging, but usually in a more linear and less explosive way.

For this reason, the choice of gap treatment should depend on the structure of the panel and on the substantive meaning of missing periods. A gap-ignoring approach is more appropriate when missing waves are rare, short, and plausibly reflect administrative or sampling irregularities rather than meaningful interruptions in the income trajectory. In those settings, preserving continuity may be preferable to discarding information. A gap-breaking approach is better suited to panels with long or frequent interruptions, or irregular spacing. In such data, forcing continuity across gaps risks distorting the index, particularly the relative version.

Table 3 compares the estimates obtained from the full sample with those obtained after randomly deleting 30% of the observations, thereby inducing additional gaps in the panel. Overall, we see that the absolute index is more robust when the panel is gappier under both `gaps()` specifications, which is consistent with the greater sensitivity of relative measures to missing intermediate observations.

Table 3: Robustness check: gaps specifications in full vs. gappy panels.

	Full sample	70% sample
EI absolute (ignore)	-0.018	-0.013
	(0.001)	(0.001)
EI relative (ignore)	-0.003	-0.006
	(0.004)	(0.002)
EI absolute (break)	-0.047	-0.049
	(0.003)	(0.005)
EI relative (break)	-0.009	-0.023
	(0.012)	(0.007)

Sensitivity to log The distinction between the absolute and relative indices becomes empirically negligible when applied to logarithmic variables, because log differences approximate proportional changes. As a consequence, the two measures are almost perfectly correlated in our empirical application based on $\ln(x)$. However, maintaining both indices remains conceptually important. The absolute index captures income instability in monetary units, reflecting the magnitude of gains and losses in levels, while the relative index evaluates changes proportionally to the income level, thus capturing the intensity of shocks relative to an individual's economic position. This distinction becomes substantially more evident when the indices are applied to income levels rather than logarithms. In such cases, absolute and proportional variations can differ markedly, particularly when comparing individuals with different income levels. Large monetary changes may represent modest proportional fluctuations for high-income individuals but substantial relative shocks for lower-income individuals. Keeping both indices therefore allows the framework to capture two complementary dimensions of economic insecurity: volatility in absolute resources and vulnerability to proportional income fluctuations. This broader perspective is especially relevant in empirical contexts where income is analysed in levels or where distributional comparisons across heterogeneous income groups are of interest. Table 4 reports the results obtained by calculating the indices using the natural logarithm of wages versus wages in levels.

Table 4: Robustness check: log wage versus wage in levels.

	Log wage	Wage in levels
EI_Absolute	-0.0180 (0.0011)	-0.1223 (0.0103)
EI_Relative	-0.0027 (0.0042)	-0.0141 (0.0016)

5 Conclusions

This paper provides a Stata implementation of the absolute and relative insecurity indices derived in the axiomatic literature, with the aim of making these measures more readily usable in empirical work. By making the computation of these indices operational in standard software, the package may facilitate wider use of insecurity measures in applied analyses and improve comparability across studies. Accordingly, the paper should be seen as a first step in the software translation of this literature, rather than as an exhaustive treatment of all possible insecurity measures or empirical settings. Future work may develop in two directions. On the empirical side, an important next step is the application of the package to different types of panel data in order to assess how absolute and relative insecurity perform in practice and how sensitive results are to alternative specifications. On the software side, further developments may extend the package to additional measures, broader data environments, and expanded post-estimation tools that support interpretation and comparison of results. Overall, we hope that this paper encourages further empirical and methodological work on the measurement of insecurity by providing a practical tool grounded in a well-defined axiomatic framework.

6 Programs and supplemental materials

To install the software files, type (in the same line)

```
. net install economic_insecurity,
from("https://raw.githubusercontent.com/FedericoFiorani/
economic_insecurity/main/") replace
```

To inspect the package before installation, type (in the same line)

```
. net describe economic_insecurity,
from("https://raw.githubusercontent.com/FedericoFiorani/
economic_insecurity/main/")
```

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