

## Article

# The Benchmark Consumption Coverage Ratio: A Cross-Country Indicator of Income Adequacy

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## Abstract

This study introduces the benchmark consumption coverage ratio (BCCR), a benchmark-referenced consumption coverage ratio that expresses price-adjusted median equivalised disposable income as coverage of a selected market consumption benchmark. It positions the BCCR within the broader family of income-to-benchmark adequacy ratios, while defining its narrower role as showing how far median equivalised disposable income in different countries covers an international market consumption benchmark grounded in empirically observed private consumption in a high-consumption reference economy. The empirical design uses three internally consistent specifications: a main Eurostat Price Level Index/Purchasing Power Standard (PLI/PPS) specification for 30 countries over 2017–2024, a Eurostat income specification using the Numbeo Cost-of-Living Index (COLI) to test deflator robustness on the same country sample, and an OECD income specification using Numbeo COLI to assess broad consistency across 38 countries over 2017–2023. The validation outcomes are severe material and social deprivation, inability to face unexpected financial expenses, and difficulty making ends meet, with controls for the Gini coefficient, unemployment, and social spending. The results show that higher BCCR values are consistently associated with lower deprivation and financial strain, including after socio-economic controls. Robustness checks indicate that the findings are not driven by serious multicollinearity, one influential country, or the reference-basket choice; fixed-effects models provide partial within-country robustness. The contribution of the BCCR is interpretative rather than causal: it translates comparable median income into coverage, shortfall, surplus, residual income share after benchmark coverage, and required income growth. A BCCR value of 1 denotes full coverage of the selected benchmark, not a universal normative standard.

**Keywords:** benchmark consumption coverage ratio; income adequacy; median equivalised disposable income; purchasing power standards; consumption benchmark; severe material and social deprivation; financial strain; cross-country comparison



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## 1. Introduction

Cross-country comparisons of households' economic position usually rely on monetary indicators of income, consumption, or macroeconomic development. These indicators are necessary; however, they do not always answer the applied interpretative question: what share of a selected consumption benchmark is covered by median equivalised disposable income? Median equivalised disposable income adjusted for differences in price levels shows the volume of comparable income, but by itself it does not express the degree

of benchmark coverage, the shortfall relative to that benchmark, or the income growth required to reach a selected reference point.

This problem is particularly important in the analysis of income adequacy, socio-economic vulnerability, and financial strain. The existing literature already contains a broad group of approaches in which income or another resource is related to a benchmark, including welfare ratios (Allen, 2001), poverty welfare ratios and income-to-poverty or income-to-needs ratios (Citro & Michael, 1995), reference budgets and minimum income standards (Goedemé et al., 2015), living wage approaches (Anker & Anker, 2017), and residual income and affordability approaches (Stone, 2006). These approaches show that a monetary indicator becomes more informative when it is compared with a threshold, a basket, a needs standard, or a residual-resource requirement. However, they do not provide a compact cross-country ratio that would express median equivalised disposable income, adjusted for price comparability, as coverage of a selected international market consumption benchmark.

To address this narrower task, the article introduces the benchmark consumption coverage ratio (BCCR), a benchmark-referenced consumption coverage ratio. The BCCR is defined as the ratio of price-adjusted median equivalised disposable income to a selected benchmark of market consumption. Its purpose is not to create a new class of adequacy ratios or to replace existing monetary income indicators but to apply the already established income-to-benchmark logic to cross-country comparisons of median income. In this form, the BCCR translates comparable income into a scale of coverage, shortfall, surplus, residual income share after benchmark coverage, and required income growth towards selected reference points.

The study addresses four questions. First, how can median equivalised disposable income, adjusted for cross-country price differences, be expressed as a benchmark consumption coverage ratio? Second, is the BCCR consistent with external indicators of socio-economic vulnerability and financial strain? Third, are the main results robust to the inclusion of socio-economic controls, diagnostic checks, fixed-effects robustness checks, and alternative price adjustment and denominator specifications? Fourth, what applied interpretations does the BCCR provide in comparison with a conventional monetary income value?

The empirical part of the study is based on three specifications. The main EU\_PLI\_PPS specification uses Eurostat data on median equivalised disposable income and applies the official PLI(HFCE)/PPS price adjustment framework for 30 countries over the period 2017–2024. The EU\_COLI specification uses the same Eurostat sample but applies the Cost-of-Living Index (COLI) price adjustment logic as a robustness check for the choice of deflator. The OECD\_COLI specification uses OECD and COLI data for 38 countries over the period 2017–2023 and is used only for a broad international consistency check. The main empirical validation framework includes severe material and social deprivation, inability to face unexpected financial expenses, and difficulty making ends meet, as well as the following control variables: the Gini coefficient, unemployment, and social spending.

The contribution of the article is conceptual, methodological and empirical. Conceptually, the article positions the BCCR within the family of income-to-benchmark measures and adequacy ratios. Methodologically, it formalises the BCCR and its derived interpretations: coverage, shortfall, surplus, residual income share, and required income growth. Empirically, the article provides a multi-specification assessment of the BCCR, including models with socio-economic controls, variance inflation factor (VIF) diagnostics, influence diagnostics, leave-one-country-out checks, fixed-effects robustness checks, COLI specifications, and an alternative denominator check using the Global household final consumption expenditure (Global HFCE) benchmark.

The remainder of the article is organised as follows. Section 2 reviews the literature on income-to-benchmark and adequacy ratio measures and positions the BCCR among the closest related approaches. Section 3 presents the methodology, data sources, specifications, and interpretative transformations of the BCCR. Section 4 provides the empirical analysis and robustness checks. Section 5 discusses the interpretation of the results, the relationship between the BCCR and existing approaches, and the limitations of the study. Section 6 presents the main conclusions.

## 2. Literature Review: Income-to-Benchmark Measures and the Positioning of the BCCR

The benchmark consumption coverage ratio (BCCR) belongs to a broader family of income-to-benchmark and adequacy ratio measures. These measures do not treat monetary income as self-explanatory; instead, they interpret resources relative to a threshold, basket, cost standard, or residual income requirement. The purpose of this literature review is, therefore, not to present the BCCR as an entirely unprecedented measurement logic. Rather, it positions the BCCR in relation to the closest existing approaches and identifies its narrower contribution: the application of income-to-benchmark reasoning to median equivalised disposable income adjusted for cross-country price comparability and assessed against a selected international consumption benchmark.

This positioning is important because the BCCR is constructed on the basis of price-adjusted median income. In the official PLI/PPS implementation, the BCCR remains closely related to PPS-adjusted median equivalised disposable income because the monetary numerator is already expressed in comparable price units. The contribution of the BCCR is not statistical independence from its income base. Its contribution is functional interpretability: it converts comparable income into a coverage ratio that can be read in terms of benchmark coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth towards a selected reference level.

### 2.1. Historical Welfare Ratios and Basket-Based Real Wages

The closest historical analogue to the BCCR is the welfare ratio tradition in economic history. In this literature, wages or family earnings are compared with the locally priced cost of a subsistence or respectability basket. Allen's (2001) work on real wages and the long-run divergence of living standards uses basket-based comparisons to evaluate how far earnings could sustain a family at a specified level of consumption. Later work on historical household incomes and real wages further emphasises that living standard measurement depends not only on nominal wages but also on the relation between earnings, household structure and the cost of required consumption (Humphries & Weisdorf, 2019).

More recent work continues this basket-based real-wage tradition. Zegarra (2022) provides new welfare ratio estimates for Western European cities between 1600 and 1850, using a linear programming approach to construct a least-cost food basket subject to nutritional requirements. This reinforces the point that welfare ratio methods remain grounded in locally priced consumption baskets, whereas the BCCR applies the broader income-to-basket logic to price-comparable median equivalised disposable income and a selected international consumption benchmark.

The conceptual similarity with the BCCR is clear: both approaches translate a monetary resource into an answer about basket coverage. A welfare ratio equal to one indicates that earnings cover the specified basket. Values below or above one can be interpreted as shortfall or excess relative to that standard. This family of measures, therefore, demonstrates that the general idea of comparing income with a consumption benchmark has a long-established scholarly precedent.

The methodological difference is nevertheless substantial. Historical welfare ratios usually rely on worker wages or reconstructed family earnings, rather than median equivalised disposable income. They generally refer to gross earnings or historical income concepts rather than after-tax household resources. Their benchmark is typically a subsistence or respectability basket, evaluated in the local prices of a given city, country, or period. Such measures, therefore, answer the question of whether local earnings are sufficient for a locally priced consumption standard. The BCCR uses a different resource concept and a different benchmark logic. It evaluates median equivalised disposable income, adjusted for cross-country price comparability, against a selected high-consumption benchmark. Thus, the BCCR adopts the broad income-to-basket logic of welfare ratios but applies it to a contemporary cross-country median-income setting.

## 2.2. Welfare Ratios in Poverty Measurement

A second closely related tradition is the use of welfare ratios in poverty measurement. In household welfare analysis, resources are often represented by income or, especially in developing country poverty measurement, by a consumption aggregate. Deaton and Zaidi (2002) provide a detailed methodological framework for constructing such consumption aggregates for welfare analysis, emphasising the role of household composition, price differences, and the relation between welfare aggregates and poverty analysis. Ravallion's (1998) work on poverty lines similarly treats poverty measurement as a comparison between household resources and a poverty or basic needs standard.

This literature is relevant because it shows how a monetary resource becomes analytically more interpretable when it is expressed relative to a threshold. A household's resource level can be compared with a poverty line, and the resulting ratio can indicate whether the household is below, at, or above that line. The same framework also supports the interpretation of shortfalls and surpluses relative to a standard.

The BCCR differs from poverty welfare ratios in the meaning of both numerator and denominator. Poverty welfare ratios often use household consumption expenditure or household income as the welfare aggregate. The relevant benchmark is a poverty line or basic needs line, which may be national, local, spatially adjusted, or expressed in international PPP terms. This benchmark is designed to identify poverty or minimum resource adequacy. The BCCR is not a poverty measure. Its denominator is not a poverty line and does not classify households as poor or non-poor. Instead, the BCCR uses median equivalised disposable income at the country level and compares it with a selected high-consumption benchmark, including the shortfall relative to that benchmark. The common ratio form links the approaches conceptually, but the substantive interpretation is different.

## 2.3. Income-to-Poverty and Income-to-Needs Ratios

Income-to-poverty and income-to-needs ratios provide a further precedent for BCCR's functional interpretation. In these approaches, income is interpreted by comparing it with a poverty threshold, needs threshold, or other explicit standard. Citro and Michael's (1995) report on poverty measurement frames poverty analysis as the comparison between family resources and thresholds, while also recognising the importance of threshold design and resource definition. Atkinson (1987) similarly stresses that poverty measurement involves explicit choices regarding the poverty line, the index of poverty, and the normative assumptions embedded in measurement procedures. Foster et al. (1984) formalise the poverty gap logic by showing how poverty can be measured not only through incidence but also through the depth of shortfall below a poverty line.

This literature is important for the BCCR because it makes clear that ratio measures can answer questions that monetary income levels alone do not answer directly. A

monetary value says how much income is available. A ratio to a threshold says whether that income is below, equal to, or above a selected standard, and by how much. The poverty-gap tradition further shows that shortfall relative to a benchmark is a meaningful analytical object in its own right.

The BCCR uses a similar functional logic but not the same benchmark. Income-to-poverty and income-to-needs ratios are usually household- or family-level measures. They often use thresholds that vary by family size, household composition, and sometimes age structure. Some systems use pre-tax money income, while others use disposable income or broader resource concepts. The BCCR instead uses median equivalised disposable income and applies a cross-country price comparability framework. Its benchmark is not a poverty or needs threshold but a selected consumption benchmark. Therefore, the BCCR should be understood as an income-to-benchmark measure rather than as an income-to-poverty measure.

#### *2.4. Reference Budgets and Minimum Income Standards*

Reference budgets and minimum income standards form the most direct basket adequacy tradition relevant to the BCCR. Reference-budget studies construct priced baskets of goods and services for a defined living standard, often linked to social participation, minimum adequacy, or a socially acceptable standard of living. [Goedemé et al. \(2015\)](#) develop cross-country comparable reference budgets in Europe using a common theoretical and methodological framework while carefully accounting for institutional, climatic, cultural, and price differences across countries. [Penne et al. \(2020\)](#) further argue that reference budgets can serve as needs-based indicators for assessing the adequacy of minimum income protection. [Davis et al. \(2018\)](#) present the minimum income standard as a benchmark for a participatory social minimum, emphasising that adequacy standards are grounded in social expectations as well as material requirements.

This literature strongly supports the idea that income adequacy can be interpreted through the cost of a basket. It also shows that the construction of such baskets is methodologically demanding. The content of the basket depends on the living standard being defined, the household type, national institutions, prices, climate, public services, and assumptions about social participation. Reference budgets are, therefore, not merely lists of average consumption goods. They are structured attempts to price the goods and services required for a defined standard of living.

Recent work also confirms that reference budget outcomes depend on the method used to construct the basket. [Mäkinen \(2021\)](#) compares two Finnish reference budgets and shows that different methodological approaches can produce different estimates of what is needed for social participation. This finding reinforces the role of reference budgets as context-sensitive instruments and prepares the contrast with the BCCR developed below.

The BCCR differs from reference budget and minimum income standard approaches in both scope and benchmark design. It does not construct a national minimum budget, a local socially acceptable standard, or a household type-specific basket. Nor does it attempt to determine the minimum resources needed for adequate participation in each country. Instead, the BCCR applies basket adequacy reasoning to median equivalised disposable income using a selected high-consumption benchmark grounded in empirically observed market consumption choices under conditions of comparatively high private purchasing capacity. In this sense, the BCCR relies less on an expert specification of what households need and more on an observed pattern of consumption that becomes feasible when income constraints are less binding. Reference budgets are richer and more context-sensitive for assessing minimum or socially acceptable living standards; the BCCR is more compact and oriented towards cross-country benchmark coverage comparison. The difference, therefore,

is not that one approach uses a basket and the other does not but that they use different types of baskets for different measurement purposes.

### 2.5. *Living Wage and Living Income Gap Methodologies*

Living wage and living income methodologies provide another important analogue because they connect monetary resources with a costed standard of living and a target-income gap. [Anker and Anker \(2017\)](#) develop a methodology for estimating a wage sufficient to support a basic but decent standard of living for workers and their families in a particular place. [D’Arcy and Finch \(2019\)](#) show, using the UK experience, that translating the living wage concept into a monetary figure involves technical choices, data choices, and normative judgements about social expectations.

The relevance for the BCCR lies in the target-relative logic. Living wage methods do not simply report observed wages; they compare wages with a costed living standard and thereby identify whether a gap exists between actual earnings and a target level. This logic is close to BCCR’s required growth interpretation: if a country’s median equivalised disposable income covers less than a selected benchmark level, the ratio can be used to express how much income would need to increase to reach that target.

The methodological object, however, is different. Living wage approaches focus on wages, workers, and reference families. Their baskets are local and are usually designed to represent a basic but decent standard of living, including food, housing, non-food non-housing needs, and sometimes a margin for unforeseen events. They may also distinguish between net and gross living wages after accounting for taxes and payroll deductions. The BCCR is not a wage setting tool and does not calculate a wage floor. It uses median equivalised disposable income rather than wages and compares this income with a selected high-consumption benchmark rather than a locally constructed living wage basket.

### 2.6. *Residual Income and Affordability Approaches*

Residual income and affordability approaches are relevant because they shift attention from income levels alone to what remains after necessary costs. [Stone \(2006\)](#) argues that housing affordability should be evaluated through a residual income approach because the same housing-cost-to-income ratio can imply very different living conditions for households with different incomes and needs. [Hulchanski \(1995\)](#) criticises the uncritical use of housing expenditure-to-income ratios and identifies multiple meanings attached to such ratios in policy and research. [Kutty \(2005\)](#) develops the concept of housing-induced poverty, describing situations in which households cannot afford non-housing necessities after paying housing costs.

Recent affordability research continues this residual income tradition. [Airgood-Obrycki et al. \(2023\)](#) compare standard rental cost burden measures with residual income cost burdens and show that conventional affordability ratios may understate hardship because they do not account for the wider set of expenses households face after paying rent and utilities. This reinforces why the BCCR should not be interpreted as a full affordability or residual income model: it provides only a benchmark-relative interpretation of residual income share after benchmark coverage.

This literature differs from the BCCR in its formulaic principle. Residual income approaches usually begin with household income and subtract necessary costs, especially housing costs. The resulting residual is then evaluated against the amount needed for non-housing necessities. The benchmark is local, household type-specific, and expenditure-specific. The resource concept may be disposable income, cash income, or another measure of available household resources, depending on the study.

The BCCR is related to this tradition only in a simplified benchmark-relative sense. It does not subtract actual housing costs, debt service, childcare, healthcare, transport, taxes, or other unavoidable expenditures. It, therefore, should not be interpreted as a measure of actual residual income, liquidity, savings, or debt capacity. When the BCCR exceeds one, the excess can be read as a residual income share after benchmark coverage. This is a benchmark-relative interpretation, not a measure of actual household residual income or a full affordability calculation. This distinction is central for maintaining the indicator's interpretive discipline.

### *2.7. Research Gap and Positioning of the BCCR*

The reviewed literature shows that the BCCR should be placed within an established family of income-to-benchmark approaches. Historical welfare ratios compare wages or family earnings with locally priced subsistence or respectability baskets. Poverty welfare ratios and income-to-needs measures compare household resources with poverty or needs thresholds. Reference budgets and minimum income standards construct locally contextualised baskets for adequate living or social participation. Living wage methods translate a costed local standard into a target wage. Residual income approaches evaluate whether households have enough income left after necessary expenditures. These traditions already contain the core interpretive functions of coverage, benchmark comparison, shortfall, surplus, required growth logic, and residual income reasoning.

The research gap, therefore, does not lie in the absence of income-to-benchmark reasoning. It lies in the absence of a compact measure that applies this reasoning to median equivalised disposable income adjusted for cross-country price comparability and normalised against a selected international consumption benchmark. The BCCR addresses this narrower gap. It is not a poverty line, not a local reference budget, not a living wage, not a residual income model, and not a fully independent substitute for PPS-adjusted income. The BCCR should, therefore, not be interpreted as a poverty standard, a minimum income standard, or a normative social adequacy threshold; its interpretation points are descriptive and benchmark-specific. It is a benchmark-referenced consumption coverage ratio designed to make comparable median income directly interpretable in terms of coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth.

This positioning also clarifies the relation between the BCCR and PPS-adjusted income. PPS-adjusted median income remains the necessary monetary basis because it expresses household income in comparable price units. The BCCR builds on that basis and adds an interpretation layer. The resulting ratio answers a different class of questions: not simply how much comparable income a country has but how much of a selected consumption benchmark that income covers. The measure is, therefore, best understood as a cross-country adaptation of established adequacy ratio logic, rather than as an isolated new income indicator. The principal methodological contrasts between BCCR and neighbouring income-to-benchmark approaches are summarised in Table 1.

Taken together, the comparison indicates that the BCCR does not introduce a new mathematical family of indicators. It reorganises established income-to-benchmark reasoning around a specific object: price-comparable median equivalised disposable income. Its information value is consequently not a claim of superiority over all existing measures but a narrower claim of functional answerability. The BCCR is designed to express benchmark coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth directly, while more detailed reference budget, living wage, and residual income approaches remain better suited to household type-specific adequacy, wage setting, and full affordability analysis. This positioning leads into the methodological construction

in the next section, where the BCCR is defined through a price-adjusted median-income numerator and a selected market consumption benchmark denominator.

**Table 1.** Methodological positioning of the BCCR relative to neighbouring income-to-benchmark approaches.

| Approach                                                                                                      | Resource and Price Basis                                                                                                                               | Benchmark and Meaning of 1                                                                                             | Main Methodological Contrast with the BCCR                                                                                                            |
|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| BCCR                                                                                                          | Median equivalised disposable income; after-tax household resources; adjusted for cross-country price comparability in the main PLI/PPS specification. | Selected international consumption benchmark; 1 means full coverage of the selected benchmark.                         | Benchmark-normalised coverage scale for cross-country median disposable income; comparative and criterion-based benchmark.                            |
| Historical welfare ratios (Allen, 2001; Humphries & Weisdorf, 2019)                                           | Worker wage or reconstructed family earnings; usually gross historical earnings; evaluated through local historical prices.                            | Subsistence or respectability basket; 1 means that local earnings cover the locally priced basket.                     | BCCR uses median equivalised disposable income and a selected high-consumption benchmark, not worker wages and local subsistence baskets.             |
| Poverty welfare ratios (Deaton & Zaidi, 2002; Ravallion, 1998)                                                | Household consumption aggregate or income; adjusted through poverty line and spatial price methods where applicable.                                   | Poverty or basic needs line; 1 means that the household reaches the poverty standard.                                  | BCCR is not a poverty measure and does not use a poverty line as denominator.                                                                         |
| Income-to-poverty/income-to-needs ratios (Citro & Michael, 1995; Atkinson, 1987; Foster et al., 1984)         | Family or household income; tax treatment and equivalence adjustment vary by poverty measurement system.                                               | Poverty or needs threshold; 1 means income equals the threshold.                                                       | BCCR applies ratio logic to country-level median equivalised disposable income and a reference consumption benchmark.                                 |
| Reference budgets and minimum income standards (Goedemé et al., 2015; Penne et al., 2020; Davis et al., 2018) | Disposable resources, benefits, or wages for specific household types; local prices under a common methodology.                                        | Locally contextualised basket for adequate living or social participation; 1 means income covers the reference budget. | BCCR does not build national minimum budgets; it uses a selected consumption benchmark for cross-country comparison.                                  |
| Living wage/living income gap (Anker & Anker, 2017; D’Arcy & Finch, 2019)                                     | Worker wages and reference family assumptions; net or gross wage depending on tax treatment.                                                           | Local basic but decent living basket; 1 means wage reaches the living wage standard.                                   | BCCR is not a wage setting tool; it evaluates median disposable income rather than wages and uses a selected high-consumption benchmark.              |
| Residual income/affordability approaches (Stone, 2006; Hulchanski, 1995; Kutty, 2005)                         | Household income after necessary costs, especially housing; local household-type standards.                                                            | Housing and non-housing necessity standards; sufficiency means enough residual income after essential costs.           | BCCR does not measure actual residual income; it provides only a benchmark-relative interpretation of residual income share after benchmark coverage. |

Source: Author’s synthesis.

### 3. Methodology

#### 3.1. Conceptual Framework

In this study, the BCCR (benchmark consumption coverage ratio) is used as a benchmark-relative indicator that reflects the extent to which median equivalised household disposable income, adjusted for cross-country differences in price levels, covers the standardised benchmark level of consumption defined by the U.S. reference basket. Rather than literally measuring the proportion of a single basket of goods with

a fixed composition that income in each country can purchase, the purpose of the ratio is to standardise real equivalised income, for interpretative purposes, against a single benchmark level of consumption.

The BCCR is based on three principles. First, median equivalised disposable income is used as the baseline income indicator. Second, income is brought to a comparable price base using a cross-country price deflator. Third, adjusted income is normalised relative to a reference consumption benchmark. The empirical implementation distinguishes three analytical specifications. The EU\_PLI\_PPS specification uses Eurostat income data and the official PLI(HFCE)/PPS price benchmark ([Eurostat, n.d.-e, n.d.-f](#)) and serves as the main evidence panel. The EU\_COLI specification uses the same Eurostat income strand but applies the COLI price adjustment logic ([Numbeo, n.d.](#)) as a deflator robustness check. The OECD\_COLI specification uses OECD income data and COLI ([OECD, n.d.-a; Numbeo, n.d.](#)) as an operational extension for broader international consistency. In each specification, the numerator and the reference basket are expressed in the same equivalence scale system and monetary baseline. If Eurostat income data are used, the reference basket is adjusted using the modified OECD scale. If OECD income data are used, the reference basket is adjusted using the square root scale.

The quantitative interpretation of the BCCR is, therefore, primarily intra-specification. The EU\_PLI\_PPS specification provides the main evidence for the study; the EU\_COLI specification checks the sensitivity of the results to the price adjustment method on the same Eurostat-based country set; and the OECD\_COLI specification is used only for broader international consistency. Absolute BCCR levels, descriptive interpretation points, and interpretation ranges derived from the EU\_PLI\_PPS specification are not transferred automatically to the COLI-based specifications.

### 3.2. Datasets

The BCCR calculation and subsequent empirical analysis use source-specific maximum available panels determined by the joint availability of the required income, price adjustment, reference basket, and outcome variables. The analysis is organised around three harmonised empirical specifications rather than a single mixed dataset.

The first specification, EU\_PLI\_PPS, is the main evidence panel. It uses Eurostat median equivalised disposable income and the official PLI(HFCE)/PPS price benchmark ([Eurostat, n.d.-e, n.d.-f](#)) for 30 European countries over 2017–2024. This specification is used for the main BCCR estimates, the comparison with PPS-adjusted income and adjacent monetary indicators, the analysis of severe material and social deprivation (SMSD), financial strain outcomes, socio-economic controls, and the decision-oriented interpretation of the BCCR scale.

The second specification, EU\_COLI, uses the same Eurostat-based income strand ([Eurostat, n.d.-e](#)) and the same 30-country coverage for 2017–2024 but applies the COLI price adjustment logic ([Numbeo, n.d.](#)). This specification is used only as a deflator robustness check against the main EU\_PLI\_PPS specification and is not used to derive the main descriptive interpretation points of the BCCR scale. The third specification, OECD\_COLI, uses OECD median equivalised disposable income ([OECD, n.d.-a](#)), a square root equivalence scale, and COLI ([Numbeo, n.d.](#)) for 38 countries over 2017–2023. This specification is used for broad international consistency checks only. A limitation of both COLI-based specifications is that the historical Numbeo index values used in the analysis cannot be fully reproduced from the current public interface.

External vulnerability outcomes are used only within the Eurostat-based specifications. The main deprivation outcome is SMSD ([Eurostat, n.d.-g](#)), while financial strain outcomes include inability to face unexpected financial expenses ([Eurostat, n.d.-c](#)) and difficulty making ends

meet (Eurostat, n.d.-d). The socio-economic controls include the Gini coefficient (Eurostat, n.d.-b; OECD, n.d.-b), the unemployment rate (Eurostat, n.d.-h; OECD, n.d.-c), and social spending or social protection expenditure (Eurostat, n.d.-a; OECD, n.d.-d). GDP per capita (World Bank, n.d.-a), nominal income, and actual individual consumption (AIC) (Eurostat, n.d.-f) are treated as adjacent comparator indicators rather than as core socio-economic controls. All aggregate figures are calculated by year and, where necessary, by simple arithmetic means over the specified period. The main data sources and their analytical roles are summarised in Table 2.

**Table 2.** Primary data sources and analytical roles in the BCCR specifications.

| Component                | Source                                                        | Role in This Study                                                                                                         |
|--------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Eurostat income          | EU-SILC ilc_di03                                              | Median equivalised disposable income for EU_PLI_PPS and EU_COLI; modified OECD scale; PPS or nominal baseline.             |
| OECD income              | OECD Income Distribution Database                             | Median equivalised disposable income for OECD_COLI; square root equivalence scale.                                         |
| Official price benchmark | Eurostat–OECD PPP/PLI(HFCE)                                   | Official PPS conversion and PLI/HFCE adjustment for the main EU_PLI_PPS specification.                                     |
| COLI                     | Numbeo historical COLI                                        | Operational price adjustment proxy for EU_COLI deflator robustness and OECD_COLI broad consistency.                        |
| Reference basket         | BLS Consumer Expenditure Survey; U.S. Census Bureau           | U.S. reference basket and equivalence-scale harmonisation for all specifications.                                          |
| Outcomes                 | Eurostat EU-SILC                                              | SMSD, inability to face unexpected expenses, and difficulty making ends meet for Eurostat-based specifications.            |
| Controls and comparators | Eurostat, OECD, World Bank, Eurostat AIC, World Bank/ICP HFCE | Gini, unemployment, social spending, GDP, AIC, nominal income, and Global HFCE benchmark for models and robustness checks. |

Source: Author’s compilation based on Eurostat (n.d.-e, n.d.-f, n.d.-b, n.d.-g, n.d.-h, n.d.-a, n.d.-c, n.d.-d), the OECD (n.d.-a, n.d.-b, n.d.-c, n.d.-d), Numbeo (n.d.), the U.S. Bureau of Labor Statistics (2025), the U.S. Census Bureau (2026), the World Bank (n.d.-a, n.d.-b, n.d.-c, n.d.-d), and the International Monetary Fund (n.d.). Full processed datasets and model sample flags are provided in Supplementary S1.

The income figures in the study are equivalised income figures, but the equivalence system depends on the source. Eurostat-based specifications use the modified OECD scale, while the OECD-based specification uses the square root scale. Price adjustments are applied according to the relevant specification: the official PLI(HFCE)/PPS framework in EU\_PLI\_PPS and the COLI operational price adjustment logic in EU\_COLI and OECD\_COLI. Within a single empirical specification, only one price adjustment logic is used.

### 3.3. Definition of Variables and Standardisation

#### 3.3.1. Income Indicator

The baseline variable is median equivalised disposable income, denoted here as  $D_{eq,i,t}$ , where  $i$  denotes country and  $t$  denotes year.

For the purposes of this study,  $D_{eq,i,t}$  is a generic term for equivalised disposable income, whilst the specific system of equivalent units is determined by the data source:

- If the Eurostat-based income strand is used,  $D_{eq,i,t}$  refers to income adjusted using the modified OECD scale;
- If the OECD-based income strand is used,  $D_{eq,i,t}$  refers to income equivalised using a square-root scale.

This approach prevents the indiscriminate mixing of different equivalence systems and ensures the internal consistency of each BCCR operational specification.

### 3.3.2. Price-Level Adjustment of Income

To ensure that incomes are comparable across countries, they must be adjusted against a comparable price benchmark. An adjusted income is generally expressed as:  $D_{eq,i,t}^{adj}$ .

#### 1. Primary official specification for PLI(HFCE)/PPS

The primary official strand uses the official PLI(HFCE)/PPS framework. If the source income is already expressed in PPS, the additional two-stage adjustment does not apply:

$$D_{eq,i,t}^{adj} = D_{eq,i,t}^{PPS}$$

If the source income is available in nominal terms in the national currency, the standard price adjustment is applied using  $PPP(HFCE)$ :

$$D_{eq,i,t}^{adj} = \frac{D_{eq,i,t}^{nominal}}{PPP_{i,t}^{HFCE}} \quad (1)$$

The analytically equivalent two-stage model via the exchange rate and the PLI takes the following form:

$$D_{eq,i,t}^{EUR} = \frac{D_{eq,i,t}^{nominal}}{ER_{i,t}}$$

$$D_{eq,i,t}^{adj} = \frac{D_{eq,i,t}^{EUR}}{PLI_{i,t}^{HFCE} / 100}$$

For the purposes of this study, the official PLI(HFCE)/PPS strand is the primary baseline implementation.

#### 2. COLI research specification

For the COLI specification, income is first adjusted to a common nominal currency baseline, where necessary:

$$D_{eq,i,t}^{EUR} = \frac{D_{eq,i,t}^{nominal}}{ER_{i,t}}$$

Following this, COLI is used to adjust the price levels:

$$D_{eq,i,t}^{adj} = D_{eq,i,t}^{EUR} \cdot \frac{COLI_{US,t}}{COLI_{i,t}} \quad (2)$$

If the source income has already been presented using a common nominal currency baseline, the first step is omitted. This study uses the COLI specification as a research operational proxy for broader international samples. Its comparability is functional rather than institutionally verified and is, therefore, not regarded as a fully equivalent alternative to the official PLI/PPS specification.

### 3.3.3. Reference Consumption Basket

The benchmark in the BCCR methodology is the annual expenditure of a single U.S. consumer unit, based on data from the BLS Consumer Expenditure Survey (U.S. Bureau of Labor Statistics, 2025). For BCCR purposes, this basket serves as a reference and interpretive tool: it sets a standardised consumption level against which adjusted income is benchmarked. Therefore, in the current operationalisation, the BCCR is not a direct index of the revaluation of the same basket of fixed quantitative composition in each country.

The selection of the United States as the reference economy should be understood as an operational benchmark choice rather than as a political or universal normative preference.

In the present framework, a suitable reference economy should satisfy several practical criteria: a high observed level of private market consumption, a sufficiently large and diversified population base, transparent and reproducible household expenditure statistics, global economic relevance, and stable data availability over time. These criteria make the benchmark economically interpretable for broad cross-country comparison and exclude the use of very small high-income jurisdictions as reference economies, even if their measured consumption levels are high, because such economies may be structurally atypical and less informative for general international comparison.

The BCCR framework is, therefore, not intrinsically tied to the United States. If another large and economically relevant country were to satisfy these benchmark selection criteria more strongly in a future empirical setting, the framework could be re-anchored to that reference economy. However, within any given empirical specification, the reference economy and the associated basket must remain fixed over the analysed period in order to preserve comparability. Any change in the reference economy would require recalculating the full BCCR series under the new benchmark specification rather than switching the denominator within an existing series.

A further boundary of the benchmark definition concerns actual individual consumption (AIC). AIC per capita in PPS is not used as the BCCR denominator in the present specification because it is a national accounts consumption measure that includes not only goods and services purchased directly by households but also individual services financed by government and NPISHs. The BCCR framework compares median equivalised disposable income available for private market expenditure with a reference benchmark based on actual consumer unit market expenditure. Using AIC as the denominator while retaining median disposable income as the numerator would, therefore, mix a private income resource concept with a broader consumption concept that partly includes publicly provided services. An AIC-based version of the BCCR would require a correspondingly broader numerator, such as adjusted disposable income including social transfers in kind, and would constitute a different specification rather than a substitute for the present private-income benchmark coverage measure.

Let us designate the annual expenditure per consumer unit as  $C_{US,t}^{CU,USD}$ .

#### A. Standardisation using the modified OECD scale (as used by Eurostat)

If the income indicator is derived from the Eurostat strand, the reference basket is adjusted using the modified OECD scale. The total number of equivalent units per year is

$$EQ_t = CU_t + 0.5(A_t - CU_t) + 0.3C_t$$

where  $CU_t$  is the number of consumer units,  $A_t$  is the number of adults, and  $C_t$  is the number of children (U.S. Census Bureau, 2026). The standardisation factor is:

$$k_t^{mod} = \frac{EQ_t}{CU_t} \quad (3)$$

The nominal reference cost of the U.S. basket per equivalent unit is, therefore:

$$C_{US,t}^{eq,EUR,mod} = \frac{C_{US,t}^{CU,EUR}}{k_t^{mod}} \quad (4)$$

where

$$C_{US,t}^{CU,EUR} = \frac{C_{US,t}^{CU,USD}}{ER_t^{USD/EUR}}$$

For the core PLI/PPS specification, the U.S. basket is adjusted to the same PPS base as income:

$$C_{US,t}^{eq,PPS,mod} = \frac{C_{US,t}^{CU,USD}}{k_t^{mod} \cdot PPP_{US,t}^{HFCE}} \quad (5)$$

#### B. Standardisation using the square root scale (as used by the OECD)

If the income indicator is derived from the OECD strand, the reference basket is adjusted using the square root scale. Let us assume that  $\bar{s}_t$  represents the average size of a consumer unit/household in the U.S. in year  $t$ . The standardisation factor on this scale is then determined as:

$$k_t^{sqr} = \sqrt{\bar{s}_t}$$

Accordingly,  $k_t^{sqr}$  is the standardisation factor on the square root scale, rather than the average household size itself.

Then:

$$C_{US,t}^{eq,EUR,sqr} = \frac{C_{US,t}^{CU,EUR}}{k_t^{sqr}} \quad (6)$$

If adjusting to the PPS baseline, the following is required:

$$C_{US,t}^{eq,PPS,sqr} = \frac{C_{US,t}^{CU,USD}}{k_t^{sqr} \cdot PPP_{US,t}^{HFCE}} \quad (7)$$

#### C. Rules for application for different specifications

The methodology applies the following rules:

- If Eurostat income data are used, the U.S. basket is equivalised using the modified OECD scale;
- If OECD income data are used, the U.S. basket is equivalised using the square root scale;
- If the official PLI(HFCE)/PPS strand is used, the U.S. basket is adjusted to PPS via  $PPP_{US,t}^{HFCE}$ ;
- If the COLI strand is used, price adjustments apply only to income; the U.S. reference basket is not deflated via COLI but remains the benchmark in the baseline nominal currency system of this specification. The purpose of this is to avoid double price adjustment: in the COLI strand, income is already converted to the U.S. price baseline using a multiplier  $\frac{COLI_{US,t}}{COLI_{i,t}}$ ; therefore, no further adjustment of the reference basket via COLI is required. The reference basket values used in the calculations are presented in Table 3.

**Table 3.** Reference U.S. basket values used in the BCCR specifications.

| Year | $C_{US,t}^{eq,PPS,mod}$ | $C_{US,t}^{eq,EUR,mod}$ | $C_{US,t}^{eq,EUR,sqr}$ |
|------|-------------------------|-------------------------|-------------------------|
| 2017 | 27,225.90               | 31,978.98               | 33,648.77               |
| 2018 | 27,710.24               | 31,296.63               | 32,811.94               |
| 2019 | 27,099.69               | 34,009.12               | 35,638.54               |
| 2020 | 25,675.34               | 32,030.22               | 33,986.50               |
| 2021 | 27,952.96               | 34,113.41               | 36,507.96               |
| 2022 | 29,118.26               | 41,669.80               | 44,707.66               |
| 2023 | 29,772.94               | 42,742.59               | 45,163.77               |
| 2024 | 30,299.61               | 43,416.53               | 46,811.42               |

Note: Values are processed benchmark denominators used in the updated BCCR calculations. The EU\_PLI\_PPS basket is expressed in the PPS-compatible baseline; the COLI baskets are expressed in the nominal baseline of the corresponding COLI specification. Global HFCE is used separately as a world average robustness benchmark and is reported in Supplementary S1. Source: Author's calculations based on the [U.S. Bureau of Labor Statistics \(2025\)](#), the [U.S. Census Bureau \(2026\)](#), the [International Monetary Fund \(n.d.\)](#), [Eurostat \(n.d.-f\)](#), and the [World Bank \(n.d.-b, n.d.-c, n.d.-d\)](#).

### 3.4. BCCR Construction

In general terms, the BCCR is calculated as follows:

$$BCCR_{i,t} = \frac{D_{eq,i,t}^{adj}}{C_{US,t,s}^{ref}} \quad (8)$$

where  $D_{eq,i,t}^{adj}$  is the equivalised disposable income, adjusted to a common price benchmark in accordance with the selected price adjustment specification.

$C_{US,t,s}^{ref}$  is the U.S. reference basket, adjusted to the appropriate system of equivalent units and monetary baseline according to the relevant specification.

The paper uses the following specific forms of the denominator.

For the primary Eurostat PLI/PPS strand:

$$C_{US,t,s}^{ref} = C_{US,t}^{eq,PPS,mod}$$

For the overlapping COLI strand based on the Eurostat data:

$$C_{US,t,s}^{ref} = C_{US,t}^{eq,EUR,mod}$$

For the broad COLI strand based on the OECD data:

$$C_{US,t,s}^{ref} = C_{US,t}^{eq,EUR,sqrt}$$

In the primary PLI/PPS specification, the BCCR should be interpreted as a benchmark-normalised form of PPS-adjusted median income. Across each year, it represents a simple scaling of PPS-adjusted income because the denominator is common to all countries in year  $t$ . Therefore, BCCR's contribution in this specification lies not in empirical orthogonality to PPS income but in translating price-adjusted income into a comprehensible scale of benchmark consumption coverage.

### 3.5. Decision-Oriented Interpretation of the BCCR

Building on Equation (8), several decision-oriented interpretation measures can be derived from the BCCR scale. These measures do not represent additional independent variables; rather, they are direct transformations of the BCCR and express the same adjusted income information in terms of benchmark coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth.

Let  $Y_{i,t}$  denote the adjusted median equivalised disposable income of country  $i$  in year  $t$ , and let  $B_t$  denote the reference consumption benchmark used in the relevant BCCR specification. Since  $BCCR_{i,t} = Y_{i,t}/B_t$ , the direct BCCR-scale transformations are defined as follows:

$$\begin{aligned} Coverage_{i,t} &= BCCR_{i,t} \\ Shortfall_{i,t} &= 1 - BCCR_{i,t}, BCCR_{i,t} < 1 \\ Surplus_{i,t} &= BCCR_{i,t} - 1, BCCR_{i,t} > 1 \\ ResidualShare_{i,t} &= 1 - \frac{1}{BCCR_{i,t}}, BCCR_{i,t} > 1 \end{aligned} \quad (9)$$

For example,  $BCCR = 0.60$  means that adjusted median equivalised disposable income covers 60% of the selected reference benchmark. If  $BCCR_{i,t} < 1$ , the relevant interpretation is the shortfall from the benchmark. If  $BCCR_{i,t} > 1$ , the relevant interpretation may include the surplus over the benchmark and the residual income share after benchmark coverage.

The latter should not be interpreted as actual savings but only as a calculated residual share relative to the selected benchmark.

For any selected target  $\tau$ , the proportional income growth required to reach that target is defined as:

$$g_{i,t}(\tau) = \max\left\{\frac{\tau}{BCCR_{i,t}} - 1, 0\right\} \quad (10)$$

The target  $\tau$  may represent full benchmark coverage ( $\tau = 1$ ), a descriptive BCCR interpretation point, a reference country's BCCR level, or another explicitly defined benchmark. If a country is already above the selected target, the required growth is reported as zero in descriptive tables. The corresponding non-negative required income increase can also be expressed in monetary terms as:

$$\Delta Y_{i,t}(\tau) = \max\left\{Y_{i,t}\left(\frac{\tau}{BCCR_{i,t}} - 1\right), 0\right\} = \max\{B_t(\tau - BCCR_{i,t}), 0\}. \quad (11)$$

These transformations are used only for interpretation. They do not imply causal effects, policy obligations, or universal normative thresholds. Their purpose is to translate adjusted median income into a benchmark-referenced scale that directly expresses coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth.

### 3.6. Validation and Robustness Strategy

The empirical validation strategy evaluates the BCCR as a benchmark-referenced adequacy ratio rather than as a causally identified determinant of deprivation, income, or GDP. The checks reported in the study assess external coherence, robustness, and interpretive stability. They do not provide causal identification and should not be interpreted as evidence that changes in the BCCR mechanically cause changes in the outcome variables.

The main evidence comes from the EU\_PLI\_PPS specification. This specification is used for the baseline BCCR estimates, the comparison with PPS-adjusted median income and adjacent monetary indicators, the analysis of socio-economic vulnerability outcomes, the controlled models, and the descriptive interpretation points of the BCCR scale.

The core external outcomes are severe material and social deprivation (SMSD; Eurostat, n.d.-g), inability to face unexpected financial expenses (Eurostat, n.d.-c), and difficulty making ends meet (Eurostat, n.d.-d). These variables are not included in the BCCR formula and are used to evaluate whether the benchmark coverage scale is externally coherent with socio-economic vulnerability and financial strain. The updated validation framework, therefore, relies on SMSD and two financial strain outcomes, which provide the relevant harmonised outcome coverage for the main Eurostat-based analysis.

To reduce omitted-variable concerns, the validation models include socio-economic controls for income inequality, labour market conditions, and the social policy environment. These controls are represented by the Gini coefficient (Eurostat, n.d.-b; OECD, n.d.-b), the unemployment rate (Eurostat, n.d.-h; OECD, n.d.-c), and social spending or social protection expenditure (Eurostat, n.d.-a; OECD, n.d.-d). GDP per capita (World Bank, n.d.-a), nominal median income (Eurostat, n.d.-e; OECD, n.d.-a), and AIC per capita in PPS (Eurostat, n.d.-f) are treated as adjacent monetary comparators rather than as the core socio-economic controls in the vulnerability models.

The study reports simple, controlled, and pooled OLS specifications with adjusted R-squared values and robust standard errors where appropriate. The BCCR and PPS-adjusted income are not interpreted as independent predictors in the same substantive model because in the official PLI/PPS specification, the BCCR is structurally derived from PPS-adjusted income through a common annual denominator. The comparison with PPS-

adjusted income is, therefore, used to clarify the structural overlap between the BCCR and its income numerator, rather than to claim discriminant superiority.

Robustness diagnostics include VIF tests for multicollinearity, Cook's Distance and related influence diagnostics, and leave-one-country-out checks. These diagnostics are used to verify whether the main associations are driven by multicollinearity or by a small number of influential countries. They constrain the interpretation of the results rather than serving as independent evidence of causality.

Fixed-effects panel models with country and year effects are used only as supplementary robustness checks. They control for time-invariant country-specific heterogeneity and common year shocks, but they are not treated as causal models. This caution is particularly important because PPP/PLI/PPS indicators are primarily designed for spatial comparability and because part of the annual variation in the BCCR reflects the common annual reference basket component in the denominator.

The EU\_COLI specification is used as a deflator robustness check on the same Eurostat-based country set, while the OECD\_COLI specification is used for broad international consistency only. The COLI-based specifications are not used to derive the main descriptive interpretation points of the BCCR scale. Basket robustness is assessed by comparing the baseline U.S. reference basket with a Global HFCE benchmark ([World Bank, n.d.-b, n.d.-c, n.d.-d](#)). These checks evaluate the sensitivity of the BCCR scale to the choice of denominator and do not imply that the alternative benchmark is superior or that the BCCR is independent from PPS-adjusted income.

Any BCCR interpretation points reported in the empirical analysis are derived solely from the main EU\_PLI\_PPS specification and have descriptive, sample-specific, and specification-specific status. They are not universal policy thresholds and are not transferred automatically to the COLI-based specifications.

## 4. Empirical Analysis

This section presents the empirical analysis of the BCCR. The purpose of the analysis is not to demonstrate that the BCCR is statistically independent from PPS-adjusted median income in the official PLI/PPS specification. In that specification, the BCCR is structurally close to PPS-adjusted income because the reference basket denominator is common across countries within a year. The empirical analysis, therefore, focuses on three questions: whether the BCCR is externally coherent with socio-economic vulnerability and financial-strain outcomes; whether the results are robust to socio-economic controls, diagnostic checks, fixed effects, price adjustment, and basket assumptions; and how the BCCR translates real median income into a decision-oriented benchmark-coverage scale.

### 4.1. Empirical Specifications, Data Coverage, and Comparator Discipline

The empirical analysis uses three internally consistent specifications. The main specification is the Eurostat/PLI-PPS branch, which provides the primary evidence. The Eurostat/COLI branch uses the same Eurostat country set and income source but applies the COLI price adjustment specification as a deflator robustness check. The OECD/COLI branch is used only for broad international consistency and is not used for deprivation or financial strain modelling.

The empirical period follows the latest jointly available annual data for the variables required in each specification. The main Eurostat/PLI-PPS and Eurostat/COLI branches cover 30 countries over 2017–2024. The OECD/COLI branch covers 38 countries over 2017–2023. Full processed country-year datasets, variable definitions, and model sample flags are reported in Supplementary S1, Tables S1–S7. The three empirical specifications and their analytical roles are summarised in Table 4.

**Table 4.** Empirical specifications and analytical roles.

| Specification | Income Source | Price Adjustment | Countries | Years     | Outcome Variables                                                        | Analytical Role                 |
|---------------|---------------|------------------|-----------|-----------|--------------------------------------------------------------------------|---------------------------------|
| EU_PLI_PPS    | Eurostat      | PLI/PPS          | 30        | 2017–2024 | SMSD; inability to face unexpected expenses; difficulty making ends meet | Main evidence                   |
| EU_COLI       | Eurostat      | COLI             | 30        | 2017–2024 | Same Eurostat outcomes                                                   | Deflator robustness             |
| OECD_COLI     | OECD          | COLI             | 38        | 2017–2023 | No deprivation or financial strain outcomes                              | Broad international consistency |

Note: The three specifications are not merged into a single hybrid dataset. Each specification uses its own income source, price adjustment logic, and equivalence-scale convention. Source: Author’s compilation based on the data sources described in Table 2 and Supplementary S1.

The comparator analysis defines the empirical boundary of the BCCR relative to adjacent monetary indicators. In the main EU\_PLI\_PPS specification, the BCCR and PPS-adjusted median equivalised disposable income are almost perfectly aligned at the country-mean level. This is expected by construction and is interpreted as structural overlap rather than discriminant independence. GDP per capita, nominal median income, and AIC per capita in PPS are, therefore, treated as adjacent comparators rather than as core controls in the vulnerability models. The comparative  $R^2$  values from the simple validation models are summarised in Table 5.

**Table 5.** Simple validation models for vulnerability outcomes:  $R^2$  by predictor, EU\_PLI\_PPS country means, 2017–2024.

| Outcome                               | BCCR  | PPS-Adjusted Income | Nominal Income | GDP per Capita | AIC per Capita in PPS |
|---------------------------------------|-------|---------------------|----------------|----------------|-----------------------|
| SMSD                                  | 0.444 | 0.443               | 0.350          | 0.252          | 0.301                 |
| Inability to face unexpected expenses | 0.443 | 0.443               | 0.401          | 0.305          | 0.367                 |
| Difficulty making ends meet           | 0.425 | 0.425               | 0.358          | 0.281          | 0.376                 |

Note: These are simple descriptive country-mean models. The BCCR and PPS-adjusted income have almost identical fit in the PLI/PPS branch. The country-mean correlation between the BCCR and PPS-adjusted income is Pearson  $r = 0.999992$  and Spearman  $\rho = 0.999110$ . Source: Author’s calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

#### 4.2. Core Validation Against Socio-Economic Vulnerability and Financial Strain

The core validation environment uses socio-economic vulnerability and financial strain outcomes rather than additional monetary variables. Three Eurostat outcomes are used: severe material and social deprivation (SMSD), inability to face unexpected financial expenses, and difficulty making ends meet. The socio-economic controls are the Gini coefficient, the unemployment rate, and social spending. This design separates the benchmark adequacy question from adjacent monetary comparisons such as GDP, AIC, and nominal income.

The first set of results uses country means over 2017–2024. The BCCR is negatively associated with all three outcomes. However, its statistical fit remains almost identical to PPS-adjusted income, which confirms external coherence with vulnerability outcomes but not discriminant independence from PPS-adjusted income. The associations between the BCCR and the three vulnerability outcomes are summarised in Table 6.

**Table 6.** The BCCR and vulnerability outcomes, EU\_PLI\_PPS country means, 2017–2024.

| Outcome                               | BCCR Pearson r | BCCR Spearman rho | BCCR R <sup>2</sup> | PPS-Income R <sup>2</sup> | Interpretation                                  |
|---------------------------------------|----------------|-------------------|---------------------|---------------------------|-------------------------------------------------|
| SMSD                                  | −0.666         | −0.711            | 0.444               | 0.443                     | Negative association; similar fit to PPS income |
| Inability to face unexpected expenses | −0.666         | −0.684            | 0.443               | 0.443                     | Financial strain association                    |
| Difficulty making ends meet           | −0.652         | −0.787            | 0.425               | 0.425                     | Strong rank association                         |

Note: All signs are in the expected direction. A higher BCCR is associated with lower socio-economic vulnerability and financial strain. Similarity to PPS-adjusted income is expected in the PLI/PPS branch. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

The controlled models use country means over 2017–2023 because social spending is incomplete for 2024. The addition of the BCCR to the controls-only specification improves model fit for all three outcomes. The same models using PPS-adjusted income instead of the BCCR produce nearly identical fit, which is again interpreted as structural proximity rather than empirical independence. The results of the controlled vulnerability models are summarised in Table 7.

The pooled annual controlled models over 2017–2023 confirm the same direction. With country-clustered standard errors, the BCCR coefficient is negative and statistically significant for SMSD (coefficient = −13.427,  $p = 0.00299$ ), inability to face unexpected expenses (coefficient = −22.723,  $p = 0.000917$ ), and difficulty making ends meet (coefficient = −30.658,  $p = 0.000217$ ). These results support the external coherence of the BCCR with vulnerability outcomes, while leaving the interpretation of the added value of the BCCR at the benchmark coverage level rather than the level of statistical independence from PPS-adjusted income.

**Table 7.** Controlled vulnerability models with socio-economic controls, EU\_PLI\_PPS country means, 2017–2023.

| Outcome                               | Controls-Only R <sup>2</sup> | Controls-Only adj. R <sup>2</sup> | BCCR Coefficient | HC3 $p$ -Value | Model R <sup>2</sup> | Model adj. R <sup>2</sup> | Delta R <sup>2</sup> |
|---------------------------------------|------------------------------|-----------------------------------|------------------|----------------|----------------------|---------------------------|----------------------|
| SMSD                                  | 0.458                        | 0.395                             | −13.594          | 0.0116         | 0.605                | 0.541                     | 0.147                |
| Inability to face unexpected expenses | 0.391                        | 0.321                             | −23.030          | 0.0055         | 0.536                | 0.462                     | 0.145                |
| Difficulty making ends meet           | 0.461                        | 0.399                             | −30.690          | 0.0074         | 0.602                | 0.538                     | 0.141                |

Note: Controls are Gini, unemployment, and social spending. Country-mean models use  $N = 30$ . Detailed simple and controlled OLS outputs, including robust and clustered standard errors, are reported in Supplementary S1, Tables S8–S20. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

#### 4.3. Robustness, Diagnostics, and Alternative Specifications

The diagnostic and robustness checks constrain the interpretation of the core results. These checks include VIF diagnostics, influence diagnostics, leave-one-country-out tests, fixed-effects models, deflator robustness, broad international consistency, and basket robustness. The purpose of these tests is not causal identification but verification of whether the main descriptive associations are sensitive to model specification, influential observations,

or benchmark assumptions. The main diagnostic and robustness results are summarised in Table 8.

**Table 8.** Robustness diagnostics summary.

| Check                                    | Main Result                                                 | Interpretation                              |
|------------------------------------------|-------------------------------------------------------------|---------------------------------------------|
| VIF: controls only                       | Max VIF = 1.55                                              | Low multicollinearity                       |
| VIF: BCCR + controls                     | Max VIF = 1.94                                              | No serious multicollinearity                |
| VIF: BCCR + GDP + controls               | Max VIF = 9.99                                              | Interpret with caution                      |
| VIF: BCCR + AIC + controls               | Max VIF = 11.99                                             | High multicollinearity                      |
| VIF: BCCR + PPS-adjusted income boundary | Max VIF = 131,978                                           | Structural overlap, not a substantive model |
| Leave one country out                    | Sign and $p < 0.05$ stable for all three outcomes           | Main results not driven by one country      |
| Luxembourg check                         | High leverage but not Cook's D driver in main pooled models | No exclusion justified                      |
| United States check                      | Influential in OECD_COLI, Cook's D $< 1$                    | Relevant only to broad consistency branch   |

Note: The BCCR + PPS-adjusted income boundary model is included only to demonstrate structural overlap. The BCCR and PPS-adjusted income are not interpreted as independent predictors in a single substantive model. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

Fixed-effects models serve as supplementary robustness checks. They control for time-invariant country-specific heterogeneity and common year shocks, but they are not used for causal identification. The sign of the BCCR coefficient remains negative for all three Eurostat outcomes. Statistical significance with country-clustered standard errors is retained for SMSD and difficulty making ends meet, while the relationship with inability to face unexpected expenses weakens in the two-way fixed-effects specification. The results of the two-way fixed-effects robustness checks are summarised in Table 9.

**Table 9.** Two-way fixed-effects robustness, EU\_PLI\_PPS, 2017–2023.

| Outcome                               | BCCR Coefficient | Clustered SE | Clustered $p$ -Value | Within $R^2$ | Interpretation           |
|---------------------------------------|------------------|--------------|----------------------|--------------|--------------------------|
| SMSD                                  | −17.896          | 7.824        | 0.0297               | 0.198        | Negative and significant |
| Inability to face unexpected expenses | −17.412          | 12.962       | 0.1896               | 0.098        | Negative, weaker         |
| Difficulty making ends meet           | −44.069          | 13.678       | 0.00314              | 0.309        | Negative and significant |

Note: Models include the BCCR, Gini, unemployment, social spending, country fixed effects, and year fixed effects. These are supplementary robustness checks and should not be interpreted as causal estimates. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

The alternative price adjustment and basket checks further support the robustness of interpretation. The Eurostat/COLI specification is strongly aligned with the main Eurostat/PLI-PPS specification on the overlapping country set. The OECD/COLI branch is used only for broad international consistency. Finally, replacing the U.S. reference basket with a Global HFCE benchmark changes the absolute BCCR scale but does not materially alter the cross-country structure. The results of the alternative specification and basket robustness checks are summarised in Table 10.

**Table 10.** Alternative specification and basket robustness summary.

| Robustness Check                           | Main Result                                                          | Interpretation                     |
|--------------------------------------------|----------------------------------------------------------------------|------------------------------------|
| EU_PLI_PPS vs. EU_COLI                     | Pearson = 0.973; Spearman = 0.976                                    | High deflator consistency          |
| EU_PLI_PPS vs. EU_COLI ranks               | Mean rank deviation = 1.333; max = 4                                 | Rank structure broadly stable      |
| OECD_COLI: BCCR vs. OECD income            | Pearson = 0.932; Spearman = 0.959                                    | Broad income consistency           |
| OECD_COLI: BCCR vs. GDP                    | Pearson = 0.858; Spearman = 0.937                                    | Broad macro-consistency            |
| U.S. basket vs. Global HFCE,<br>EU_PLI_PPS | Country-mean Pearson = 0.99996;<br>Spearman = 0.99956                | Basket change mainly rescales BCCR |
| U.S. basket vs. Global HFCE ranks          | Mean rank deviation = 0.067; max = 1;<br>within-year ranks identical | Country ordering stable            |

Note: The U.S. basket is retained as the baseline demanding benchmark. Global HFCE is treated as a world-average robustness benchmark, not as a replacement. Full diagnostic outputs are provided in Supplementary S1, Tables S21–S41. Source: Author’s calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

#### 4.4. Decision-Oriented Interpretation of the BCCR Scale

The statistical results above define the empirical boundary of the BCCR: in the official PLI/PPS specification, it is structurally close to PPS-adjusted income and should not be treated as a statistically independent substitute for that income measure. The decision-oriented indicators reported in this subsection are derived directly from the BCCR definition and transformations presented in Section 3.5 and Equations (9)–(11). They are not additional econometric variables, but interpretive transformations of the BCCR scale: coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth.

A simple country-mean model for the main EU\_PLI\_PPS specification over 2017–2024 was used to derive descriptive interpretation points from SMSD. The model was  $\text{SMSD} = \alpha + \beta \times \text{BCCR}$ , with  $\alpha = 16.8103$ ,  $\beta = -16.4773$ ,  $R^2 = 0.4438$ , and adjusted  $R^2 = 0.4240$ . These interpretation points are descriptive, sample-specific, and specification-specific. They are not universal policy standards. Because the values of 0.413 and 0.717 were derived from and applied to the same 30-country sample, they have not been validated out of sample and should be interpreted only as in-sample descriptive reference points. The descriptive BCCR interpretation points derived from the SMSD model are presented in Table 11.

**Table 11.** Descriptive BCCR interpretation points, EU\_PLI\_PPS, 2017–2024.

| Criterion               | BCCR Value | Status                                            |
|-------------------------|------------|---------------------------------------------------|
| SMSD = 10%              | 0.413      | Descriptive, sample-specific interpretation point |
| SMSD = 5%               | 0.717      | Descriptive, sample-specific interpretation point |
| Full benchmark coverage | 1.000      | Definitional benchmark coverage point             |

Note: The observed country-mean BCCR range is 0.2491–1.1213. The interpretation points are derived only for the main EU\_PLI\_PPS baseline specification with the U.S. reference basket. The SMSD-derived points were obtained and applied within the same 30-country sample and have not been externally validated on an independent sample. Source: Author’s calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

Based on the two SMSD-derived interpretation points, countries can be grouped into low, intermediate, and high BCCR ranges. These ranges are not normative categories. They provide a descriptive summary of how benchmark coverage is associated with vulnerability profiles in the empirical sample. The resulting low, intermediate, and high BCCR ranges and their associated vulnerability profiles are presented in Table 12.

The same scale can be translated into required-growth terms. For countries below a selected BCCR target, the required growth is calculated using Equation (10); that is, the selected target BCCR divided by the current BCCR minus one, with a lower bound of zero

for countries already above the target. Thus, a value of 100% means that adjusted median income would have to double to reach the selected BCCR target. This calculation is not a forecast and not a policy prescription. It is an interpretative translation of the BCCR scale into a benchmark-relative income growth requirement. An illustrative application of the decision-oriented BCCR interpretation is presented in Table 13.

**Table 12.** BCCR ranges and vulnerability profiles, EU\_PLI\_PPS country means, 2017–2024.

| Range                            | Countries | Mean BCCR | Mean SMSD | Unexpected Expenses | Make-Ends Severe |
|----------------------------------|-----------|-----------|-----------|---------------------|------------------|
| Low BCCR (<0.413)                | 6         | 0.327     | 15.55     | 38.13               | 37.92            |
| Intermediate BCCR (0.413–<0.717) | 12        | 0.544     | 4.96      | 33.93               | 21.01            |
| High BCCR ( $\geq 0.717$ )       | 12        | 0.852     | 3.59      | 24.08               | 11.23            |

Note: Low BCCR countries are Türkiye, Romania, Bulgaria, Hungary, Slovakia, and Greece. Intermediate BCCR countries are Croatia, Latvia, Portugal, Lithuania, Poland, Czechia, Estonia, Spain, Slovenia, Italy, Cyprus, and Malta. High BCCR countries are Ireland, France, Finland, Sweden, Denmark, Belgium, Germany, Netherlands, Austria, Switzerland, Norway, and Luxembourg. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

**Table 13.** Illustrative decision-oriented interpretation, EU\_PLI\_PPS country means, 2017–2024.

| Country    | Mean BCCR | Coverage of Benchmark | Shortfall to BCCR = 1 | Growth to BCCR = 1 | SMSD  | Unexpected Expenses | Make-Ends Severe |
|------------|-----------|-----------------------|-----------------------|--------------------|-------|---------------------|------------------|
| Türkiye    | 0.249     | 24.9%                 | 75.1%                 | +301.4%            | 15.59 | 30.89               | 25.87            |
| Romania    | 0.306     | 30.6%                 | 69.4%                 | +226.4%            | 24.36 | 46.45               | 30.98            |
| Bulgaria   | 0.332     | 33.2%                 | 66.8%                 | +201.1%            | 21.11 | 42.05               | 44.51            |
| Slovenia   | 0.634     | 63.4%                 | 36.6%                 | +57.7%             | 2.44  | 28.49               | 16.41            |
| Italy      | 0.642     | 64.2%                 | 35.8%                 | +55.8%             | 5.68  | 32.98               | 23.64            |
| Germany    | 0.828     | 82.8%                 | 17.2%                 | +20.7%             | 4.76  | 31.80               | 6.88             |
| Norway     | 0.989     | 98.9%                 | 1.1%                  | +1.1%              | 2.19  | 21.89               | 7.40             |
| Luxembourg | 1.121     | 112.1%                | 0.0%                  | 0.0%               | 1.98  | 20.75               | 9.84             |

Note: Growth to BCCR = 1 is calculated only as a benchmark-relative interpretation of the scale. Full required growth calculations for all 30 countries are provided in Supplementary S1, Tables S42–S47. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

The functional difference between the BCCR and PPS-adjusted income can be summarised through decision-oriented questions. PPS-adjusted income directly provides a real monetary level. The BCCR does not replace this monetary basis, but it embeds the reference benchmark and, therefore, directly expresses coverage, shortfall, surplus, residual income share after benchmark coverage, and required growth. The functional answerability of the BCCR relative to PPS-adjusted income is summarised in Table 14.

Overall, the BCCR is structurally close to PPS-adjusted median income and is not claimed to be discriminantly independent from it. It is consistently associated with lower vulnerability outcomes, remains robust under socio-economic controls and diagnostics, and is best interpreted as a benchmark coverage scale expressing coverage, shortfall, and required growth.

**Table 14.** Functional answerability of the BCCR relative to PPS-adjusted income.

| Decision Question                                | PPS-Adjusted Income                                | BCCR                                          |
|--------------------------------------------------|----------------------------------------------------|-----------------------------------------------|
| Real income comparison across countries          | Direct                                             | Direct, but benchmark-normalised              |
| Share of reference consumption benchmark covered | Requires external basket denominator               | Direct: $BCCR \times 100\%$                   |
| Shortfall relative to benchmark                  | Requires income minus basket calculation           | Direct: $1 - BCCR$ , if $BCCR < 1$            |
| Required growth to benchmark                     | Requires target income to be specified             | Direct: target BCCR/current BCCR $- 1$        |
| Residual income share after benchmark coverage   | Requires benchmark and residual income calculation | Direct only when $BCCR > 1$ : $1 - 1/BCCR$    |
| Interpretation for non-specialist audience       | Monetary unit requires additional context          | Coverage scale gives direct benchmark meaning |

Note: PPS-adjusted income remains the necessary monetary basis. The BCCR operationalises benchmark adequacy questions by embedding the reference consumption benchmark into the scale. Source: Author's calculations based on the processed datasets described in Section 3.2 and Supplementary S1.

## 5. Discussion and Limitations

The empirical results support the interpretation of the BCCR as a benchmark-referenced consumption coverage ratio rather than as a fully independent substitute for PPS-adjusted median income. In the official PLI/PPS specification, the BCCR is structurally close to PPS-adjusted income because both measures share the same price-adjusted income base and the BCCR normalises that income by a common annual reference basket denominator. This property defines the empirical boundary of the measure. The BCCR should, therefore, not be read as a source of new cross-sectional income ranking information beyond PPS-adjusted income.

The added value of the BCCR lies in a different measurement function. PPS-adjusted income expresses real median equivalised disposable income in a comparable monetary unit. The BCCR converts this monetary measure into a benchmark coverage scale. It, therefore, allows the same income information to be interpreted in terms of coverage of a reference consumption benchmark, shortfall from that benchmark, surplus, residual income share after benchmark coverage, and required income growth toward selected reference points. This interpretive function is central to the empirical results reported above.

### 5.1. The BCCR as a Benchmark-Referenced Adequacy Ratio

The results show that the BCCR and PPS-adjusted median income have nearly identical cross-country statistical behaviour in the main PLI/PPS specification. This is not an incidental result, but an expected feature of the construction. In this specification, the denominator is common to all countries within a year; consequently, the cross-country ordering largely follows the PPS-adjusted income numerator. The empirical analysis, therefore, treats the strong overlap between the two measures as a structural boundary condition rather than as a weakness to be hidden.

This boundary condition clarifies the contribution of the BCCR. The ratio is not designed to replace PPS-adjusted income as a monetary income measure. Instead, it re-expresses that income relative to a selected reference level of market consumption. A BCCR value below 1 indicates that median equivalised disposable income is below the selected benchmark. A BCCR value equal to 1 indicates full coverage of the benchmark. Values above 1 indicate that median income exceeds the selected benchmark, making it possible to discuss surplus and residual income share after benchmark coverage in a directly interpretable way.

This interpretation also explains why the BCCR is useful despite its statistical closeness to PPS-adjusted income. PPS-adjusted income answers the question of how much

real income the median equivalent unit has. The BCCR answers the related but distinct question of how far that income reaches relative to a defined consumption benchmark. The second question requires a denominator. The BCCR incorporates that denominator in a transparent way.

This does not make the BCCR a new income ranking variable in the narrow statistical sense. Rather, it embeds a benchmark coordinate into PPS-adjusted income, allowing the same income information to be read as coverage of a selected consumption reference point. This makes the measure easier to communicate in applied and policy-oriented contexts, where a statement such as “median income covers 62% of the benchmark” is more directly interpretable than a monetary PPS value alone.

### 5.2. The BCCR, Deprivation, and Financial Strain

The main empirical results show a consistent negative association between the BCCR and three indicators of socio-economic vulnerability: severe material and social deprivation, inability to face unexpected financial expenses, and difficulty making ends meet. These outcomes are conceptually close to the adequacy interpretation of the BCCR because they reflect not only income levels but also the pressure that households face when income is insufficient relative to ordinary needs and unexpected financial requirements.

The association remains present after including the Gini coefficient, unemployment, and social spending as socio-economic controls. This result is important because it reduces the risk that the observed relationship is merely an artefact of income inequality, labour market conditions, or differences in the social protection environment. The controlled models do not establish causality, but they show that the BCCR remains externally coherent with vulnerability and financial strain outcomes when these additional factors are included.

The fixed-effects checks provide a stricter but supplementary test. After controlling for country and year fixed effects, the BCCR coefficient remains negative for all three Eurostat outcomes. The association remains statistically significant for severe material and social deprivation and for difficulty making ends meet, while it weakens for inability to face unexpected expenses. This pattern should be interpreted as partial within-country robustness, not as causal identification. It indicates that the main association is not purely a cross-sectional artefact, but the evidence remains descriptive and validation-oriented.

### 5.3. Relation to Existing Measures and the Prior Literature

Section 2 positions the BCCR within a broader family of income-to-benchmark and adequacy ratio approaches. Its contribution is not the invention of ratio logic itself but the application of that logic to price-comparable median equivalised disposable income and a selected international market consumption benchmark.

The distinctive feature of the BCCR within this family is the consistency between the numerator and the denominator. The BCCR does not compare income with a poverty line, a local minimum budget or a wage setting standard. It compares median equivalised disposable income with a selected high-consumption market expenditure benchmark. In this sense, the ratio preserves a private income/private market expenditure logic: the numerator reflects disposable income available to households after taxes and transfers, while the denominator reflects observed market consumption expenditure rather than a broader concept of total individual consumption including publicly provided services.

The relation to PPS-adjusted income is, therefore, specific. PPS-adjusted median income is not a competing adequacy ratio approach but the monetary basis of the main BCCR specification. The BCCR does not claim statistical independence from this numerator. It adds an interpretive layer by expressing PPS-adjusted income as coverage of a selected

consumption benchmark. This makes the BCCR a cross-country adaptation of established adequacy ratio logic rather than an isolated new income indicator.

AIC per capita in PPS is also distinct from the BCCR. AIC is an important official consumption-based welfare comparator, but it is not an income-to-benchmark ratio and does not show how far median equivalised disposable income covers a selected benchmark. Moreover, AIC includes individual consumption financed by government and NPISHs, whereas the present BCCR specification compares private disposable income with a private market expenditure benchmark. Using AIC as the denominator while retaining median disposable income as the numerator would mix different resource and consumption concepts. An AIC-based coverage measure would, therefore, require a broader numerator, such as adjusted disposable income including social transfers in kind, and would constitute a different specification.

#### *5.4. The Reference Basket and the Role of Global HFCE Robustness*

The reference basket plays an essential interpretive role in the BCCR framework. The U.S. basket is used as a demanding benchmark of market consumption. It is not treated as a universal normative standard and does not imply that every country should reproduce the exact composition of U.S. consumption. Its function is to provide a transparent and empirically observable reference level against which price-adjusted median income can be normalised. As specified in Section 3.3.3, the choice of the reference economy is based on operational benchmark selection criteria rather than on a normative preference for a particular country.

The robustness checks using a Global HFCE benchmark clarify the sensitivity of the BCCR scale to the choice of denominator. Replacing the U.S. basket with the Global HFCE benchmark substantially increases the absolute BCCR values because the global denominator is lower than the U.S. consumption benchmark. However, country rankings remain highly stable, and the associations with deprivation and financial strain outcomes remain directionally unchanged. This suggests that the main cross-country structure of the results is not solely an artefact of the U.S. basket denominator.

The comparison also highlights a key limitation of any benchmark-referenced measure: the absolute interpretation of the scale depends on the chosen benchmark. The U.S. basket and the Global HFCE benchmark answer different interpretive questions. The U.S. basket represents a demanding market consumption benchmark, while Global HFCE provides a world average sensitivity benchmark. The stability of rankings under both alternatives supports the robustness of the cross-country structure, but it does not make either benchmark universally normative.

#### *5.5. Limitations and Future Research*

Several limitations define the scope of the findings. First, the BCCR is structurally close to PPS-adjusted median income in the official PLI/PPS specification. Its contribution should, therefore, be interpreted as measurement translation and benchmark-referenced adequacy interpretation, not as the discovery of a new independent income variable.

Second, the empirical analysis is associational. The controlled OLS models, influence diagnostics, and fixed-effects checks strengthen the robustness of the findings, but they do not identify causal effects. The fixed-effects results are reported as supplementary validation checks that account for time-invariant country-specific heterogeneity and common year shocks; they should not be interpreted as a quasi-experimental or instrumental variable design.

Third, the descriptive BCCR interpretation points are sample-specific and specification-specific. The values associated with SMSD levels of 10% and 5% were derived from and

applied to the same 30-country sample and have not been externally validated on an independent sample; they should, therefore, be treated as in-sample descriptive interpretation points rather than universal policy thresholds. Similarly,  $BCCR = 1$  denotes full coverage of the selected reference benchmark, not a universal standard of adequate living conditions.

Fourth, the COLI-based specifications have an auxiliary role. The Eurostat/COLI specification tests robustness to an alternative price adjustment approach on the same Eurostat country set, while the OECD/COLI specification provides broad international consistency. These specifications should not be treated as metrologically equivalent to the official PLI/PPS specification, and the empirical interpretation ranges derived from the main specification should not be transferred mechanically to them.

Fifth, the benchmark denominator is conceptually specific. The present BCCR specification compares median equivalised disposable income with a benchmark grounded in empirically observed private market consumption expenditure in a high-consumption reference economy. Alternative BCCR specifications may use other benchmark concepts, but they must preserve conceptual consistency between the resource concept in the numerator and the consumption concept in the denominator. For example, an AIC-based specification would require a broader numerator, such as adjusted disposable income including social transfers in kind, and would answer a different research question.

Future research may extend the BCCR framework in several directions. Longer time series could be used to test the stability of the decision-oriented interpretation over time. Additional reference baskets could help distinguish high-consumption, world average, and minimum-adequacy benchmarks. Household-level microdata could test how the BCCR logic relates to within-country distributional patterns. Further work could also compare BCCR more systematically with reference budget, income-to-needs, residual income, and affordability ratio approaches.

## 6. Conclusions

This study introduced and empirically evaluated the benchmark consumption coverage ratio (BCCR) as a benchmark-referenced consumption coverage ratio. The BCCR expresses median equivalised disposable income, adjusted for cross-country differences in price levels, as the degree of coverage of a selected market consumption benchmark. Conceptually, the BCCR belongs to a broader family of income-to-benchmark measures and adequacy ratios.

A comparison of the BCCR with closely related approaches in the literature further clarifies its position among adequacy measures. The BCCR shares the general logic of income-to-benchmark indicators, but differs in its resource base, type of benchmark, and level of aggregation. Unlike ratios based on poverty lines, local reference budgets, living-wage methods, and residual income approaches, the BCCR applies benchmark coverage logic to median equivalised disposable income adjusted for cross-country price comparability and to a selected international market consumption benchmark. The BCCR should, therefore, be understood as a compact tool for cross-country interpretation of income adequacy, rather than as a substitute for more detailed local or household-level methods of needs assessment.

The empirical results show that the BCCR is consistently and negatively associated with severe material and social deprivation and with indicators of financial strain. These associations remain after controlling for income inequality, unemployment, and social expenditure. Diagnostic checks further refine the interpretation of the results: The BCCR models with control variables do not show serious multicollinearity; influence diagnostics and leave-one-country-out checks indicate that the main associations are not driven by any single country; and fixed-effects models provide partial within-country robustness,

although the statistical significance is weaker for the indicator of inability to cope with unexpected financial expenses.

Checks based on alternative specifications clarify the robustness of the results obtained. The Eurostat/COLI specification supports the rank and directional robustness of the main EU\_PLI\_PPS results on the same country sample. The OECD/COLI specification additionally indicates broad international consistency in the structure of the BCCR. These results do not imply full metrological equivalence between COLI and the official PLI/PPS specification; however, they show that the main interpretative structure of the BCCR is not confined to a single implementation of price adjustment.

The alternative denominator check using Global HFCE also shows that the absolute BCCR scale depends on the selected consumption benchmark. Replacing the U.S. basket with Global HFCE substantially changes the absolute BCCR values, since the global denominator is lower than the U.S. market consumption benchmark. At the same time, country rankings and the direction of associations with vulnerability indicators are broadly preserved. Accordingly, the choice of benchmark basket affects the absolute interpretation of the scale but does not undermine the main cross-country structure of the results. Neither the U.S. basket nor Global HFCE should be regarded as a universal normative standard.

The practical value of the BCCR lies in its ability to answer directly questions that a monetary income indicator does not reveal by itself without an external benchmark. Comparable median income shows the amount of real income available to the typical equivalised unit. The BCCR allows the same information to be read as benchmark coverage, shortfall from the benchmark, excess over the benchmark, the share of residual income after benchmark coverage, and the income growth required to reach a selected interpretative point. This makes the BCCR useful for descriptive cross-country analysis of income adequacy, socio-economic vulnerability, and communication of results in a form that is more accessible for applied analysis.

The findings are subject to several limitations. The analysis is descriptive and associational and does not identify causal effects. A BCCR value of 1 denotes full coverage of the selected benchmark, not a universal standard of adequate living conditions. The descriptive interpretation points obtained in the study are sample- and specification-specific and should not be regarded as universal policy thresholds. Future research may extend this framework through longer time series, additional benchmark baskets, household-level microdata, alternative resource concepts, and separate BCCR specifications.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/economics14080306/s1>. Supplementary S1 contains the processed analytical datasets for the three BCCR specifications, variable definitions, data source mapping, model sample flags, econometric outputs, diagnostic tests, robustness checks, and decision-oriented BCCR calculation tables. Supplementary S1 contains the following supplementary tables: Table S1: Supplementary S1 contents; Table S2: Data sources and source mapping; Table S3: Variable definitions and analytical roles; Table S4: Processed EU\_PLI\_PPS analytical dataset; Table S5: Processed EU\_COLI analytical dataset; Table S6: Processed OECD\_COLI analytical dataset; Table S7: Model-sample flags and sample sizes; Table S8: Descriptive statistics by specification; Table S9: EU\_PLI\_PPS country means; Table S10: Correlation tests for BCCR, comparators and vulnerability outcomes; Table S11: Simple OLS models using country means; Table S12: Simple pooled annual OLS models; Table S13: Comparator R-squared summary; Table S14: Consistency between EU\_PLI\_PPS and EU\_COLI specifications; Table S15: Broad-consistency correlations for OECD\_COLI; Table S16: Controlled OLS models using country means; Table S17: Standardised coefficients in controlled models; Table S18: Pooled controlled OLS models; Table S19: All-available 2017–2024 sensitivity models; Table S20: EU\_COLI and OECD\_COLI controlled robustness checks; Table S21: Variance inflation factor (VIF) summary; Table S22: Full VIF diagnostics for EU\_PLI\_PPS; Table S23: Full

VIF diagnostics for EU\_COLI; Table S24: Full VIF diagnostics for OECD\_COLI; Table S25: Predictor correlation diagnostics; Table S26: Cook's Distance and influence summary; Table S27: EU\_PLI\_PPS country-mean influence diagnostics; Table S28: EU\_PLI\_PPS pooled influence diagnostics; Table S29: Leave-one-country-out robustness checks; Table S30: EU\_COLI influence diagnostics; Table S31: OECD\_COLI influence diagnostics; Table S32: Two-way fixed-effects results for EU\_PLI\_PPS; Table S33: Fixed-effects structure sensitivity; Table S34: Fixed-effects sensitivity without social spending; Table S35: Fixed-effects all-available sensitivity; Table S36: EU\_COLI fixed-effects robustness checks; Table S37: OECD\_COLI fixed-effects broad-consistency checks; Table S38: Reference-basket dynamics and denominator sensitivity; Table S39: U.S. benchmark versus Global HFCE summary; Table S40: Rank stability under the U.S. benchmark and Global HFCE; Table S41: Classification relative to full benchmark coverage (BCCR = 1); Table S42: SMSD-based BCCR interpretation points; Table S43: Financial-strain alignment at selected BCCR points; Table S44: BCCR range classification; Table S45: Required income growth to selected BCCR targets; Table S46: Annual decision-oriented BCCR indicators; Table S47: Functional answerability of BCCR relative to PPS-adjusted income; Table S48: Processed wide-format EU\_PLI\_PPS input table; Table S49: Processed wide-format EU\_COLI input table; Table S50: Processed wide-format OECD\_COLI input table. The supplementary datasets and calculations draw on data from Eurostat (n.d.-a, n.d.-b, n.d.-c, n.d.-d, n.d.-e, n.d.-f, n.d.-g, n.d.-h), the OECD (n.d.-a, n.d.-b, n.d.-c, n.d.-d), Numbeo (n.d.), the International Monetary Fund (n.d.), the U.S. Bureau of Labor Statistics (2025), the U.S. Census Bureau (2026), and the World Bank (n.d.-a, n.d.-b, n.d.-c, n.d.-d).

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model-sample flags, econometric outputs, robustness diagnostics, and decision-oriented BCCR calculation tables are provided in Supplementary S1.

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## Abbreviations

| Abbreviation   | Meaning                                                                   |
|----------------|---------------------------------------------------------------------------|
| AIC            | Actual Individual Consumption                                             |
| BCCR           | Benchmark Consumption Coverage Ratio                                      |
| BLS            | U.S. Bureau of Labor Statistics                                           |
| CES            | Consumer Expenditure Survey                                               |
| COLI           | Cost-of-Living Index                                                      |
| EU_COLI        | Eurostat Income and COLI Price Adjustment Specification                   |
| EU_PLI_PPS     | Eurostat Income and Official PLI(HFCE)/PPS Price Adjustment Specification |
| EU-SILC        | European Union Statistics on Income and Living Conditions                 |
| GDP            | Gross Domestic Product                                                    |
| HC3            | Heteroscedasticity-Consistent Covariance Estimator, Type 3                |
| HFCE           | Household Final Consumption Expenditure                                   |
| ICP            | International Comparison Program                                          |
| IDD            | Income Distribution Database                                              |
| IMF            | International Monetary Fund                                               |
| NPISHs         | Non-Profit Institutions Serving Households                                |
| OECD           | Organisation for Economic Co-operation and Development                    |
| OECD_COLI      | OECD income and COLI Price Adjustment Specification                       |
| OLS            | Ordinary Least Squares                                                    |
| PLI            | Price Level Index                                                         |
| PLI/PPS        | Price Level Index/Purchasing Power Standard Framework                     |
| PPP            | Purchasing Power Parity                                                   |
| PPS            | Purchasing Power Standard                                                 |
| R <sup>2</sup> | Coefficient of Determination                                              |
| SE             | Standard Error                                                            |
| SMSD           | Severe Material and Social Deprivation                                    |
| US             | United States                                                             |
| VIF            | Variance Inflation Factor                                                 |

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