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Measuring price dynamics from the perspective of the poorest households in Poland

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Abstract

Poland, like many other countries, lacks a price dynamics index tailored to the poorest households. The aim of this article is to develop a Subsistence-Adjusted Price Index (SAPI) – an indicator of the dynamics of the costs of living. SAPI complements the Consumer Price Index (CPI) by enabling a more accurate assessment of the real cost of living faced by the poorest households, while also allowing for regional analysis. The analysis is based on data on the subsistence minimum from the Polish Institute of Labour and Social Studies and CPI inflation data from Statistics Poland covering the period 2006–2024. The analysis revealed substantial discrepancies between the two measures: the cumulative price increase measured by the SAPI amounted to 154.87%, whereas the CPI indicated an increase of only 87.58%. In addition, the SAPI appears to lead the CPI by approximately two years. It was recommended that the SAPI be included in official statistics and adopted as an indexing factor for social benefits, minimum wages and pensions, which could improve the effectiveness of social policy and reduce income inequality in Poland.

Keywords

- Subsistence-Adjusted Price Index (SAPI)
- CPI
- subsistence minimum
- inflation
- social benefits

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Introduction

Portillo et al. (2016) propose a model that integrates monetary economics with economic development theory by incorporating a food subsistence threshold into a New Keynesian framework. The authors' key thesis is that in economies where a significant portion of the population lives close to the subsistence level, relative food prices become the main channel for transmitting economic shocks and, therefore, a significant determinant of overall inflation. This means that in such countries, classical monetary policy principles derived from models of highly developed economies may lead to erroneous conclusions and suboptimal central bank responses.

A minimum level of food consumption ($\overline{c}_F$) was introduced into the standard utility function, defining the biological minimum for household survival. This modification causes total consumption to be nonlinearly proportional to income, and the demand for food becomes nonlinear and less elastic to changes in prices and income.

The marginal utility of food increases rapidly as consumption approaches the threshold $\overline{c}_F$. Therefore, even a small increase in food prices in poor countries forces significant changes in the consumption of other goods and the structure of household expenditures. As a result, supply shocks in agriculture translate much more strongly into overall inflation and production declines in the non-food sector than in developed economies. This relationship introduces a structural mechanism that reflects the process of economic transformation – as income increases, the share of food in the basket market decreases, and the economy becomes less sensitive to food shocks.

A supply shock in the food sector of poor countries triggers a stronger increase in overall inflation, as households cannot limit their food consumption below the subsistence level. This forces a reduction in demand for non-food goods, which in turn intensifies the recessionary effect of the shock. The authors show that in such economies, more than half of overall inflation is explained by changes in food prices, while in developed economies, this share drops to a few percent.

The model developed by Portillo et al. (2016) suggests that general inflation does not accurately reflect the cost of living for households operating in different segments of income distribution. The classic index is inappropriate for measuring inflationary pressures in an economy where a large portion of the population operates under subsistence constraints. In such cases, an alternative index based on the subsistence minimum should be considered, accounting for the nonlinear structure of expenditures and the sensitivity of consumption to food prices. In economies where a significant portion of consumption is for goods that are income-inelastic, the conventional inflation index distorts the picture of inflation-

ary pressures. Introducing an index based on the subsistence level, different from traditional inflation yet correlated with it, would allow for a better measurement of the real cost of living and explain the sources of differences in inflation dynamics between income groups. Nowadays, differentiating the indicator into regional levels will allow for an even better assessment of the poverty level.

Diewert's (2020) contribution should not be overlooked in this field of research. He develops an economic approach based on the assumption that consumers make decisions to minimise the costs of achieving a given level of utility, which accounts for substitution effects – changes in consumption patterns in response to changes in relative prices. Diewert (2020) demonstrates that the typical Laspeyres and Paasche indices represent, respectively, upper and lower bounds of the Konüs index – the ratio of the minimum costs of achieving a given level of utility at different price levels – which represents the theoretical "true" cost-of-living index. He also discusses the existence of intermediate indices that provide stable reference points for maintaining a constant standard of living. He discusses superlative indices such as Fisher, Walsh, Törnqvist-Theil and CES, which are closely related to elastic forms of utility functions and accurately capture consumer behaviour in response to price changes. A strong approximation exists between these indices, making them practically interchangeable (Diewert, 2020). It highlights significant practical challenges, such as the problem of matching products in aggregated data, resulting from, among other things, irregular purchases or seasonality, which requires the use of extended reference periods and more flexible product definitions.

Turvey's (2000) article demonstrates that although the cost-of-living index (COLI) theory developed by, among others, Diewert elegantly formalises the idea of comparing the minimum expenditures needed to maintain the same level of utility at two sets of prices, it relies on assumptions that are systematically violated in actual consumer behaviour. It highlights the problems of inconsistent preferences, endowment effects, dependence of utility on the consumption of others and discrepancies between the weighting period and the price period, which undermines the interpretability of the CPI as an approximation of a true COLI. He particularly criticises the inclusion of durable goods (e.g. housing) in the index, which are of little use as a deflator, compensatory index or measure of inflation. He demonstrates that in practice, the decisive factors are a clearly defined index purpose, basic economics, common sense and, sometimes consciously adopted, arbitrary procedures. In conclusion, the author argues that the formal theory of the "true COLI" is intellectually interesting but may be largely ignored by statistical offices: it is better to openly describe the CPI as a measure of changes in the cost of a reference basket than to try to link it to a hypothetical, highly simplified theoretical construct.

These conclusions are consistent with the contributions of Lokshin et al. (2023). Their report demonstrates the impact of the cost-of-living crisis of 2022–2023 on

various household groups in Europe and Central Asia. The authors use the COLI method to construct a CPI that reflects actual consumption patterns and price changes for individual households. The paper highlights the limitations of the standard CPI, which, based on a universal consumption basket, fails to capture the range of price increases and individual differences in spending patterns. The empirical results indicate significant heterogeneity in price increases, with the poorest households suffering the most, experiencing inflation on average 2.3 percentage points higher than the wealthiest ones (Lokshin et al., 2023, p. 3). The largest differences were primarily related to increases in food and energy prices, which account for the largest share of expenditures among less affluent households. The regressive nature of inflation was particularly evident, implying the need for a more differentiated approach to social policy. The authors recommend using individual cost of living indicators to monitor and index social benefits, especially for the most vulnerable groups, such as single-person households and the elderly. The above two works provide empirical evidence of the uneven effects of inflation, especially for the poorest, and indicate the need to use more precise, individual indicators of the cost of living for monitoring and shaping social policy.

The Distributional Consumer Price Indices (D-CPIs) are a modern set of indices that measure real-time inflation heterogeneity across sociodemographic group in the US, maintaining full consistency with the methodology of the official CPI. The methodology combines monthly price changes from the CPI with annual expenditure shares from the Consumer Expenditure Survey, allowing for the calculation of group-specific inflation while maintaining a consistent total with the aggregate CPI. The study reveals that inflation has been significantly higher for lower-income groups, resulting in a real increase in income inequality that is approximately 45% faster than suggested by official data (Jaravel, 2024). Furthermore, 2.3 million people are currently misclassified above the poverty line despite being within it. In the post-COVID-19 period, inflation has been highest for the middle class, primarily due to increases in gasoline and vehicle prices, which have contributed to an accelerated real wage compression. Jaravel (2024) also highlights higher inflation rates for older adults and African Americans and explains the limitations of the methodology, including the conservative nature of the Laspeyres index and the homothetic nature of consumer preferences. The results emphasise the need to account for inflation heterogeneity in official statistics and social policy to better reflect economic reality.

While the D-CPI could be implemented in Poland, recent research has focused on a different approach – optimising the existing CPI weights – within a five-year project supervised by the Polish economist Białek[2] (2018–2023). The project in-

[2] ”Optymalizacja pomiaru wskaźnika cen dóbr i usług konsumpcyjnych” [Research project]. 2018–2023. Narodowe Centrum Nauki. (Project No. 2017/25/B/HS4/00387).

volved research on the best selection of parameters for the Fisher superlative index, which best approximates the COLI, as well as on optimising the weights and lag parameter in Laspeyres indices. One of the goals is to create a new, hybrid component index combining the advantages of various methods to minimise the CPI bias while simultaneously reducing the need for frequent, costly weight updates. It combines the ideas of Young and Lowe indices and is an innovative proposal in price index methodology, utilising additional information on the correlations between prices and product quantities. In an empirical study based on scanner data from Polish supermarkets (products such as milk, sugar, coffee, rice), the hybrid index and its geometric version proved to be better approximations for the Fisher index than the traditional Laspeyres index, despite using expenditure data from the previous period (Białek, 2020). Białek's research had previously suggested the need for optimisation – frequent updates of weights in the Polish CPI basket effectively mitigate substitution effects, and the greatest impact on bias is exerted by price imputation of new and disappearing goods, while correlations between prices and quantities have a minimal impact on the CPI bias (Białek, 2014).

1. Definition of a market basket and a subsistence minimum

Market basket is a fundamental concept in measuring inflation, denoting a set of goods and services representative of an average consumer in each country or region. This basket is a simplified model of household consumption patterns – it reflects which commodities are purchased, in what proportions, and how their prices change over time.

In practice, the inflation basket includes both tangible goods, e.g. food, clothing and fuel, and services, e.g. transportation, education and healthcare. The selection of its components is representative – the goal is to represent average consumer spending as closely as possible, rather than to fully capture all possible market transactions. Currently, the most used inflation indices are the Consumer Price Index (CPI) and the Harmonised Index of Consumer Prices (HICP).

The Consumer Price Index (CPI) is a national inflation index that reflects changes in the average price level of consumer goods and services purchased by households in each country. Data for its calculation typically comes from household budget surveys and national accounts, and the weighting structure reflects the shares of individual expenditure categories in total consumer spending. In most countries, including Poland, the CPI weights are updated periodically, usually at least every

few years, to ensure the stability of intertemporal comparisons. The CPI is used, among other things, to index wages and social benefits, deflate macroeconomic indicators and assess national price dynamics.

The Harmonised Index of Consumer Prices (HICP) is an inflation measure developed by Eurostat to ensure the comparability of inflation data across European Union member states; however, it is also introduced by countries outside the EU. The HICP coexists with national CPIs and is based on the same underlying data: both the HICP and CPI "are built on the same granular data, and uniform concepts, methods and compilation techniques are applied up to the elementary level" (Knetsch et al., 2024, p. 3). The HICP covers only households' final monetary consumption expenditure, meaning it excludes items that do not generate actual monetary flows, such as imputed rent for owner-occupied housing (OOH). An important methodological aspect of the HICP is the annual update of weights, based on the latest data on the structure of consumer spending. This allows the index to respond more quickly to changes in consumer behaviour and better reflect the current consumption structure in member states.

Another difference is the purpose of constructing both indices. The CPI is primarily used for national inflation analyses and practical applications, such as indexing benefits and wages. The HICP, on the other hand, has an international character – it provides a basis for inflation comparisons across European Union countries and serves as the key inflation indicator used by the European Central Bank in its monetary policy decision-making process in the euro area.

In this paper, the living wage or **subsistence minimum** will be defined based on an indicator developed by the Polish Institute of Labour and Social Studies (IPiSS) called *Minimum Egzystencji*, which translates to subsistence minimum (SM).

The subsistence minimum (sometimes called the biological minimum) assumes the absolute minimum necessary for survival – it marks the line of extreme poverty. It considers the costs of food, housing, clothing and footwear, health care and hygiene, as well as education. It completely ignores the costs of transportation and communications, culture, sports and recreation (Kurowski, 2002). Therefore, it is not an indicator that captures the minimum of a decent life – this is the responsibility of the IPiSS index called the *Minimum Socjalne*, translated as the social minimum. The SM index is based on data from Statistics Poland (GUS) and originally comprised, among other things, a limited list of approximately 20 product groups defined according to "safe consumption" standards. This basket included basic food items, medical supplies (limited to a small number of prescriptions per year), essential hygiene products, modest clothing and footwear (including repairs and replacements), and minimal education-related expenses, such as used textbooks and participation in a small number of school events (Deniszczuk & Sajkiewicz, 1997). It also accounts for minimal housing with access to basic utilities: "the area of the apartment was assumed to correspond to the so-called sanitary standard,

which is approximately 7 m^2 of usable area per person, i.e. approximately 5 m^2 of living area" (Kurowski, 2002, p. 4).

The most significant limitation of this approach is the lack of comparability with data prior to 2006. At that time, thorough, more restrictive changes were introduced to the basket calculation, along with annual updates of weights (Deniszczuk et al., 2006). The valuation assumed that low-income households purchase inexpensive, unprocessed food from supermarkets or local markets and take advantage of promotions and discounts. It is also assumed that low-income households experience difficulties in paying rent regularly, with some households falling into arrears. In the housing context, the phenomenon of homelessness has been recognised as a state of being below the SM level. Furthermore, it is assumed that the child's parents can take advantage of the family benefits to which they are entitled under the social assistance system. In the context of education, the household incurs expenses for necessary school supplies, such as notebooks, used textbooks, gymnastics uniforms and replacement shoes. It was also assumed that, with the exception of underwear and footwear, clothing was obtained through donations, while a limited number of children's garments – such as trousers subject to rapid wear – were purchased at markets or marketplaces. It was assumed that households purchased the least expensive hygiene products, especially those offered at promotional prices or in discount retail chains. The list of purchased medications was expanded, and it was assumed that specialist medical services would be used only by children, while other household members would rely exclusively on services covered by general health insurance. In addition, a contingency reserve of 5% of total other expenditures was included (Deniszczuk et al., 2006).

Since the basket has a weighted structure and represents the minimum needs of a household, it can function as a full substitute for the standard inflation basket. As of 2024, its simplified structure is as follows: 41% allocated to food, 42.4% to rent and energy, 2.8% to home furnishings, 3.9% to clothing and footwear, 1.7% to health care, 3.4% to hygiene and 4.8% to other expenditures (excluding education) (Kurowski, 2025).

2. Methodology

The most basic methods of calculating inflation are the Laspeyres (1871), Paasche (1874), and Fisher (1922) indices.

The Laspeyres index uses a basket of goods from a base period and measures its cost in the current period:

$$P_{La} = \frac{\sum_i p_t^i q_0^i}{\sum_i p_0^i q_0^i} \tag{1}$$

where:

p_t^i – the price of good i in the current period,
p_0^i – the price of good i in the base period,
q_0^i – the quantity of good i in the basket in the base period.

The greatest advantage of the above index is the simplicity and interpretability of price changes. However, it does not account for changes in consumption patterns and may overestimate inflation in the event of substitution of goods. The Paasche index, on the other hand, uses a basket of the current period and measures the price change relative to the base period:

$$P_{Pa} = \frac{\sum_i p_t^i q_t^i}{\sum_i p_0^i q_t^i} \tag{2}$$

where:

q_t^i – the quantity of good i in the current period.

Unlike the Laspeyres method, it considers actual consumption patterns in each period. However, it requires accurate data on current expenditures and may underestimate inflation if consumers react quickly to price increases by substituting goods. One could argue that the best indicator of inflation would be to combine these two methods by averaging them. Therefore, five decades later, Irving Fisher presented his method:

$$P_F = \sqrt{P_{Pa} \cdot P_{La}} \tag{3}$$

Currently, basket weights are updated annually; thus, a Paasche-type index with annually updated weights is applied. In the case of IPiSS SM index, the new SAPI index can be defined as follows:

$$\mathrm{SAPI} = \frac{\mathrm{SM}_t - \mathrm{SM}_0}{\mathrm{SM}_0} \tag{4}$$

The acronym SAPI stands for a Subsistence-Adjusted Price Index, which constitutes the focus of this study. The most recent research on the subsistence minimum (Kurowski, 2025) presents a rate-of-change index that partially reflects the SAPI concept. Unfortunately, a major limitation is the lack of consistent data, as IPiSS changed the method of determining SM since 2006 and the data are not fully comparable with previous years (Kurowski, 2007). Extending the analysis by recon-

structing historical data is currently beyond the scope of this work. This paper will also use the SM index per single person (average costs for single men and single women), due to its more restrictive nature resulting from higher per capita costs. The CPI is not random in nature; however, statistical tests were used to maintain standard analytical practice and enable comparison of the results with other studies.

In this work, an Augmented Dickey-Fuller test (ADF) was performed to to assess the stationarity of both indices. This was followed by correlation and cross-lagged correlation analyses, as well as the Engle-Granger cointegration test (1987), to examine the relationship between the CPI and SAPI. To test homoscedasticity, Levene's test was conducted to determine the equality of their variances. To demonstrate the possibility of regional analysis, preliminary calculations were also conducted, showing how SAPI has developed across Polish voivodeships.

3. Results

3.1. Nationwide measurements

Table 1 presents the subsistence minimum (SM) index, used as a base to calculate the Subsistence-Adjusted Price Index (SAPI).

Table 1. Subsistence minimum for a single-person household as an average value for men and women (in PLN)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
372.70	386.30	413.20	415.33	472.72	500.68	521.11	541.91	544.09	545.76
2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
555.02	574.01	591.14	616.55	614.74	617.36	775.42	901.04	949.89	

Source: own work based on IPiSS datasets from 2006 to 2024 (IPiSS, n.d.).

Analysing the data, it can be shown that the SAPI in Poland evolved as shown in Table 2 for individual years.

Table 3 presents inflation values for the same analysed years in Poland. Average annual inflation was computed using GUS data, employing the CPI with a base year of 1998 = 100 and a chain-linked methodology based on monthly indices where the previous month equals 100. For each year, the CPI was averaged, using a weighted average based on the number of days in each month. The price dynamics index is then calculated as the ratio of the current year's average to the previous year's average. Figure 1 provides a comparison between CPI and SAPI.

Table 2. SAPI calculated from IPiSS data rounded to two decimal places

2007	2008	2009	2010	2011	2012	2013	2014	2015
3.65%	6.96%	7.78%	6.15%	5.91%	4.08%	3.99%	0.40%	0.31%
2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
1.70%	3.42%	2.98%	4.30%	–0.29%	0.43%	25.60%	16.20%	5.42%

Source: own work.

Table 3. Annual average CPI in Poland from 2007 to 2024; calculated using data from Statistics Poland

2007	2008	2009	2010	2011	2012	2013	2014	2015
2.39%	4.35%	3.83%	2.71%	4.23%	3.74%	1.17%	0.17%	-0.91%
2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
–0.65%	2.00%	1.80%	2.19%	3.36%	5.17%	14.46%	11.36%	3.81%

Source: own work based on data from Statistics Poland (GUS, n.d.).

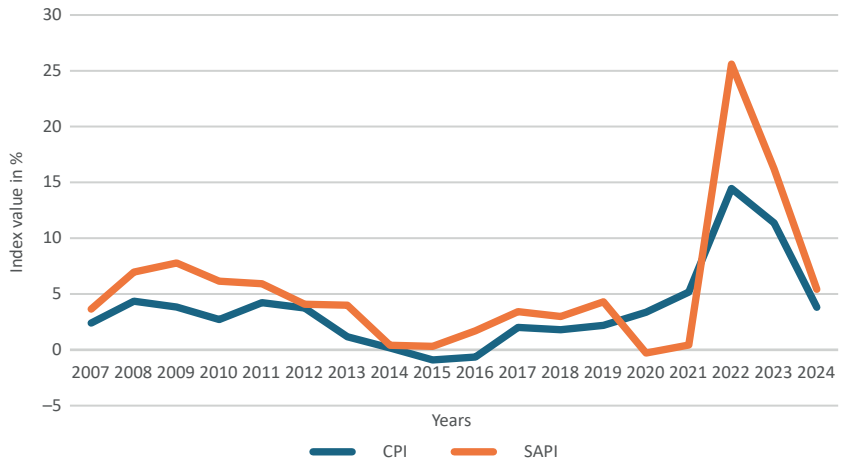

Figure 1. Comparison between CPI and SAPI in Poland from 2007 to 2024

Source: own work.

The geometric mean of annual inflation equals 3.56% for the CPI and 5.34% for the SAPI. Over the analysed period, cumulative inflation amounted to 154.87% according to the SAPI, compared with 87.58% as measured by the CPI.

Heuristic data analysis shows that the CPI uses methods that mitigate the impact of extremes, providing more stable reading, better distinguishing between core inflation and seasonal or one-off spikes, and is preferred by central banks for interest rate decisions due to its greater stability. In contrast, the SAPI is highly

sensitive to one-off changes in commodity prices, blending long-term trends with short-term effects, making it useful for monitoring current price shocks. Therefore, the CPI is a more reliable measure of long-term inflation and underlying price pressure because it reduces the impact of one-off commodity price changes and seasonality. The SAPI, on the other hand, better identifies sudden market shocks, thus better reflecting actual inflation.

In 2015–2016, Poland experienced a period of broad-based deflation, largely caused by falling energy and transport prices, which impacted the CPI. At the same time, food prices, which dominate the SM index, behaved differently – in 2016, their price growth was 1.0%. Although moderate, this represented an increase, not a decrease. The highest increases were for sugar (26.9%), fruit (5.5%), fish (3.6%) and vegetables (2.8%). The increases of other product prices included bread (0.6%), pasta products and couscous (0.5%), as well as selected types of meat: pork (1.5%), calf (1.3%) and beef (0.5%) (GUS, 2017). In 2020, the SAPI was negative, even though the CPI was positive and high – that year, the increase was in services (tourism, entertainment, culture) and discretionary consumer goods, which were included in the CPI basket but not in the subsistence minimum basket.

The year 2022 represents a special case in inflation analyses in Poland. According to the National Bank of Poland (NBP) Inflation Report (NBP, 2022), the CPI reached a record high. This increase was not due to classical demand mechanisms, but rather to an exogenous supply shock – Russia's aggression against Ukraine, a sharp rise in energy and commodity prices, and disruptions in supply chains. Furthermore, the scale of fiscal interventions (Anti-Inflation Shields or Government Solidarity Shield) and the breakdown of standard monetary policy transmission caused the relationships between inflation, GDP growth and unemployment in 2022 to deviate from historical macroeconomic relationships. During this period, high inflation coexisted with record-low unemployment and positive economic growth, consistent with the short-run Phillips curve relationship, driven by supply shocks rather than demand-pull factors. For this reason, 2022 can be considered an outlier – an unusual period dominated by one-off and external factors.

3.2. Voivodeship-wide measurements

Since 2013, the IPiSS report has also included a spatial analysis covering all voivodeships. Taking this step further, IPiSS reports since 2021 have also included SM calculations for cities with selected population ranges, allowing for even more diversification and precision in calculating actual inflation. Table 4 presents the SM values in PLN for individual voivodeships in the years 2013–2024.

For each voivodeship, regional SAPI was calculated and presented in Table 5.

Table 4. Subsistence minimum for a single-person household as an average value for men and women in PLN in each Polish voivodeship

Region	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
DŚ	563.73	569.60	573.07	587.81	611.67	631.99	654.71	679.56	701.05	823.84	946.73	990.93
KP	539.66	536.43	540.14	549.65	561.24	585.67	608.30	632.56	660.62	777.18	896.21	938.30
LE	501.95	505.42	505.92	512.23	522.47	542.59	574.14	595.41	617.54	713.54	828.49	871.35
LU	554.56	560.19	567.90	578.90	603.22	628.79	658.66	686.26	713.90	795.71	920.67	977.04
ŁÓ	547.23	544.96	543.58	550.65	569.79	594.78	621.99	650.33	676.34	778.50	901.75	943.68
MP	534.11	531.52	534.63	541.43	560.78	581.81	605.61	633.58	665.54	762.19	870.32	933.18
MZ	525.48	530.48	534.03	544.26	561.91	575.87	595.66	619.98	650.77	775.88	908.84	951.58
OP	528.10	528.36	532.19	547.58	571.45	588.17	614.66	632.78	668.70	797.91	924.09	973.22
PK	505.59	504.87	507.10	512.09	531.14	549.45	572.56	594.47	615.20	725.21	843.84	894.78
PL	543.38	544.71	544.39	547.26	563.08	580.24	600.85	619.05	651.45	739.01	846.35	877.50
PM	563.94	573.28	573.89	581.72	603.36	623.41	646.91	671.97	697.99	839.36	965.31	1008.36
ŚL	559.82	561.81	559.08	570.91	595.01	611.61	640.57	663.98	701.21	793.37	918.78	979.79
ŚK	523.13	521.09	514.06	519.93	547.67	567.75	598.73	621.60	648.63	744.64	852.04	909.59
WM	516.32	509.25	511.44	523.94	545.20	562.69	594.37	620.89	650.22	769.52	896.29	927.95
WP	551.77	561.06	564.62	574.60	593.69	613.47	638.99	661.94	691.73	780.67	905.96	962.81
ZP	589.48	589.56	594.29	601.00	609.82	626.65	658.89	684.01	710.25	792.43	926.99	979.71

Note: the above codes mean (voivodeships): DŚ – Lower Silesian, KP – Kuyavian-Pomeranian, LE – Lublin, LU – Lubusz, ŁÓ – Łódź, MP – Lesser Poland, MZ – Masovian, OP – Opole, PK – Subcarpathian, PL – Podlaskie, PM – Pomeranian, ŚL – Silesian, ŚK – Holy Cross (Świętokrzyskie), WM – Warmian-Masurian, WP – Greater Poland, ZP – West Pomeranian.

Source: based on (IPiSS, n.d.).

Table 5. Regional SAPI and their cumulative value calculated from IPiSS data rounded to two decimal places

Region	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	CUM
DŚ	1.04%	0.61%	2.57%	4.06%	3.32%	3.59%	3.80%	3.16%	17.52%	14.92%	4.67%	75.78%
KP	–0.60%	0.69%	1.76%	2.11%	4.35%	3.86%	3.99%	4.44%	17.64%	15.32%	4.70%	73.87%
LE	0.69%	0.10%	1.25%	2.00%	3.85%	5.81%	3.70%	3.72%	15.55%	16.11%	5.17%	73.59%
LU	1.02%	1.38%	1.94%	4.20%	4.24%	4.75%	4.19%	4.03%	11.46%	15.70%	6.12%	76.18%
ŁÓ	–0.41%	–0.25%	1.30%	3.48%	4.39%	4.57%	4.56%	4.00%	15.10%	15.83%	4.65%	72.45%
MP	–0.48%	0.59%	1.27%	3.57%	3.75%	4.09%	4.62%	5.04%	14.52%	14.19%	7.22%	74.72%
MZ	0.95%	0.67%	1.92%	3.24%	2.48%	3.44%	4.08%	4.97%	19.22%	17.14%	4.70%	81.09%
OP	0.05%	0.72%	2.89%	4.36%	2.93%	4.50%	2.95%	5.68%	19.32%	15.81%	5.32%	84.29%
PK	–0.14%	0.44%	0.98%	3.72%	3.45%	4.21%	3.83%	3.49%	17.88%	16.36%	6.04%	76.98%
PL	0.24%	–0.06%	0.53%	2.89%	3.05%	3.55%	3.03%	5.23%	13.44%	14.52%	3.68%	61.49%
PM	1.66%	0.11%	1.36%	3.72%	3.32%	3.77%	3.87%	3.87%	20.25%	15.01%	4.46%	78.81%
ŚL	0.36%	–0.49%	2.12%	4.22%	2.79%	4.74%	3.65%	5.61%	13.14%	15.81%	6.64%	75.02%
ŚK	–0.39%	–1.35%	1.14%	5.34%	3.67%	5.46%	3.82%	4.35%	14.80%	14.42%	6.75%	73.87%
WM	–1.37%	0.43%	2.44%	4.06%	3.21%	5.63%	4.46%	4.72%	18.35%	16.47%	3.53%	79.72%
WP	1.68%	0.63%	1.77%	3.32%	3.33%	4.16%	3.59%	4.50%	12.86%	16.05%	6.28%	74.49%
ZP	0.01%	0.80%	1.13%	1.47%	2.76%	5.14%	3.81%	3.84%	11.57%	16.98%	5.69%	66.20%

Note: see Table 4.

Source: own work.

Between 2014 and 2024, regional SAPI ranged from 61% in the Podlaskie Voivodeship to 84% in the Opole Voivodeship. The highest values are attributed to the sharp increase in housing, services and energy costs, as well as increased demand pressure resulting from urbanisation and rising incomes. In metropolitan regions (e.g. Masovia and Pomerania), demand factors dominated, while in peripheral regions (Opole and Warmian-Masurian Voivodeships), cost factors and limited market competition dominated. The lowest values (Podlaskie, West Pomeranian and Łódź Voivodeships) suggest weaker consumer demand, lower incomes, and the impact of external factors such as cross-border trade and stable real estate prices.

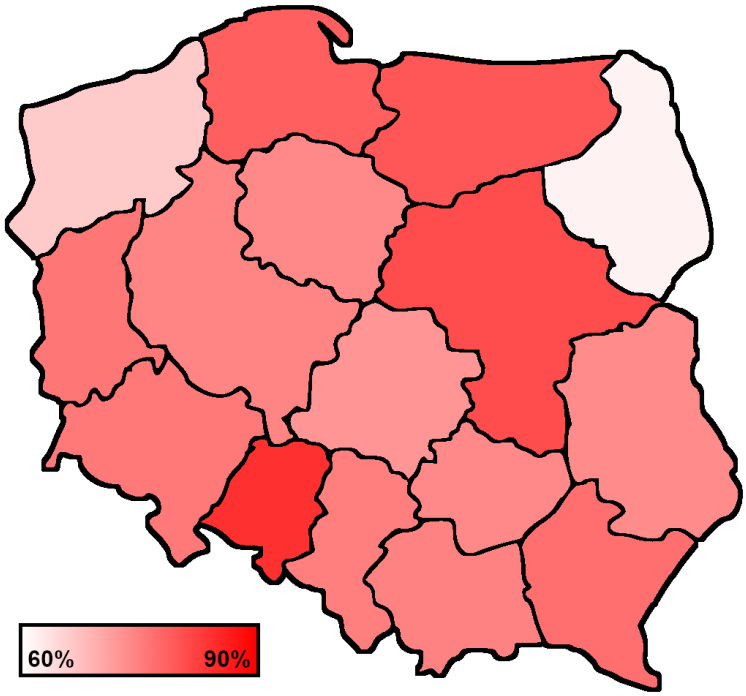

Figure 2. Cumulative SAPI value for Polish voivodeships from 2014 to 2024

Source: own work.

Regional analysis of the SAPI index reveals significant variation in the dynamics of prices for basic goods for the poorest households. As shown in Figure 2 and Table 5, cumulative SAPI growth ranged from 61% in the Podlaskie Voivodeship to 84% in the Opole Voivodeship, indicating surprising, yet predictable, disparities in inflationary pressures between regions. The factors influencing these differences are beyond the scope of this study.

4. Empirical testing and validation

Each of the tests presented was performed at a 5% significance level. The Augmented Dickey-Fuller test with 1 lag was performed to test whether the CPI and SAPI are stationary. The number of lags was selected based on the AIC criterion. Both the SAPI and CPI achieve stationarity at order I(1) (then $ADF_{SAPI} \approx -4.878$ and $ADF_{CPI} \approx -3.463$. The correlation between differentiated data is $r \approx 0.887$ ($p \approx 0.000$), which confirms the short-term relationship. The Engle-Granger cointegration test (1987) allows for testing when both series are of the same order – the result ADF ≈ –3.133 confirms the long-term relationship.

Due to the small amount of data, the Shapiro-Wilk test was used to analyse the normal distribution of differences between the indices. The test results of $W \approx 0.870$ and $p \approx 0.017$ confirm that the differences are not normally distributed. Therefore, the two-tailed Wilcoxon test was used to compare the differentiated data sets. With a *p*-value of approximately 0.734, the test provides no evidence of a statistically significant difference between SAPI and CPI changes; however, this may be due to the small data sample. Additionally, cross-lagged correlation was calculated on differentiated data. Tables 6 and 7 present the results for up to five lags.

Table 6. Cross-lagged correlation values with up to 5 lags between differentiated SAPI and CPI

Number of lags	SAPI is ahead by	CPI is ahead by
1 lag	0.00099874	–0.00529646
2 lags	–0.68111341	–0.27416939
3 lags	0.24192432	–0.26749151
4 lags	0.29400005	–0.10067681
5 lags	–0.05026842	0.49829130

Source: own work.

Table 7. Cross-lagged correlation *p*-values with up to 5 lags between differentiated SAPI and CPI

Number of lags	SAPI *p*-value	CPI *p*-value
1 lag	0.997	0.984
2 lags	0.003	0.320
3 lags	0.367	0.353
4 lags	0.288	0.743
5 lags	0.864	0.094

Source: own work.

The results indicate asymmetry: the only significant relationship is a moderate, negative correlation with a 2-period lead of the SAPI relative to the CPI, while the CPI does not significantly lead the SAPI at any of the lags. When the growth rate of subsistence minimum accelerated, approximately two periods later, the growth rate of the overall CPI inflation weakened. Existence costs for the poor (food, energy, basic housing) are more volatile and susceptible to commodity price shocks, causing them to fluctuate rapidly. However, the CPI is smoother because it includes services, durable goods and components less sensitive to short-term increases in food or energy prices.

Discussion and conclusions

The results indicate that the SAPI and CPI are two imperfectly synchronised inflation measures, with fluctuations in the prices of basic necessities for low-income households leading changes in overall inflation by about two periods with a negative correlation. This suggests that anti-inflation policies based solely on the CPI may not adequately reflect the actual price pressures on the poorest households. According to Portillo et al. (2016), an increase in the prices of basic goods should translate into an increase in overall inflation, so the correlation should be positive; however, the observed result is a negative correlation, which means that the increase in prices for the poorest is correlated with a subsequent decrease in overall inflation. To confirm the conclusions that SAPI changes lead CPI changes by 2 lags, I propose conducting a Granger causality test along with a sensitivity study of the 2022 outlier and extension with historical data. Although the composition of the subsistence minimum basket may raise doubts due to infrequent updates, it is still a very good indicator of the lowest poverty line. The SAPI can be useful as a tool supporting inflation analysis, especially in quickly responding to changes in the prices of basic goods, but it does not completely replace the official CPI.

An open question remains as to whether the SAPI measures the intended economic phenomenon. An index based solely on the subsistence level has a built-in static view of need. Even poor people have different preferences and needs, e.g. higher medical costs or transportation to work. A fixed basket may not adequately capture the complexity of poverty and changing needs, but it is still a significantly better indicator than the CPI. Between 2006 and 2024, the SM basket increased in price almost twice as fast as the CPI basket, which means that the poorest households experienced substantially higher inflation than that indicated by the general CPI. Over this period, cumulative inflation amounted to 154.87% according to the SAPI, compared with 87.58% under the CPI.

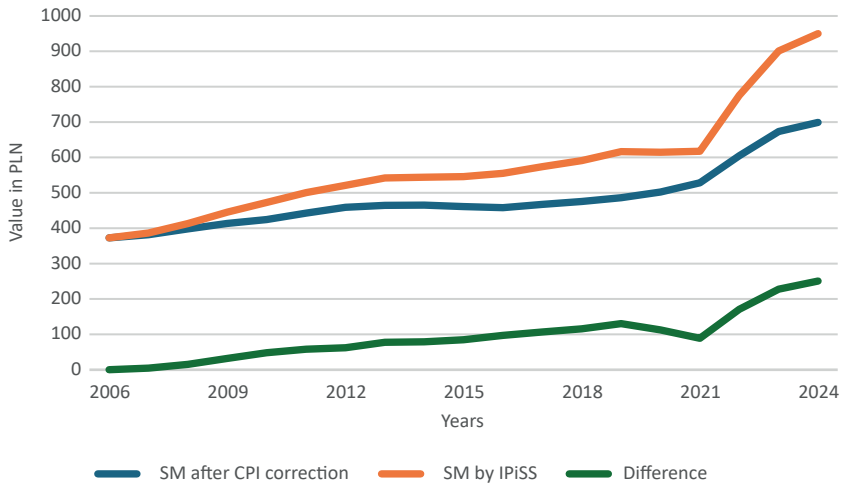

Figure 3. Differences between SM valorised with CPI and with SAPI

Source: own work.

Figure 3 shows that if the 2006 SM amount was indexed to inflation, it would reach PLN 699.09 in 2024. This means a shortfall of PLN 250.80, or approximately 26.4% of the actual SM amount in 2024. In the same year, spending on clothing, footwear, health care, personal hygiene and expenses other than food or housing amounted to 13.8% of the SM amount (Kurowski, 2025). Other conclusions should be drawn from the analysis – the fact that the CPI is not correlated with the (differentiated) SAPI means that these are two independent indicators. Considering this statement and the simulation presented in Figure 3, it would be dangerous and inappropriate to adjust social benefits based on the CPI.

Overall, the findings of this paper indicate that the SAPI could and should be used to update social benefits such as family allowances, housing benefits and social scholarships, ensuring they are aligned with the real costs of living for the poorest households. Currently the main legal act regulating the indexation of social benefits in Poland is the Act on Pensions and Disability Benefits from the Social Insurance Fund (Ustawa, 1998), which in Article 89 defines the formula as: indexation = average annual CPI in the previous calendar year + at least 20% of the real increase in average wages in the previous year. In contrast, the indexation of unemployment benefits is based solely on the CPI inflation index and does not take wage increases into account, as specified in the Act on Employment Promotion and Labour Market Institutions (Ustawa, 2004) and the Act on the Labour Market and Employment Services (Ustawa, 2025).

It can serve as a reference for setting the minimum wage and monitoring poverty and social inequality, as is the case in Georgia.

The Georgian law of 1997 introduced a systematic mechanism for monitoring and adjusting citizens' living standards by establishing and updating the subsistence minimum (Law, 1997). Based on the calculated minimum, the statistical institution Geostat determines the relationship between the basket of basic goods and the minimum income. If an increase in consumer prices causes the real minimum income to fall below the subsistence minimum, the law provides for an automatic adjustment of the minimum income, restoring it to a level that guarantees coverage of basic needs. This adjustment must be made within three months of the price change, ensuring the administration's rapid response to changes in the standard of living. A similar system could be implemented in Poland, if an annual automatic adjustment based on the SAPI were created.

Additionally, the SAPI can function as a regional measurement of inflation. The introduction of SAPI analysis down to regional structure could significantly improve the methods of measuring price dynamics in Poland. In an economy characterised by pronounced regional disparities, a uniform inflation index could lead to analytical distortions and erroneous conclusions regarding the actual economic processes occurring at the local level. First, a regionally differentiated inflation index would allow for a more precise representation of actual changes in household living costs in specific parts of the country. Second, the use of such indices would enable more equitable and effective development of state income and social policy. Adjusting the indexation of social benefits, minimum wages and pensions to the regional rate of price growth would help reduce real income inequalities resulting from geographical variations in inflation. Third, regional inflation measurement would provide valuable information for economic decision-makers at both the central and local government levels. This data could provide a basis for more precise planning of regional policy, public investments and support programs for households and businesses affected by particularly high price increases. Fourth, the publication of regional inflation indices could contribute to increased transparency and credibility of official statistics, as well as strengthen citizens' trust in institutions responsible for measuring and analysing economic phenomena. Citizens may perceive the official inflation rate as unreliable in relation to their own consumption experiences; the introduction of regional indices would allow statistics to better reflect the realities of the socio-economic life.

Considering the analysis, it seems reasonable to consider using the SAPI as a complementary tool in monitoring inflation and shaping social policy in Poland. This index, sensitive to changes in the prices of basic consumer goods, can serve as an early warning of inflationary pressures affecting the most vulnerable social groups, while also allowing for a better alignment of social benefits and the minimum wage with the real cost of living. Including the SAPI in statistical publications and in the decision-making process of public institutions could improve the ad-

equacy of social policy, increase data transparency and strengthen public trust by more realistically reflecting the costs of living for low-income households.

As a suggestion for future research, I propose conducting similar studies for other countries, particularly developing countries or the Global South. Theoretically, extending the conclusions of Portillo et al. (2016) suggests that the SAPI index would possibly correlate less with the CPI in highly developed countries and more with less developed countries. Differences between the SAPI and the CPI in these regions should be examined. Regarding the SAPI itself (as mentioned before), to further improve and implement the indicator, a sensitivity analysis should be conducted with respect to the outlier year 2022 and with respect to other, less stringent SM indicators, e.g. for households with two, three or more members. The year 2022 would require special treatment, for example, using a dummy variable or the Gregory-Hansen test (1996). This test allows us to verify whether, despite a shock, a long-term relationship between variables still exists, albeit with changed parameters. In other words, it allows us to distinguish whether 2022 represents a permanent break in the relationship or merely a shift in its level. Other tests, including ACF/PACF to confirm non-stationarity and Granger causality tests should be performed, along with ANOVA/Kruskal-Wallis to check whether the differences between voivodeships are statistically significant. Expanding the SAPI index for Poland to include data prior to 2006, using historical data should be a priority to repeat all previous statistical tests and those mentioned above.

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