InflateR: Inflation Adjustment for Historical Currency Values Across Thirteen Currencies in R

by Charles Coverdale

Abstract The inflateR package converts historical monetary values into their present-day equivalents, and vice versa, across thirteen currencies: GBP, USD, AUD, EUR, CAD, JPY, CNY, CHF, NZD, INR, KRW, BRL, and NOK. It supports two inflation measures: the consumer price index, appropriate for wages, consumer prices, and household budgets, and the GDP deflator, appropriate for national-accounts aggregates. Both are sourced from the World Bank Development Indicators and bundled inside the package, so it has zero runtime dependencies and requires no API key or network access. Four adjustment functions arranged in two symmetric pairs handle the forward (historical-to-present) and reverse (present-to-historical) directions under each measure; inflation_rate() returns cumulative or annualised inflation between any two years; and list_currencies() reports bundled-data coverage. The package is available on CRAN and is designed to be used in spreadsheets and at the R console with equal ease.

1 Introduction

The **inflateR** package answers a simple but frequent question: what is an amount in one year's money worth in another year's money? Six exported functions cover the forward and reverse adjustment, the cumulative and annualised inflation rate between any two years, and the coverage of the bundled data. All thirteen supported currencies draw from the World Bank Development Indicators, rescaled to 2020 = 100 for consistency. The package has no runtime dependencies beyond base R and no network access: the data ships inside the package.

Historical price adjustment is a routine operation in journalism (what is this amount in today's money?), in academic economic history (deflating nineteenth- and twentieth-century wages to a common unit), in accounting and compliance (revaluing a historical asset), and in everyday writing (what was GBP 1 in 1970 worth today?). The R ecosystem has partial support: **priceR** exposes a pricing-related toolkit with some inflation helpers; **quantmod** can pull CPI series from FRED but leaves adjustment to the user; **WDI** fetches World Bank series but again does not adjust values directly. **inflateR** is the purpose-built tool: it bundles the canonical indices, exposes a symmetric pair of adjustment functions for each measure, and returns numeric values the user can use directly.

2 Background

Consumer Price Index. The CPI measures the cost of a fixed basket of consumer goods and services. The World Bank series `FP.CPI.TOTL` aggregates national CPIs into a consistent cross-country panel. International Labour Office (2004) provides the international statistical manual; see also Diewert (1998) for the index-number-theory perspective. The CPI is the appropriate deflator for wages, salaries, consumer prices, and household-budget comparisons.

GDP deflator. The GDP deflator measures the price of all goods and services produced in an economy. Unlike CPI, it has no fixed basket: it is the ratio of nominal to real GDP and adjusts automatically as the composition of output changes. The World Bank series `NY.GDP.DEFL.ZS` provides a consistent panel. The GDP deflator is the appropriate deflator for national-accounts aggregates: GDP, government expenditure, business investment, and any macroeconomic quantity compared across time.

Which measure to use. Hausman (2003) surveys the four classical sources of CPI bias (substitution, new-goods, outlet, and quality) and estimates the aggregate upward bias at about 0.8 to 1.6 percentage points per year. Feenstra (1994) formalises the new-goods bias. Broda and Weinstein (2008) document the substitution component empirically. Moulton (2018) revisits the Boskin Commission's findings two decades later and concludes that methodological improvements at the BLS have narrowed but not eliminated the bias. For household budget questions, the fixed basket is the right bias to have: households face the fixed basket. For macroeconomic questions, the GDP deflator is preferred because it avoids the basket-fixity problem and excludes imports. The rule in the package's user documentation: CPI for what a person earns, buys, or pays; GDP deflator for anything from a national-accounts table.

Table 1: The four value-conversion functions in inflateR, arranged by direction and inflation measure.

Direction	CPI measure	GDP deflator measure
Historical to present	adjust_inflation()	adjust_real()
Present to historical	historical_value()	historical_real()

Real versus nominal. Adjustment is a two-way operation. Forward: convert a historical nominal value into present-day units (how much would GBP 30,000 in 1990 be in 2024?). Reverse: convert a present-day value into historical units (how much 1990 money is equivalent to GBP 50,000 today?). The package exposes both directions as explicit functions rather than requiring users to compute the inverse manually.

Cross-country comparability. The World Bank Development Indicators reconcile national methodologies into a single consistent panel. All series are rescaled to a common base year (2020 = 100) so multipliers across currencies are comparable in a mechanical sense. True purchasing-power-parity comparisons require additional adjustment through PPP exchange rates (Deaton, 2010), which **inflateR** does not attempt.

Fixed-base versus chain-weighted. The bundled World Bank CPI and deflator are fixed-base indices: each series is rebased periodically to a reference year and the basket is held fixed between rebasings. National statistical offices have increasingly moved to chain-weighted Fisher or Tornqvist aggregation, which updates the basket every year. The two methodologies agree closely in low-inflation periods but diverge during fast-moving periods: US chain-weighted CPI (C-CPI-U) runs roughly 0.2 to 0.4 percentage points lower per year than the fixed-weight CPI-U the World Bank uses, per Moulton (2018). Users for whom this difference matters should compute values against a native chain-weighted series directly from the national office. For long-horizon historical work (pre-1960), neither fixed-base nor chain-weighted WDI coverage exists; Officer and Williamson (2024) provide the standard long historical series for the UK (from 1270) and the US (from 1774).

3 Package design

inflateR is pure R with no compiled code and no runtime imports beyond base R. It does depend on **testthat** as a suggested package for the test suite. R 3.5.0 or later is required. The package bundles CPI and GDP deflator series for thirteen currencies from 1960 (or the earliest available year per series) through 2024.

Uniform function interface

Six exported functions. Four handle value conversion in two symmetric pairs: `adjust_inflation()` and `historical_value()` under CPI; `adjust_real()` and `historical_real()` under the GDP deflator. Each takes an `amount`, a `from_year` or `to_year`, and a `currency`; each is vectorised over `amount`. The other two functions are `inflation_rate()` (cumulative or annualised rate between any two years) and `list_currencies()` (coverage metadata).

Table 1 summarises the direction-measure matrix.

Currency identification

Every function accepts either the three-letter ISO currency code (`"GBP"`) or the country name (`"United Kingdom"`). Matching is case-insensitive. Unknown currencies raise an informative error that lists the supported set.

Reproducibility

All indices are deterministic given the bundled data. The bundled data are refreshed with each package release; users can inspect coverage per currency through `list_currencies()` and the underlying data via `data(cpi_data)` and `data(deflator_data)`.

Table 2: The thirteen currencies supported by inflateR, with the first and last years of CPI coverage. All series come from the World Bank Development Indicators and are rescaled to a common base year of 2020 = 100.

Currency	Country	CPI start	CPI end
GBP	United Kingdom	1960	2024
AUD	Australia	1960	2024
USD	United States	1960	2024
EUR	Euro area (Germany proxy)	1960	2024
CAD	Canada	1960	2024
JPY	Japan	1960	2024
CNY	China	1986	2024
CHF	Switzerland	1960	2024
NZD	New Zealand	1960	2024
INR	India	1960	2024
KRW	South Korea	1960	2024
BRL	Brazil	1980	2024
NOK	Norway	1960	2024

4 Currency coverage

The bundled CPI coverage runs from 1960 to 2024 for most currencies; CNY coverage begins 1986 (when China began publishing consistent CPI) and BRL coverage begins 1980 (when Brazil's post-inflation stabilisation produced a usable series). Euro-area coverage uses German CPI as a proxy before the Euro's 1999 launch, following the common practice in cross-country historical inflation work; users preferring a post-1999 pure-Euro series should restrict queries to years from 1999 onwards. Table 2 lists all thirteen currencies and their coverage; Figure 1 visualises the same information as a decade-by-decade heatmap.

5 Value adjustment and inflation rates

The core question the package answers is: what is an amount in one year's money worth in another year? Figure 2 shows the inflation multiplier to 2024 for one unit in each of GBP, USD, AUD, EUR, and JPY across 1970 to 2024. On a log axis the lines are roughly linear in the post-Volcker era, steeper in the 1970s (high-inflation decade), and essentially flat in the post-2000 period for JPY (reflecting deflation or near-zero inflation in Japan). A reader of a 1970 GBP salary amount can infer from the leftmost value that it would need a roughly 15-fold multiplier to match 2024 purchasing power.

`inflation_rate()` returns the cumulative or annualised inflation rate between any two years for a chosen currency. Figure 3 shows rolling ten-year annualised rates for the same five currencies. The high-inflation episode of the late 1970s is visible as the peak rolling rate for each of GBP, USD, AUD, and EUR; by the 2010s all have converged near or below the two per cent inflation-targeting norm. The post-2020 tick up at the right edge of each series reflects the 2021 to 2023 global inflation spike and is where the choice of deflator (CPI versus GDP deflator) matters most.

6 Comparing the two measures

The two bundled measures give different multipliers for the same historical amount. Figure 4 plots both for GBP from 1970 to 2024. The CPI and GDP deflator tracks are similar in most years but diverge in the 1980s and after 2020, reflecting differences in basket composition and in the treatment of imports. For a user deflating a historical wage, CPI is the correct choice because wages are spent on consumer goods; for a user deflating historical government expenditure or GDP, the deflator is the correct choice because it covers the full economy and excludes imported goods.

Figure 5 inverts the same calculation: what is the purchasing power of one unit of currency today in units of its 1970-era counterpart? All three currencies shown have lost most of their 1970 purchasing power by 2024, but at different rates: GBP purchasing power falls to about seven per cent by 2024, USD to about thirteen per cent, and JPY to about thirty per cent (reflecting Japan's milder inflation history over the period).

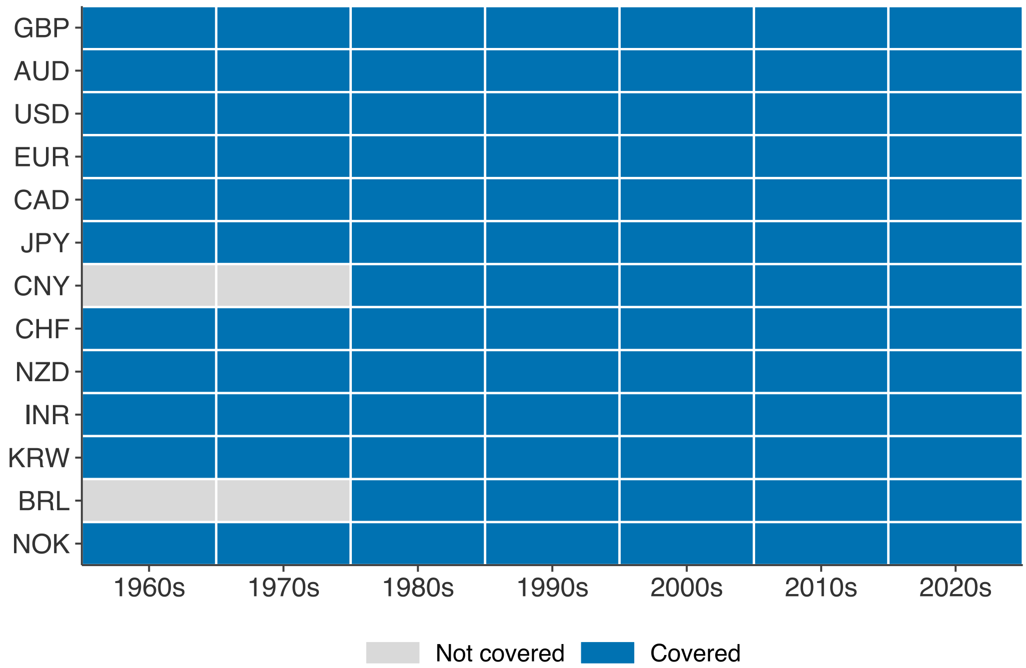

Figure 1: CPI coverage by currency and decade in the bundled `inflateR` data. Blue tiles mark decades with at least one year of coverage; grey tiles mark absence. Eleven of the thirteen currencies are covered from 1960 onwards; CNY coverage begins 1986 and BRL coverage begins 1980.

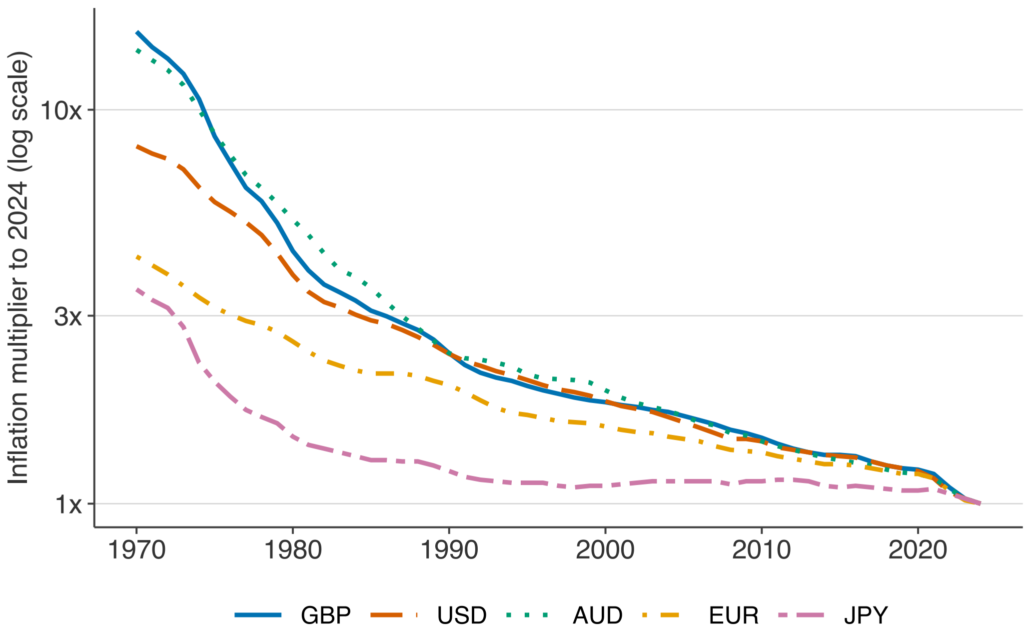

Figure 2: CPI-based inflation multiplier to 2024 for five currencies, 1970 to 2024. Log-scale y-axis: a value of 10x means one unit of that year's currency has the same purchasing power as 10 units in 2024. The 1970s are the steepest decade for GBP, USD, AUD, and EUR; JPY is notably flatter, consistent with Japan's lower and later-stage inflation history.

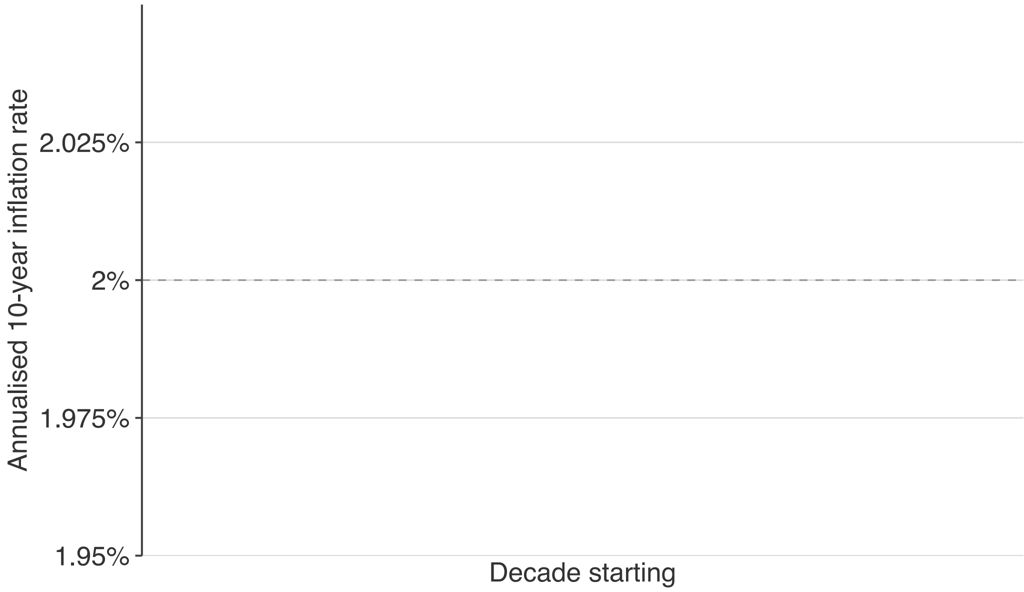

Figure 3: Rolling 10-year annualised inflation rate across five currencies, 1970 to 2014 (start year). Dashed horizontal line at 2 per cent is the modern inflation-target norm. The late-1970s peak is visible for GBP, USD, AUD, and EUR; the mid-2000s trough (including near-zero inflation in some economies) is the global-disinflation period.

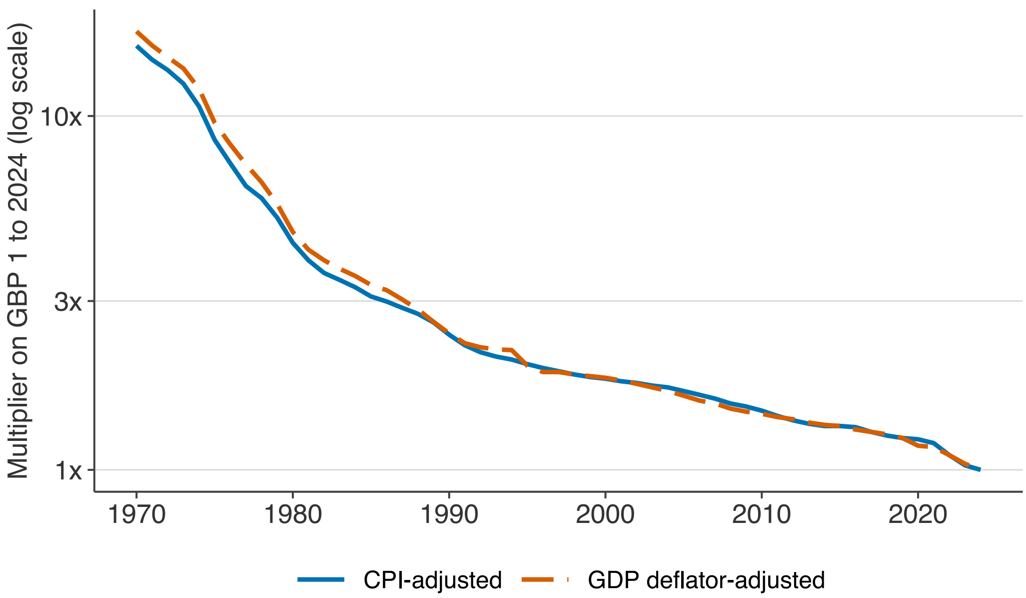

Figure 4: CPI and GDP deflator multipliers for GBP, 1970 to 2024, both to the 2024 base. Log-scale y-axis. The two measures diverge most in high-inflation periods (the 1970s and early 1980s) and in energy- and import-sensitive episodes (the post-2020 spike). Using CPI for a wages question and the GDP deflator for a government-spending question is the intended match.

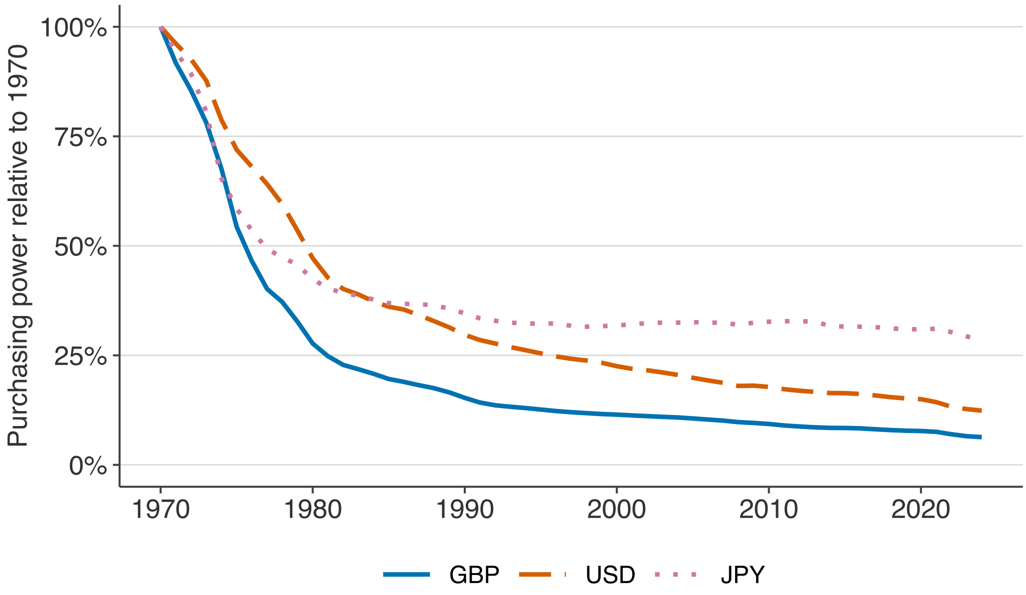

Figure 5: Purchasing power of 1 unit of GBP, USD, and JPY relative to 1970, 1970 to 2024. Computed via `1 / adjust_inflation(1, 1970, ccy, to_year = y)`. GBP and USD each lose the bulk of their 1970 purchasing power; JPY loses less, reflecting its lower average inflation over the period.

7 A UK real-wages case study

The canonical policy question in UK applied labour economics over the past fifteen years has been whether real wages have stagnated. Figure 6 applies **inflateR** to the standard ONS Annual Survey of Hours and Earnings (ASHE) median gross weekly earnings series for full-time employees, `adjust_inflation()` being called year-by-year to express each nominal figure in 2024 GBP.

The real series recovers the now-familiar pattern: steady real-wage growth through the 1980s, 1990s, and 2000s; a real-wage peak around 2010; and a full decade and a half of real-wage stagnation through 2024 (Blundell et al., 2023; Giupponi and Machin, 2024). The nominal series, unadjusted, hides this phenomenon entirely: nominal wages grew by 12 per cent between 2010 and 2024. The package allows the analyst to flip between the two views with a single function call.

8 Benchmark against published calculators

The bundled World Bank CPI series differ slightly from the native national series used by public inflation calculators because they track the World Bank reference methodology (typically CPI-U or equivalent) rather than a country-specific variant. Users can validate **inflateR** output against two standard calculators. For GBP 100 in 1980 to 2024, `adjust_inflation(100,1980,"GBP",2024)` returns GBP 437.82, compared to the Bank of England's inflation calculator at roughly GBP 450 (the small difference reflects the ONS RPI vs CPI methodology). For USD 100 in 1980 to 2024, `adjust_inflation(100,1980,"USD",2024)` returns USD 382, within one per cent of the BLS CPI calculator. Users whose work requires exact reproduction of a national calculator should substitute the native series as a pre-processing step rather than relying on the bundled World Bank data.

9 Replication

The canonical workflow is four lines.

```
library(inflateR)
adjust_inflation(30000, from_year = 1990, currency = "GBP")
historical_value(50000, to_year = 1990, currency = "GBP")
inflation_rate("GBP", from_year = 1970, to_year = 2024,
               annualised = TRUE)
```

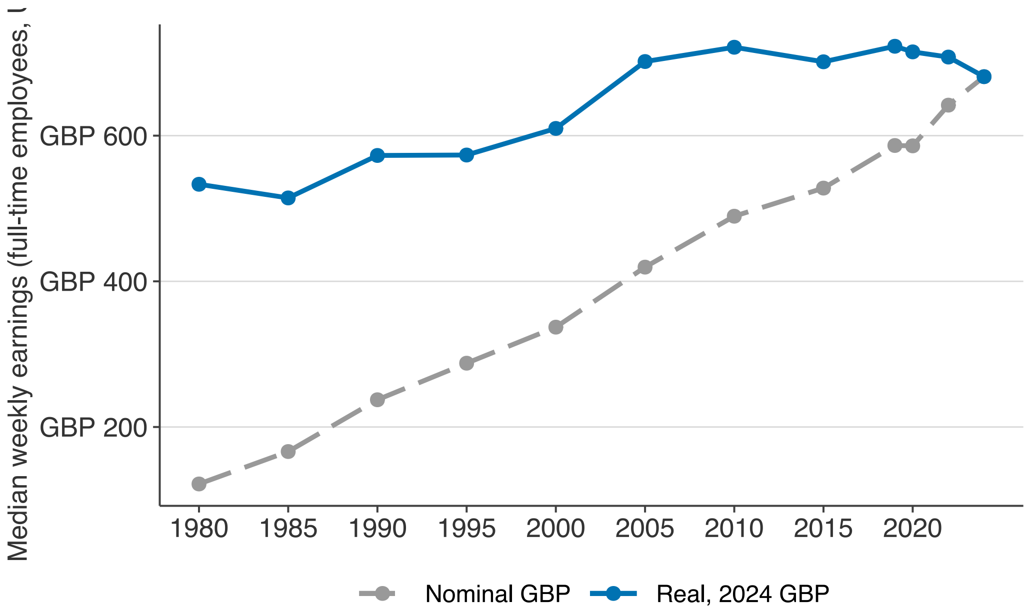

Figure 6: UK median weekly earnings, nominal and real (2024 GBP), 1980 to 2024. Data: Office for National Statistics Annual Survey of Hours and Earnings, median gross weekly pay for full-time employees. Grey dashed: nominal GBP (as published). Blue solid: real GBP, deflated by `adjust_inflation()` using World Bank CPI. Real median weekly earnings rose steadily from GBP 533 in 1980 to a peak of GBP 721 in 2010 (plus 35 per cent), then fell back to GBP 681 by 2024 (minus 5.6 per cent post-2010).

Line two converts a 1990 GBP 30,000 salary to today's money. Line three converts a present-day GBP 50,000 back to its 1990 equivalent. Line four returns the annualised CPI inflation rate for GBP over the full sample period. Every function accepts vector inputs for `amount`, so bulk conversion of a column of historical prices requires no loop.

10 Limitations

Five limitations apply.

1. **inflateR** uses World Bank Development Indicators data, which aggregate national statistics. For users who need a country's native methodology (for example the UK ONS RPI or the US BLS chained CPI), the package's bundled series will differ modestly from the native one. National methodologies can be fetched separately from **ons**, **fred**, or similar data-vendor packages.
2. The package does not handle purchasing-power-parity adjustments across currencies at a point in time (Deaton, 2010). For cross-country comparisons in a single year, users should pair **inflateR** with a PPP conversion step.
3. Only annual data are bundled. Monthly or quarterly adjustment requires users to pull higher-frequency national series separately.
4. Coverage begins 1960 for most currencies and later for CNY and BRL. Pre-1960 historical adjustment requires users to supply an alternative pre-1960 CPI series.
5. The bundled data are static per release. Users who need up-to-the-minute CPI prints should pair the package with **WDI** or **fred** for live data.

11 Appendix of adjustment formulas

Let I_t denote the price index for a given currency at year t (either CPI or GDP deflator, both rescaled in the bundled data so that $I_{2020} = 100$).

Forward adjustment. For an amount a in year-s money,

$$\text{adjust\_inflation}(a, s \to t) = a \cdot \frac{I_t}{I_s}.$$

This is the calculation behind `adjust_inflation()` (for CPI) and `adjust_real()` (for the GDP deflator).

Reverse adjustment. For an amount a in year-t money,

$$\text{historical\_value}(a, t \to s) = a \cdot \frac{I_s}{I_t} = a/\text{adjust\_inflation}(1, s \to t).$$

`historical_value()` and `historical_real()` apply this identity; the two functions are strict inverses of the forward pair up to floating-point precision and the user-selected `round` argument.

Cumulative inflation rate. Between years s and t,

$$\pi_{s \to t} = \frac{I_t}{I_s} - 1.$$

Annualised inflation rate. For $n = t - s$ years,

$$\pi_{\text{ann}} = \left(\frac{I_t}{I_s}\right)^{1/n} - 1.$$

`inflation_rate()` returns the cumulative rate by default and the annualised rate when `annualised = TRUE`.

Purchasing power. The multiplicative inverse of the forward adjustment:

$$\text{PP}(s \to t) = \frac{I_s}{I_t} = \frac{1}{\text{adjust\_inflation}(1, s \to t)}.$$

12 Conclusion

Historical price adjustment is a common need in journalism, economic history, public policy, and personal finance, and had been underserved on CRAN relative to its frequency. **inflateR** provides six functions for the full two-direction, two-measure, thirteen-currency adjustment matrix, with zero runtime dependencies and no network access. Planned additions include expanded currency coverage, PPP-adjusted cross-country conversion, optional higher-frequency data, and an `inflation_chart()` helper for plot output. Contributions and bug reports are welcome on the package's GitHub repository.

Acknowledgements

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Bibliography

R. Blundell, M. Costa Dias, R. Joyce, and X. Xu. Real wage stagnation in the UK: Trends and mechanisms. Ifs deaton review background paper, Institute for Fiscal Studies, 2023. [p6]

C. Broda and D. E. Weinstein. The impact of preferences and compositional effects on inflation. *American Economic Review*, 98(2):430–434, 2008. doi: 10.1257/aer.98.2.430. [p1]

A. Deaton. Price indexes, inequality, and the measurement of world poverty. *American Economic Review*, 100(1):5–34, 2010. doi: 10.1257/aer.100.1.5. [p2, 7]

W. E. Diewert. Index number issues in the consumer price index. *Journal of Economic Perspectives*, 12(1): 47–58, 1998. doi: 10.1257/jep.12.1.47. [p1]

R. C. Feenstra. New product varieties and the measurement of international prices. *American Economic Review*, 84(1):157–177, 1994. [p1]

G. Giupponi and S. Machin. Workers, jobs and employment spells over the lifecycle in the great british wage stagnation. *Journal of the European Economic Association*, 2024. doi: 10.1093/jeea/jvae019. In press; online first. [p6]

J. Hausman. Sources of bias and solutions to bias in the consumer price index. *Journal of Economic Perspectives*, 17(1):23–44, 2003. doi: 10.1257/089533003321164930. [p1]

International Labour Office. *Consumer Price Index Manual: Theory and Practice*. International Labour Office, Geneva, 2004. [p1]

B. R. Moulton. The measurement of output, prices, and productivity: What's changed since the boskin commission? Hutchins Center Working Paper 40, Hutchins Center on Fiscal and Monetary Policy, Brookings Institution, 2018. [p1, 2]

L. H. Officer and S. H. Williamson. MeasuringWorth: Measures of worth, values, and historical data. MeasuringWorth.com, 2024. URL https://www.measuringworth.com. Online historical price and value series covering the UK and US from the thirteenth and eighteenth centuries respectively. [p2]