IPUMS
Working Papers

Extending IPUMS Harmonization to Monetary Standardization through Inflation Adjustment and Currency Conversion

Kari C. W. Williams†
University of Minnesota

Sarah M. Flood
University of Minnesota

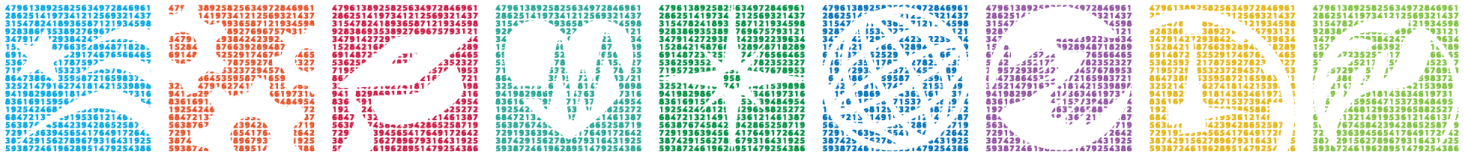
Karine Belarmino
University of Minnesota

Lara L. Cleveland
University of Minnesota

September 2025

Working Paper No. 2025-02
DOI: https://doi.org/10.18128/IPUMS2025-02

†Address correspondence to Kari Williams: will3986@umn.edu. This research was supported by grants from the National Institute for Child Health and Human Development (R01HD067258, R01HD043392, R01HD047283) and the National Science Foundation (SES 2345439).



Extending IPUMS Harmonization to Monetary Standardization through Inflation Adjustment and Currency Conversion

Kari C.W. Williams†, Sarah M. Flood, Karine Belarmino, and Lara L. Cleveland

Abstract

To facilitate meaningful comparisons, many researchers account for the changing value of money over time in their analyses. Similarly, researchers working with data from multiple countries often convert currencies to compare monetary values across datasets. As a leading provider of data that span long periods of time, IPUMS is ideally positioned to provide the research community with monetary variables that have been adjusted for inflation to facilitate efficient analysis of the data. A new tool available to IPUMS users reduces errors and increases the reproducibility of analyses that adjust monetary values. The Adjust Monetary Values feature can be applied to custom data extracts from IPUMS USA and IPUMS CPS, allowing users to convert eligible variables to 2010 dollars using the Consumer Price Index for all urban consumers (CPI-U). The Adjust Monetary Values feature has been extended to enable currency conversion in IPUMS International, allowing users to adjust monetary values for both inflation and currency exchange rates.

Introduction

IPUMS provides easy access to harmonized data that make it simple to pool samples, analyze trends over time, and make comparisons between places. Many IPUMS data collections include rich information on income and other monetary values (e.g., rent and mortgage amounts, tax liability). However, the value of currencies varies across time, requiring adjustment for inflation to make legitimate comparisons. Providing documentation on adjustment factors and how to use them (e.g., the variable CPI99, which is available in multiple IPUMS data collections including

IPUMS USA and IPUMS CPS) is important, but insufficient. Every researcher who wants to standardize dollar amounts still must manipulate the data themselves, resulting in redundant effort across many researchers. Furthermore, the tedious process of manually adjusting for inflation may be carried out slightly differently by each individual data user, thereby limiting reproducibility because of legitimate differences based on inflation factor or rounding as well as errors in calculations. Similarly, researchers working with monetary data from more than one country often must convert currencies to a common unit in addition to adjusting for inflation.

IPUMS addresses this inefficient and error-prone process by allowing users to request variables that have already been adjusted for inflation and standardized to a common year for IPUMS USA and IPUMS CPS data, and variables that have been converted to 2000 US Dollars (USD) for IPUMS International. This tool extends the work that IPUMS does to streamline the research process; it eliminates another redundant data cleaning and management task that would need to be repeated across individual researchers. Using inflation adjustments in the U.S. data as an example, this paper describes why IPUMS created a tool to adjust monetary values, the core infrastructure for implementing this functionality, and how to access the feature. We then describe the modifications to the inflationary functionality to support currency conversion for international data.

The Rationale for Disseminating Adjusted Monetary Values

U.S. federal statistical agencies and other data providers have a mandate to deliver data in a timely manner [1-2]; their work collecting, processing, analyzing, and publishing high-quality and relevant data is vital. IPUMS enhances data produced by federal statistical agencies by making them usable across time and by eliminating redundant effort for researchers. Standardizing

monetary values, for example, by adjusting variables for inflation is a natural extension of the work that IPUMS already does to harmonize data across time. IPUMS already adjusts monetary values for inflation in a limited way in the harmonized versions of the multi-year American Community Survey (ACS) public use microdata sample (PUMS) disseminated by IPUMS USA. The Census Bureau releases the multi-year ACS PUMS data with nominal, or year-specific, dollar values. As part of our data integration process, IPUMS adjusts all single years of data within the multi-year file so dollar values in these samples are standardized to dollars as valued in the final year of data included in the file (e.g., 2023 dollars for the 2019-2023 5-year file).

The cost of redundant effort for adjusting for inflation is potentially very high. IPUMS USA and IPUMS CPS have a combined active user community of 48,000 researchers, and variables reporting income and other monetary values are among the most widely used variables that IPUMS offers. For example, the variable reporting individual wage income (variable name INCWAGE) is among the ten most commonly requested variables in the past year in both IPUMS USA and IPUMS CPS; INCWAGE was included in nearly 50,000 customized datasets in the past year between IPUMS USA and IPUMS CPS. Even conservative estimates of the amount of time it takes researchers to adjust their variables for inflation are large when considering the size of the research community served by IPUMS. For example, if it takes one hour for each researcher to develop and validate the code to adjust their values for inflation and just 5% of IPUMS USA and IPUMS CPS users who download INCWAGE perform this adjustment, that is 2,400 hours of potentially redundant effort every year.

We sought to develop a robust, scalable solution to adjust values for inflation for any variable with monetary values. The Adjust Monetary Values feature does this and more: it allows users to request dynamic adjustment across all datasets within an IPUMS data collection to a single reference year. It also is wise to the fact that reference periods differ across variables and is

designed to account for this when making the proper adjustment. By allowing IPUMS users to include monetary variables that have already been adjusted for inflation in their microdata extracts, the IPUMS Adjust Monetary Values feature reduces redundancies and mistakes, while saving researchers time and increasing reproducibility.

Adjust Monetary Values Infrastructure

The Adjust Monetary Values (AMV) feature leverages the metadata that underpin the unified IPUMS data harmonization engine. Reusing the existing metadata infrastructure maximizes flexibility, streamlines maintenance, and reduces the likelihood of errors. First, we specify conversion factors in a centralized location that can be referenced by all variables in a data collection, eliminating a potential source of typographical errors. We then mark variables that are eligible for monetary adjustment, denote any specialty codes that should not be adjusted, and specify a reference year. Finally, we perform the adjustments dynamically when users request them rather than permanently storing adjusted values as alternate variables. We describe the considerations for the relevant pieces of our data processing and dissemination system below.

Conversion Factors

We specify conversion or adjustment factors using a single piece of metadata that records the factor that is required to translate dollar values in each year represented in the data collection into a target year using a specified index. We update the file annually when the latest adjustment factors are released. Currently, we offer a single adjustment; however, this model can easily accommodate additional target years or indexes in the future.

IPUMS USA and IPUMS CPS offer the ability to adjust monetary values to 2010 dollars using the Historical Consumer Price Index for all urban consumers (CPI-U). The Bureau of Labor Statistics (BLS) produces the Consumer Price Index (CPI) to indicate the relative price of a set of goods and services across time in the United States. The CPI measures inflation "as experienced by consumers in their day-to-day living expenses" and is well-suited for understanding consumers' ability to purchase an equivalent basket of goods and services at different points in time [3].

The CPI-U, which covers about 90% of the total U.S. population [4], is available as a seasonally adjusted series back to 1947, and without seasonal adjustment back to 1921 [5]. MeasuringWorth has compiled a series back to 1774 [6], which enables IPUMS USA to extend the CPI-U series to accommodate the 1850 census microdata, the earliest year of person-level census microdata in the U.S. We selected the CPI-U as the default index because of its widespread use, relevance for the general population, and availability across a long timespan, which is particularly important given the temporal depth of IPUMS data.

The BLS releases Historical CPI-U supplemental files on a monthly basis and notes that the January release may alter the annual adjustment factors for the preceding five years [7]. IPUMS CPS is the only data collection that releases data prior to the availability of the *annual* CPI-U table in January. IPUMS CPS does not make monthly data eligible for monetary adjustment until January of the following year when the annual Historical CPI-U files are released. When we add the latest adjustment factors each January, we also make any necessary revisions to the adjustment factors for the preceding five years and note such changes in our revision history.

Reference Year

IPUMS datasets generally include a variable called YEAR that reports the census or survey year when the data were collected. This year does not necessarily represent the reference year for monetary values reported in that dataset. The conversion factors described above simply report how to inflate or deflate dollar values between a given year and the target year using a specific index. To correctly adjust variables, we must also specify the appropriate reference year.

The reference year for monetary variables is generally consistent within a sample. For instance, the bulk of monetary variables reported in the Current Population Survey (CPS) are in the Annual Social and Economic supplement (ASEC); the reference period for the ASEC is the previous calendar year. However, variables included with the outgoing rotation group (ORG) or Earner Study released with the monthly CPS data record earnings for a reference week earlier in the month (typically the week including the 12th); in these cases, the survey year (i.e. the value reported by the YEAR variable) corresponds to the reference year. Similarly, the decennial census typically asks about the previous calendar year while the ACS asks about the past 12 months. Occasionally, the reference year is specific to a variable rather than the sample. The IPUMS USA variables reporting monthly mortgage payments, MORTAMT1 and MORTAMT2, are derived from a question about the monthly amount paid without further clarification regarding the time period but explicitly specifying that any reports of payment on some other periodicity should be converted to a monthly amount.

Updating each variable-sample combination to specify the reference year would be burdensome and error prone. Instead, we set a default reference year for each sample (previous year or survey year). The default reference year for CPS ASEC and decennial census samples is the previous year. The default reference year for the CPS basic monthly samples, including the

ORG variables and other topical supplements, is the survey year. The case of the ACS is more complicated because the survey is collected on a rolling basis throughout the year, the response month is not publicly released, and the reference period is relative to the date when the household is sampled. For households responding in January, the previous year would be most appropriate; whereas for those responding in December the survey year is most accurate. IPUMS sets the default reference period for ACS samples to the survey year.

While the reference period for variables is largely consistent within samples, the AMV infrastructure also provides the ability to override the default reference year at the variable level (again specifying previous year or survey year). For example, CPS ORG variables included in the monthly data are also available for download in ASEC samples. The default reference year for the ASEC is the previous year; therefore, we set variable-level overrides for ORG variables to always use the survey year as the reference year, rather than the sample-level default. Similarly, the IPUMS USA variables MORTAMT1 and MORTAMT2 have variable-level overrides to ensure they always apply the survey year as the reference year regardless of whether a user's customized extract includes samples from the ACS (reference year: survey year) or decennial (reference year: previous year). In the absence of variable-level overrides, AMV will use the default reference year for a sample.

In an extremely limited number of cases, the reference period for variables may both regularly diverge from the sample default and be inconsistent within a variable across time. We select the reference year that accommodates the majority of samples in these cases and document any samples that are using a misaligned reference year in the variable-level documentation on our websites. If neither the sample-default reference year or a variable-specific override can accommodate a majority of the samples for a variable, we do not provide monetary adjustment for the variable. All variables that are eligible for monetary adjustment include information about

the reference year in the corresponding variable-level documentation, with additional detail provided for variables that have heterogeneous reference periods.

Variables

Once the conversion factors are in place and reference periods have been set, we can mark variables as being eligible for monetary adjustment. We review each eligible variable to specify variable-specific codes that should *not* be adjusted by the AMV feature. All codes that represent monetary values, including bottom- and top-codes and midpoints are adjusted by AMV. Missing data codes, however, are not.

IPUMS uses a flexible convention for documenting missing data codes. It is important that we do not adjust missing data codes for inflation; applying the year-specific adjustment factor to these values would not produce the identifiable code convention that we use to flag these cases as missing. For example, we typically assign not in universe (NIU) cases using “9” repeated as many times as the width of a variable. The NIU code for INCTOT (9999999) is not a monetary value and adjusting it for inflation would remove a meaningful code from the data. We use similar conventions for variable codes corresponding to “Unknown,” “Refused,” “Don’t know,” and “No response.” We mark all codes that should not be adjusted for inflation in our variable harmonization crosswalks. The AMV feature collapses all missing data codes into a single category with a code consisting entirely of nines; this code is two digits wider than the missing codes in the original variable (e.g., an AMV-adjusted version of INCTOT would collapse all missing data codes into a uniform code consisting of nine nines: 99999999).

Not all monetary variables are currently available for adjustment by AMV. For the initial releases, we prioritized popular and straightforward variables. Variables that are not currently available for adjustment include those that are categorical, have changing top- or bottom-codes

over time, or sample-specific specialty codes that must be investigated. These variables need to be reviewed thoroughly and possibly modified so they can be released at a later date. A very small subset of monetary variables may have too many special considerations to be included in the automated AMV feature in the foreseeable future.

Software

IPUMS software engineers develop and maintain the code that seamlessly brings together the conversion factors, reference year information, and variable-level specifications to deliver adjusted monetary values to IPUMS researchers through our web-based data dissemination system. The customized IPUMS software supports this feature, which adjusts monetary values on demand when users select them for inclusion in their customized datasets. We describe the feature from a researcher's perspective in the next section.

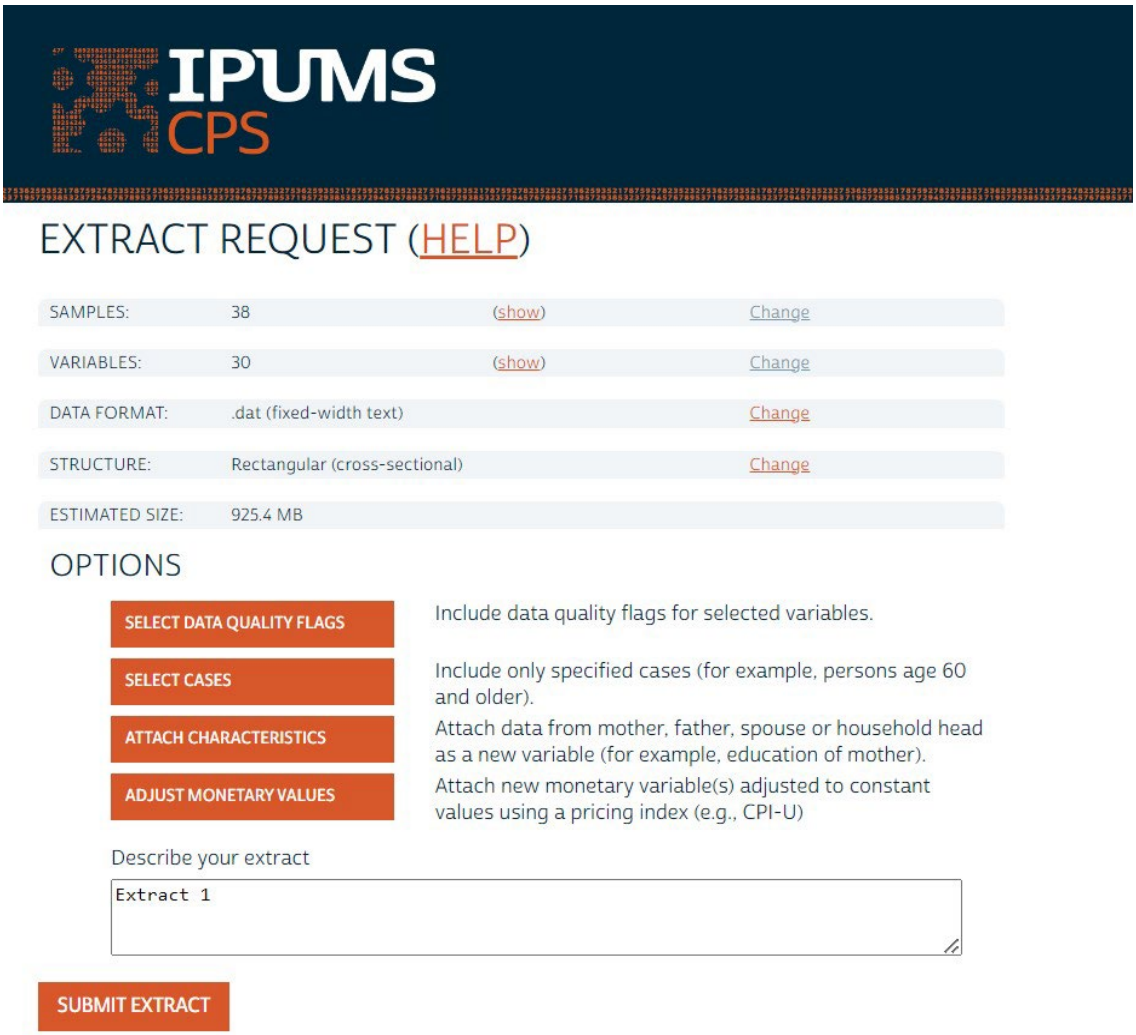
Maintenance and Expansion

Beyond the benefit of decreasing the potential for typographical errors, the IPUMS metadata-driven approach to inflation adjustment is also easy to maintain and can be readily adapted to offer adjustments using other base years or other conversion factors. By creating and disseminating adjusted variables dynamically through the IPUMS data access system (described next), we do not need to store alternate, inflation-adjusted versions for the dozens of monetary variables in these data collections. To extend the functionality to additional (i.e., new) years of data, we need only add a new row to our conversion factor metadata for the additional years. Adding alternate indexes or different base years is a future possibility.

Using the Adjust Monetary Values Feature

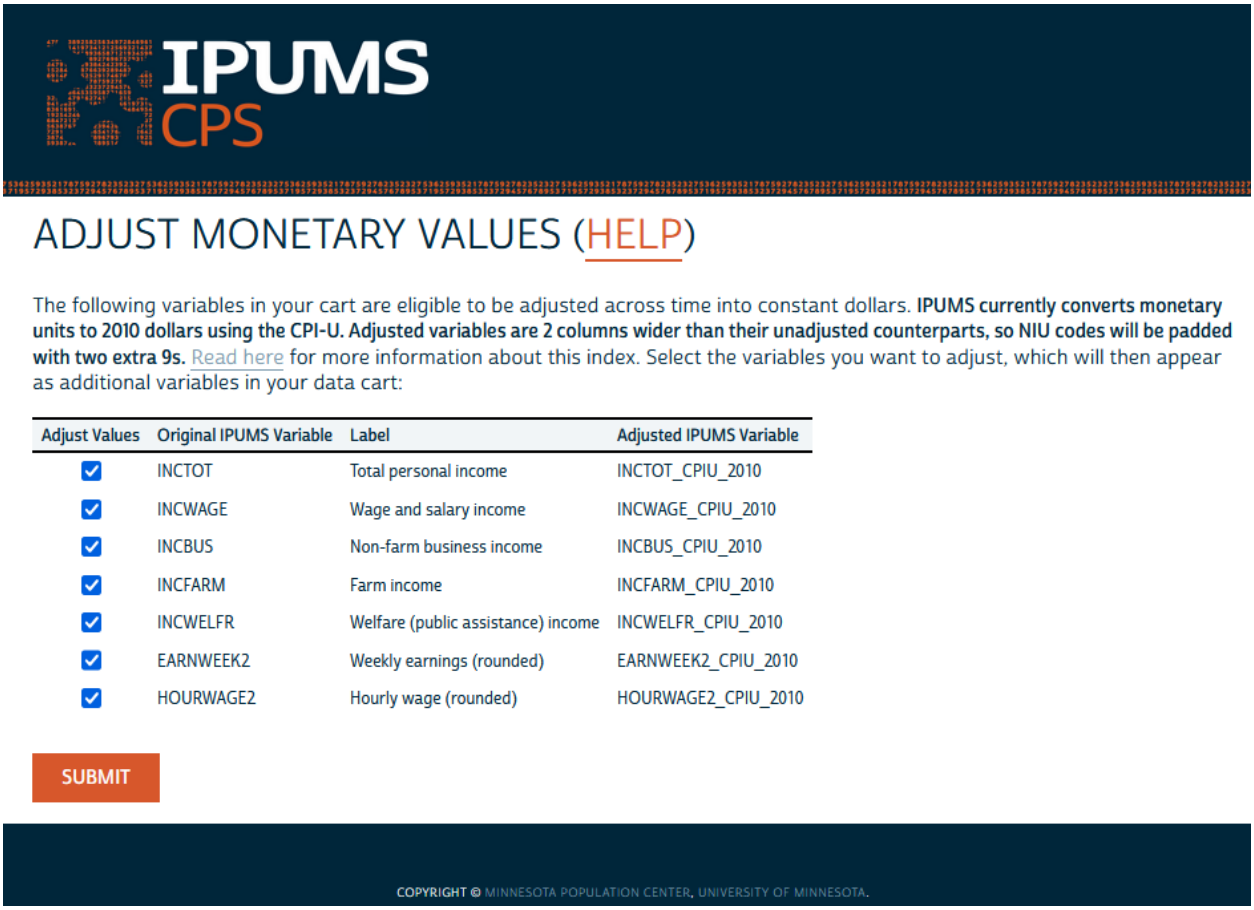
The IPUMS data access model allows users to build customized datasets by selecting the variables and samples to include in their dataset using our web-based data dissemination system. The AMV feature is a new option in that system. Users first select the samples and variables of interest to include in their customized dataset. Before submitting the specifications for their customized dataset, users may specify additional customizations on the Extract Request page. This page, shown in Figure 1, includes an option to “Adjust Monetary Values.”

Figure 1: Extract Request Page



This option cannot be selected if a user's customization specifications do not include any eligible variables or samples. The Adjust Monetary Values page, shown in Figure 2, will display a list of all variables included in the user's customized dataset that are eligible for monetary adjustment; users can choose to include adjusted versions of one or more variables in this list.

Figure 2. Adjust Monetary Values Selection Page



For each variable selected for adjustment on the Adjust Monetary Values page, IPUMS adds a new variable to the user's customized dataset. The new variable will append the index and target year (e.g., "CPIU_2010") to the harmonized IPUMS variable name. Both the original version and the adjusted version of the variable will be included in the dataset. This naming convention makes it easy to identify the original IPUMS variable and associate it with the

adjusted variable, so researchers can investigate our adjustments and easily identify the appropriate documentation for the variable. After selecting the variables to adjust, users submit their customized dataset for IPUMS to produce, then download the corresponding data file, codebook, and, if applicable, syntax files. Once users open their data file in their statistical software, they can immediately compare dollar values across time without needing to first manually adjust these values for inflation.

Adapting Inflation Adjustment Infrastructure for Currency Conversion

Cross-national income data are difficult to compare directly due to differences in both national price levels (inflation) and currency values. To make meaningful comparisons across countries and time, IPUMS International created a multiplier that adjusts national income data to reflect both:

1. Cumulative inflation from the income year to a base year (2000), normalizing for changes in domestic price levels.
2. Exchange rate movements, adjusting the inflation-normalized income to a common currency (USD) for the base year.

This approach is inspired by established economic principles in international comparisons detailed by Deaton and Heston [8] and survey harmonization practices used in cross-national databases like LIS and IPUMS [9]. Similar issues are discussed on the International Labour Organization’s ILOSTAT PRICES database website [10]. The approach builds on the IPUMS "Adjust Monetary Values" tool used by IPUMS USA and IPUMS CPS, and follows a similar logic. Whereas the U.S.-based feature uses CPI-U data from the BLS to adjust U.S. dollar values across time, this international version applies the same principle to harmonize monetary

data across both time and currencies. Users should exercise appropriate caution in their analyses using adjusted values, noting that global measures generalize both annual inflation and currency conversion and yield crude results.

Method and Data Sources

The monetary value adjustment is conducted in two steps: 1) apply cumulative country-specific inflation rates to the national currency, bringing currencies of all selected countries to a common target year; then 2) use currency conversion rates to change country-specific currency in the target year to U.S. dollars. Currently, the tool converts all selected monetary variables to USD 2000. We construct the adjustment multiplier from publicly available sources: annual average change in consumer price index (inflation) values from the International Monetary Fund (IMF) [11] and official exchange rates from the World Bank [12]. The consumer price index (CPI) measures the relative price of a basket of goods and services over time within each country. Inflation rates capture these changes. Official exchange rates provide information about annual averaged rates of conversion from one national currency to another. The resulting adjustment expresses monetary values (such as income) across all countries to a single, common metric: year 2000 USD.

The decision to use the year 2000 as the default base year for the international income standardization multiplier is grounded in both methodological rigor and practical advantages. The year 2000 marks a period of relative global stability, occurring between major financial crises, and coincides with the introduction of the euro and the expanded availability of harmonized economic data from international institutions such as the IMF and the World Bank. Additionally, it serves as a temporal midpoint for many data series available through IPUMS International, minimizing distortions caused by extreme inflation or deflation adjustments. This choice facilitates consistency, comparability, and interpretability across countries and years.

Nonetheless, we recognize that research needs vary, and IPUMS International is actively working to make it possible for users to select alternative base years to tailor the adjustment factor to their specific analytical needs.

Data Availability

Because final inflation and exchange rate figures are often released with a lag, currency conversion is not available for country-year samples beyond the most recently available year in the source data from IMF and the World Bank. Since census microdata is typically shared with IPUMS only after a country has released all its official reports, conversion is usually possible by the time a sample is made available by IPUMS International. However, if a dataset includes years beyond this cutoff, adjusted income values for those future years will contain only the uniform missing code (a series of nines) as described above. Adjustments are computed using full-year CPI data; the tool is updated annually as new values become available.

Users interested in producing fully harmonized and comparable income measures across time and space should use this feature in conjunction with other IPUMS harmonization tools. Standardized monetary values derived from the currency conversion tool are available for income and monetary variables in the international harmonized census microdata; they are particularly useful for analyses that involve cross-national inequality, poverty rates, or income growth.

Conclusion

IPUMS built the Adjust Monetary Values feature to save researchers time and effort by allowing them to include constant monetary values in their customized IPUMS datasets. This feature eliminates redundant effort across researchers and increases reproducibility of research using

monetary values by using an identical target currency and year, index, and adjustment factor to standardize monetary variables. The feature is metadata-driven, making it easy for IPUMS to maintain and extend, and reducing the opportunity for errors. Currently, the feature allows IPUMS USA and IPUMS CPS users to convert eligible variables to 2010 dollars using the CPI-U and IPUMS International users to standardize inflation-adjusted currencies to 2000 USD. Future possibilities for AMV include making additional variables eligible for monetary adjustment, allowing users to specify the target year, and offering additional pricing indexes as well as extending this functionality to other IPUMS data collections.

References

1. United States Census Bureau. What We Do [Webpage]. Washington, DC: United States Census Bureau, 2024 [cited 2025 June 24]. Available from: https://www.census.gov/about/what.html
2. United States Centers for Disease Control and Prevention, National Center for Health Statistics. NCHS Mission and Vision [Webpage]. Hyattsville, MD: National Center for Health Statistics, 2025 [cited 2025 June 24]. Available from: https://www.cdc.gov/nchs/about/mission.html
3. United States Bureau of Labor Statistics. Consumer Price Index Frequently Asked Questions [Webpage]. Washington, DC: United States Bureau of Labor Statistics, 2025 [cited 2025 June 24]. Available from: https://www.bls.gov/cpi/questions-and-answers.htm
4. United States Bureau of Labor Statistics. Consumer Price Index [Website]. Washington, DC: United States Bureau of Labor Statistics, 2024 [cited 2025 June 24]. Available from: https://www.bls.gov/cpi/overview.htm
5. United States Bureau of Labor Statistics Handbook of Methods. Consumer Price Index History [Webpage]. Washington, DC: United States Bureau of Labor Statistics, 2025 [cited 2025 June 24]. Available from: https://www.bls.gov/opub/hom/cpi/history.htm
6. Officer LH, Williamson SH. The Annual Consumer Price Index for the United States, 1774-Present [Dataset, Website]. MeasuringWorth, 2025 [cited 2025 June 24]. Available from https://www.measuringworth.com/
7. United States Bureau of Labor Statistics. Consumer Price Index Supplemental Files [Webpage]. Washington, DC: United States Bureau of Labor Statistics, 2025 [cited 2025 June 24]. Available from: https://www.bls.gov/cpi/tables/supplemental-files/home.htm
8. Deaton, Angus and Heston, Alan. 2010. "Understanding PPPs and PPP-based national accounts." American Economic Journal: Macroeconomics, 2(4): 1–35.
9. Atkinson, A. B., Rainwater, L., & Smeeding, T. M. (1995). Income Distribution in OECD Countries: Evidence from the Luxembourg Income Study (LIS).
10. International Labour Organization. 2025. Prices, Costs and Currency Conversions (PRICES database) [Database]. Geneva: International Labour Organization. [cited 2025 July 20]. Available from: https://ilostat.ilo.org/methods/concepts-and-definitions/description-prices-indicators/
11. International Monetary Fund. Consumer Price Index [Dataset, Webpage]. Washington, DC: International Monetary Fund, 2025 [cited 2025 September 10]. Available from: https://data.imf.org/en/datasets/IMF.STA:CPI
12. World Bank Group. Official exchange rate [Database, Webpage]. Washington, DC: World Bank Group, 2025 [cited 2025 September 10]. Available from: https://data.worldbank.org/indicator/PA.NUS.FCRF