Investment Price Index (IPI) Methodology Note

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This document specifies the construction of the Investment Price Index (IPI), a monthly chain Fisher price index designed to measure asset price inflation for a representative household investment portfolio in the United States. It also defines auxiliary diagnostics (deviation from monetary aggregates, rolling correlations) used for interpretation. The reference implementation is the Excel workbook IPI.xlsx.
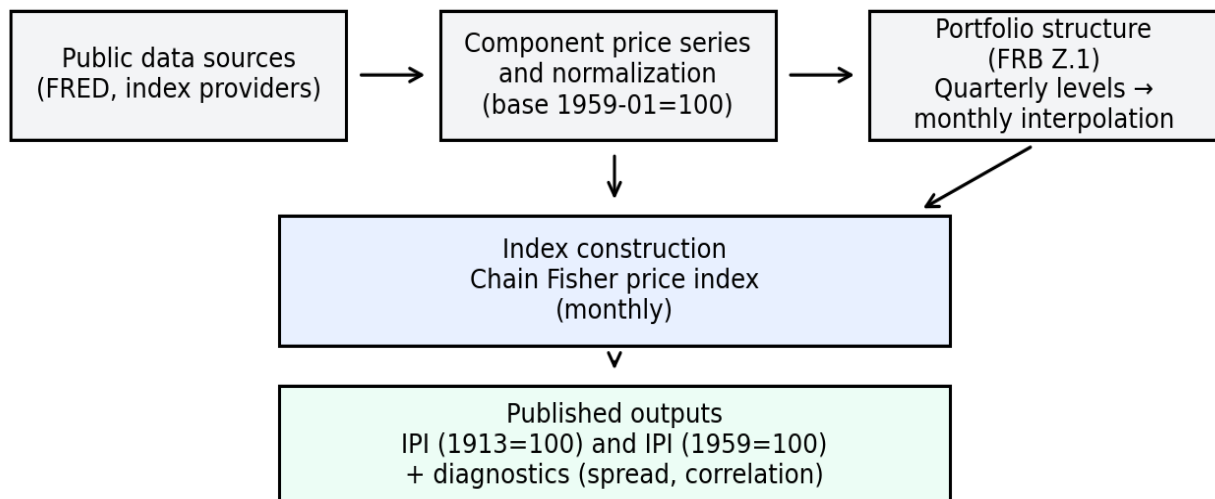

Figure 1. Data-to-index pipeline used by the IPI reference implementation.

Contents

1. Concept and definitions

Investment Price Index (IPI) is a monthly price index intended to measure changes in the price level of a representative basket of investment assets. The index is constructed as a chain Fisher price index with time-varying weights that reflect the composition of investment assets held by U.S. households (including nonprofit organizations) as reported in the Federal Reserve's Financial Accounts (Z.1).

Throughout this document: Index level refers to the published IPI series (e.g., 1959-01 = 100 or 1913-01 = 100). Investment price inflation refers to the rate of change in the index (e.g., year-over-year log change).

$$\pi^{IPI}_{t, YoY} = \ln(IPI_t) - \ln(IPI_{t-12})$$

Equation 1. Example definition of year-over-year investment price inflation (log-change).

Important: the IPI is a price index. It aims to quantify changes in the cost of acquiring a representative portfolio of investment assets, not the total return earned by holding that portfolio. Where necessary (e.g., cash and fixed-income instruments), the reference dataset uses synthetic price proxies derived from widely available yield series in a replicable manner (Section 3).

2. Scope: asset universe and what the index measures

The baseline IPI uses four broad asset blocks that jointly represent a large fraction of household balance sheet investment assets and for which long historical data are available:

Block	Label in IPI.xlsx	Interpretation
1	Real Estate	Residential real-estate price proxy; portfolio exposure via household real estate holdings.
2	Stocks & Business	Corporate equities, mutual fund shares, and proprietors' equity in noncorporate business.
3	T-Bills & Cash	Cash and near-cash instruments (e.g., checkable deposits, money market funds, short-term paper).
4	T-Notes & deposits	Longer-duration and credit-like instruments (bonds, deposits, mortgages); priced via a long-term government bond proxy.

The choice of blocks reflects a trade-off between coverage, interpretability, and the availability of long historical time series. Other asset classes are not part of the baseline index in this version.

The IPI is designed for diagnostic and analytical use (historical asset price inflation/deflation, comparison with monetary and credit indicators). It is not intended to be a mechanical trading rule.

3. Data sources and transformations

The IPI reference dataset (IPI.xlsx) consolidates publicly available data for asset price proxies and for portfolio structure. Where possible, the workbook stores source links (e.g., FRED series IDs).

3.1. Monthly price proxies

Let $p_{i,t}$ denote the price proxy index for asset block i at month t. In the reference implementation, the four component indices are normalized so that 1959-01 = 100 (columns M–P in the IPI sheet). These normalized series are used directly in the Fisher index construction.

Cash proxy (short-term government securities)

Cash and short-term government securities are represented by a rolling cash index constructed from the 3-month Treasury bill secondary market yield, y^{3m}_t (decimal). In the baseline specification, the monthly return approximation uses the previous month's yield:

$$p^{cash}_t = p^{cash}_{t-1}\left(1 + \frac{y^{3m}_{t-1}}{12}\right)$$

Equation 2. Cash proxy index update (baseline monthly approximation).

Long-term government bond proxy

Long-term government securities are represented by a synthetic constant-maturity bond price proxy derived from the 10-year Treasury constant maturity yield y^{10y}_t (decimal). The baseline implementation uses a duration-based approximation:

$$p^{bond}_t = p^{bond}_{t-1}\left(1 + \frac{y^{10y}_{t-1}}{12} - D\left(y^{10y}_t - y^{10y}_{t-1}\right)\right)$$

Equation 3. Long-term government bond price proxy update. D is an effective duration parameter (years). In practice, D is set to a constant close to 10 for a 10-year constant-maturity note.

3.2. Normalization

Each component price proxy is normalized to a common base month (1959-01): $p^*_{i,t} = 100 \cdot p_{i,t} / p_{i,1959\text{-}01}$. All core normalized series in columns K–R and the published IPI series in column S use this convention.

4. Portfolio structure and weights (FRB Z.1)

The IPI uses time-varying portfolio weights derived from the Federal Reserve's Financial Accounts (Z.1). Household and nonprofit organization balance sheet asset levels are aggregated into the four IPI blocks and converted into monthly weights.

4.1. Quarterly levels and monthly interpolation

Let $V_{i,q}$ denote the reported level (current dollars) of asset block i at quarter-end q. Because Z.1 balance sheet levels are quarterly, the reference implementation constructs monthly levels $V_{i,t}$ by linear interpolation between adjacent quarter-end observations. For months beyond the last available quarter, the latest quarter-end levels are carried forward until a new Z.1 release becomes available.

4.2. Weight definition

Monthly portfolio weights are computed from interpolated levels:

$$w_{i,t} = \frac{V_{i,t}}{\sum_{j=1}^{n} V_{j,t}}, \qquad \sum_{i=1}^{n} w_{i,t} = 1$$

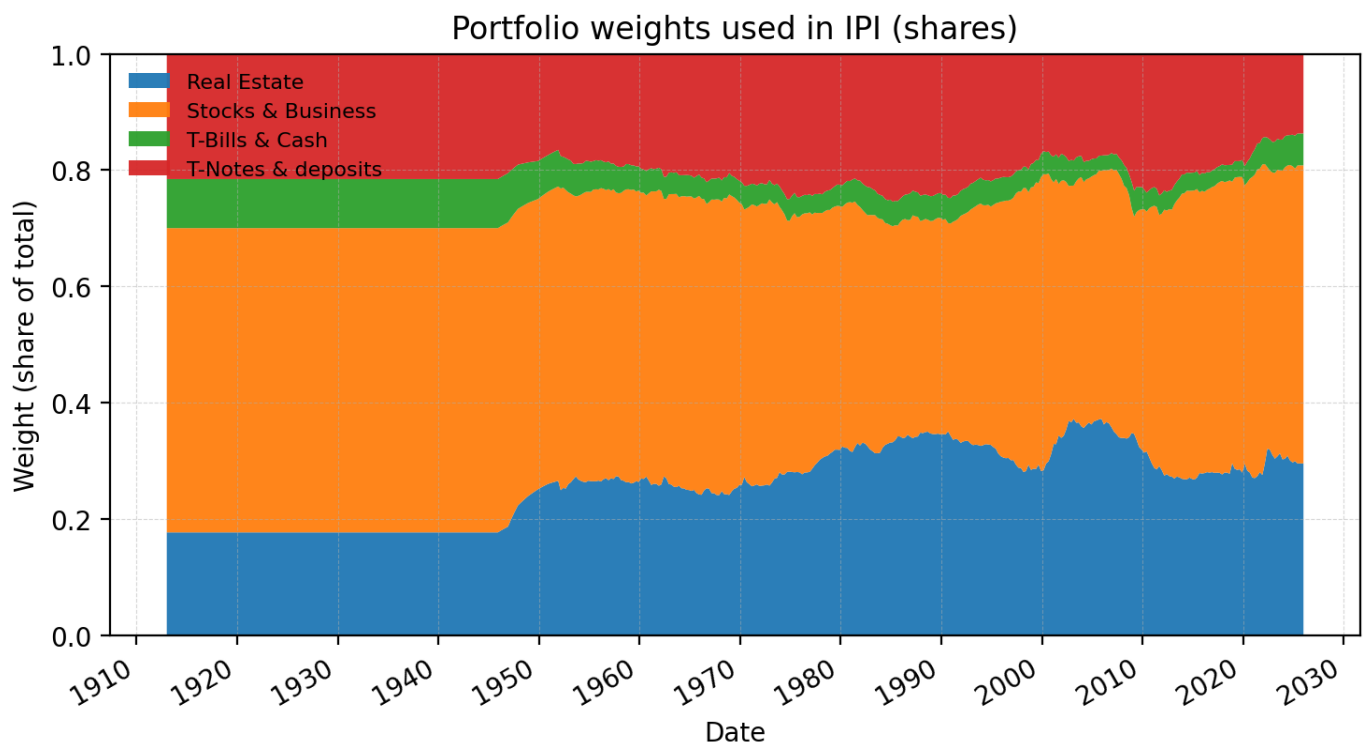Equation 4. Portfolio weights (dimensionless shares).

Figure 2. Time-varying portfolio weights used by the IPI reference dataset.

5. Index construction: chain Fisher methodology

The IPI is constructed as a monthly chain Fisher price index. The Fisher index is the geometric mean of the Laspeyres and Paasche indices. The reference implementation uses an exponential/log form for numerical stability and to accommodate time-varying weights.

5.1. Chain Laspeyres and chain Paasche

Define price relatives $g_{i,t} = p_{i,t}/p_{i,t-1}$. The chain components are updated as:

$$P_t^L = P_{t-1}^L \cdot \exp\left(\sum_{i=1}^{n} w_{i,t-1} \ln \frac{p_{i,t}}{p_{i,t-1}} \right)$$

$$P_t^P = P_{t-1}^P \cdot \exp\left(\sum_{i=1}^{n} w_{i,t} \ln \frac{p_{i,t}}{p_{i,t-1}} \right)$$

Equations 5–6. Chain Laspeyres and chain Paasche components.

5.2. Fisher aggregation

The Fisher index is the geometric mean of the two components:

$$IPI_t = \sqrt{P_t^L \cdot P_t^P}$$

Equation 7. Chain Fisher aggregation used for IPI.

The index is initialized at a base date t_0 with $IPI_{t0} = 100$ and then chain-linked forward. In the reference dataset, the headline long-run series uses t_0 = 1913-01 (column T).

6. Normalization, publication series, and derived indicators

The reference workbook publishes two primary IPI series:

Series	Column	Base	Purpose
IPI (1959=100)	S	1959-01 = 100	Convenient comparison with other macro indices normalized to 1959 in the workbook.
IPI (1913=100)	T	1913-01 = 100	Long-run headline series; historical perspective.

6.1. Real vs nominal variants

A CPI-deflated (real) version can be defined as Real IPI_t = 100 · IPI_t / CPI_t when both indices share a common base.

6.2. Monetary deviation diagnostics

Diagnostics compare IPI to monetary aggregates such as the monetary base or currency in circulation. These diagnostics are not part of the index definition.

$$Spread_t = \ln(IPI_t) - \ln(MB_t)$$

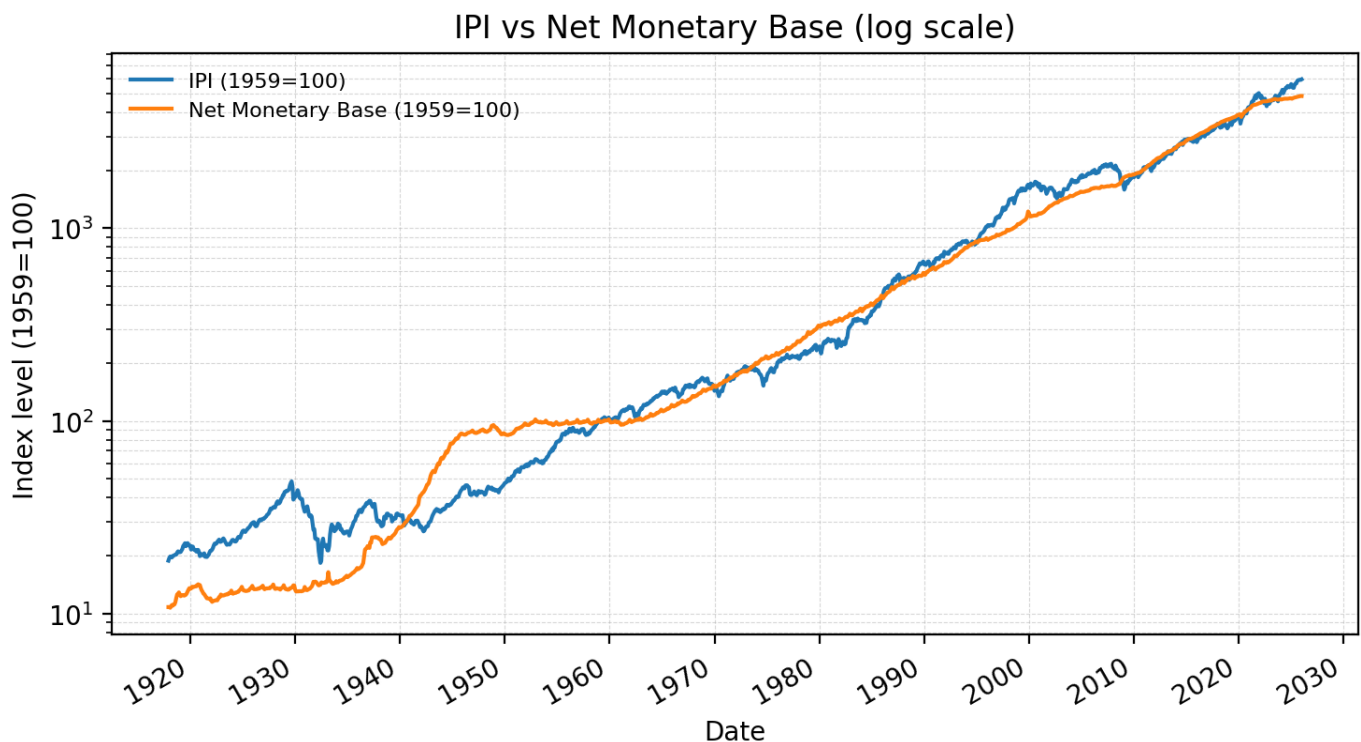Equation 8. Example deviation measure (log spread).

Figure 3. Example diagnostic plot: IPI vs Net Monetary Base (both 1959=100).

Rolling correlations are best computed on changes (e.g., log changes) rather than levels to reduce spurious correlation from shared trends.

7. Data quality, updates, and revision policy

The IPI is designed to be reproducible. All inputs are drawn from publicly available data sources, and the index construction is fully specified in this document and implemented in the reference workbook.

7.1. Missing data and quality checks

A valid monthly observation requires (i) a valid date, (ii) non-missing component price proxies, and (iii) non-missing weights (or underlying portfolio levels).

7.2. Update cadence: monthly market data updates are straightforward; portfolio structure updates depend on the Z.1 release schedule. A public website should store dataset versions to keep past publications auditable.

7.3. Revisions: GDP and Z.1 levels may be revised by providers. Recommended policy: publish latest-vintage values, maintain version history, and document material revisions.

8. Limitations and appropriate use

The IPI provides a systematic measure of investment-asset price inflation, but it has limitations:

• Proxy risk: each block is represented by a price proxy; alternative proxies may yield different results.
• Coverage: the basket does not cover all investable assets.
• Portfolio definition: weights represent household balance sheet composition; the index is not a tradable portfolio.
• Non-stationarity: level comparisons with monetary aggregates can be dominated by trends; interpret spreads/correlations with care.
• Not a trading rule: diagnostics are informative but not deterministic buy/sell signals.

The IPI can be useful for historical diagnostics of speculative booms and busts, comparison of asset price inflation to consumer inflation, and documentation of long-run relationships between monetary conditions and asset prices.

References

• Board of Governors of the Federal Reserve System. Financial Accounts of the United States (Z.1).

• Federal Reserve Bank of St. Louis (FRED). Series used in the reference workbook are listed in Appendix B.

• ILO, IMF, OECD, Eurostat, UNECE, World Bank. (2004). Consumer Price Index Manual: Theory and Practice.

Appendix A. Data dictionary for IPI.xlsx

This appendix documents the key columns used for automated ingestion and replication. Definitions are intentionally concise; the workbook itself contains additional helper columns and links to sources.

A.1. Main published series

Column	Field	Definition (concise)	Units / base
B	Date	Monthly observation date (first day of month).	Date
K	US GDP, $ bln	GDP index normalized to 1959-01 = 100 (diagnostic series).	Index (1959=100)
L	CPI	CPI index normalized to 1959-01 = 100 (diagnostic series).	Index (1959=100)
M	Real Estate	Real-estate price proxy index normalized to 1959-01 = 100.	Index (1959=100)
N	Stocks (S&P; 500)	Equity price proxy (S&P; 500 price, not total return) normalized to 1959-01 = 100.	Index (1959=100)
O	T-Bills & cash	Cash/short-term proxy index normalized to 1959-01 = 100.	Index (1959=100)
P	T-Bonds	Long-term government bond price proxy index normalized to 1959-01 = 100.	Index (1959=100)
R	Net Monetary Base	Net monetary base index normalized to 1959-01 = 100 (diagnostic series).	Index (1959=100)
S	IPI	Published IPI normalized to 1959-01 = 100.	Index (1959=100)
T	IPI 1913 = 100	Published IPI normalized to 1913-01 = 100 (headline long-run series).	Index (1913=100)

A.2. Portfolio structure

Column	Field	Definition (concise)	Units
AH	Real Estate (level)	Portfolio structure: real-estate holdings level (from Z.1, interpolated to monthly).	Current dollars (source units)
AI	Stocks & Business (level)	Portfolio structure: equities + mutual funds + proprietors' equity (monthly).	Current dollars (source units)
AJ	T-Bills & Cash (level)	Portfolio structure: near-cash instruments (monthly).	Current dollars (source units)
AK	T-Notes & deposits (level)	Portfolio structure: deposits + bonds + mortgages (monthly).	Current dollars (source units)
AL–AO	Weights (shares)	Derived weights $w_{i,t} = V_{i,t} / \Sigma V_{i,t}$ for the four blocks (monthly).	Share (0–1)

A.3. Optional / auxiliary inputs

The workbook also contains optional inputs used for diagnostics or intermediate calculations (not required for the core IPI series):

- C–H: raw inputs (GDP, CPI, yields, real estate proxy, S&P; 500 level)
- E: 3M T-bill yield (cash proxy)
- F: 10Y Treasury yield (bond proxy)
- AX: currency in circulation (level)
- AY: monetary base (level)

Appendix B. Z.1 series mapping used for portfolio structure

The portfolio structure blocks are aggregated from Federal Reserve Financial Accounts (Z.1) balance sheet series, accessed via FRED. The mapping below follows the reference workbook (Structure IPI sheet).

Block	Z.1 code	FRED series ID	Series description (as in workbook)
Real Estate	LM155035015	HOOREVLMHMV	Owner-occupied real estate; asset
Stocks & Business	LM153064105	HNOCEAQ027S	Households and nonprofit organizations; corporate equities; asset
Stocks & Business	LM153064205	HNOMFAQ027S	Households and nonprofit organizations; mutual fund shares; asset
Stocks & Business	FL152090205	ENBABSHNO	Households and nonprofit organizations; proprietors' equity in noncorporate business
T-Bills & Cash	FL153034005	MMFSABSHNO	Households and nonprofit organizations; money market mutual fund shares; asset
T-Bills & Cash	FL153020005	CDCABSHNO	Households and nonprofit organizations; checkable deposits and currency; asset
T-Bills & Cash	FL163069103	NOCOPAQ027S	Nonprofit organizations; commercial paper; asset
T-Notes & deposits	FL153030005	TSDABSHNO	Households and nonprofit organizations; total time and savings deposits; asset
T-Notes & deposits	LM153061105	HNOTSAQ027S	Households and nonprofit organizations; Treasury securities; asset
T-Notes & deposits	LM153061705	AGSEBSABSHNO	Households and nonprofit organizations; agency- and GSE-backed securities; asset
T-Notes & deposits	LM153062005	MSABSHNO	Households and nonprofit organizations; municipal securities; asset
T-Notes & deposits	LM153063005	CFBABSHNO	Households and nonprofit organizations; corporate and foreign bonds; asset
T-Notes & deposits	FL153065005	MABSHNO	Households and nonprofit organizations; total mortgages; asset
Excluded (pension entitlements)		HNOPFAQ027S	Households and nonprofit organizations; pension entitlements; asset

Component series are summed into four block totals at quarterly frequency, then interpolated to monthly frequency and converted into weights (Equation 4).

Appendix C. Replication pseudocode

High-level pseudocode for reproducing the chain Fisher construction (using normalized component indices and monthly weights):

```
Inputs:
  - Monthly dates t = 1..T
  - Normalized price proxies p[i,t] for i in {RealEstate, StocksBusiness, TBillCash, TNoteDeposits}
  - Monthly weights w[i,t] that sum to 1

Initialize:
  IPI_1913[t0] = 100
  PL[t0] = 100
  PP[t0] = 100

For each month t = t0+1 .. T:
  For each block i:
    g[i] = p[i,t] / p[i,t-1]

  PL[t] = PL[t-1] * exp( sum_i w[i,t-1] * ln(g[i]) )
  PP[t] = PP[t-1] * exp( sum_i w[i,t]   * ln(g[i]) )

  IPI_1913[t] = sqrt( PL[t] * PP[t] )

Rebase (optional):
  IPI_1959[t] = 100 * IPI_1913[t] / IPI_1913[1959-01]
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End of document.