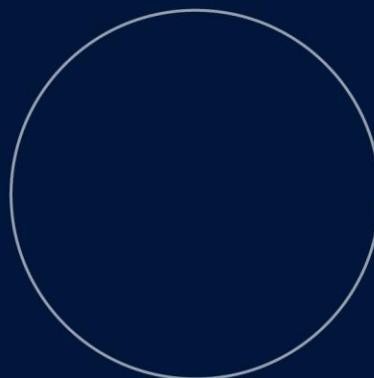




Central Bank
of Armenia

METHODOLOGY DESCRIPTION

RESIDENTIAL PROPERTY PRICE INDEX



INTRODUCTION

The Residential Property Price Index (RPPI) is a key economic indicator that captures changes in residential property prices in Armenia. It serves as a reference for assessing housing market trends with implications for financial stability, thereby supporting the monetary policy objectives of the Central Bank of Armenia (CBA). The RPPI provides information to a wide range of users, including policymakers, investors, analysts, appraisers, and the general public. The RPPI aims to provide reliable information on house price trends across different segments and regions.

The main objective of the RPPI is to accurately reflect the average price changes by adjusting for quality changes among the transacted properties. The RPPI for Armenia is based on the registered property transactions collected by the Cadastre Committee of the Republic of Armenia (CCRA). The CBA compiles the RPPI quarterly to ensure users have timely and frequent updates on the residential property market, divided into separate strata for more granularity. By improving transparency in the property market, the RPPI aids informed decision-making in both the public and private sectors.

DATA

Data source

The data source for the RPPI is the official transaction records from the Cadastre Committee of the Republic of Armenia (CCRA). The CCRA's transaction database contains full coverage of all registered changes in property ownership in Armenia. In addition to the transaction date and price expressed in Armenian Dram (AMD), the dataset includes a rich set of explanatory variables that describe each transaction in detail. In particular, each transaction is described by its locational and property-specific characteristics.

The quality characteristics used to compile the RPPI for Armenia include the following variables:

Table 1. Variables used in the RPPI

CHARACTERISTIC	DESCRIPTION
PROPERTY TYPE	Apartment or house
FLOOR AREA	The total floor area in square meters
LAND AREA	The plot size in square meters (for houses)
BUILT YEAR	The year the building was completed
CONSTRUCTION MATERIAL	The construction material of the building (for apartments)
FLOOR LEVEL	The floor level of the apartment
BUILDING LEVEL	Total number of floors of the building (for apartments)
REGION	Marz in which the property is located
ZONE	The zone level from one to twenty

Note. Zone levels correspond to the approximated market valuation for real estate taxation.
See: <http://parliament.am/legislation.php?sel=show&ID=6808&lang=arm>

Data entry errors and non-market transactions

The price index for residential properties focuses exclusively on market transactions. Identifying and eliminating non-market transactions and data entry errors in the index construction process is essential to produce an index that accurately reflects market trends and is not distorted by incorrect data. Data entry errors are identified by setting region- and property-specific boundaries for total price, price per square meter, and total floor area.

Table 2. Current thresholds for data entry errors and deviations

Variable	Region / Property type	Min	Max
Price	All	1,500,000 AMD	600,000,000 AMD
Floor area	Apartments in Yerevan	20 m2	500 m2
Floor area	Apartments outside Yerevan	20 m2	300 m2
Floor area	Houses Yerevan	40 m2	700 m2
Floor area	Houses outside Yerevan	40 m2	900 m2
Price per square meter	Yerevan	50,000 AMD	5,000,000 AMD
Price per square meter	Outside Yerevan	15,000 AMD	1,000,000 AMD
Land area	Houses	40 m2	15,000 m2

Transactions that fall outside the boundaries presented in table 2 are considered erroneous and are removed from the dataset. The data after deletion of erroneous observations are the source for computing the weights, that is further explained in section 'Aggregation', as well as for all additional indicators that are computing along the RPPI (see section 'Additional Indicators').

Data imputation

If apartments have missing entries for some characteristics, data are imputed from historical transactions. In case there has been a transaction within the same building, and if the missing information is available for one of these transactions, then the missing values are imputed (filled up). The mode is used for imputation for cases where multiple values from past transaction areas are available. Building specific variables in the dataset are: built year, building level, zone, and construction material. Apartment specific variables, such as floor area, are not imputed with historical data.

Data cleaning

The CBA uses Cook's distance to identify unusual transactions in the data set before calculating the index. This technique is based on a statistical method for identifying and eliminating influential outliers characterized by unusually high or low values in prices or their attributes. If left undetected, these influential data entries might distort the index. A regression model, similar to that described in the Methodology section, is estimated separately for each period, and Cook's Distance is calculated for each observation. Observations with high Cook's Distance

values indicate transactions that disproportionately influence the regression model. The threshold for removing these extreme values is four divided by the number of observations.

METHODOLOGY

Hedonic Price Index

Changes in property prices over time can also be influenced by many other factors, from location to physical characteristics such as year of construction and floor area. To accurately measure the price trend, it is important to isolate the impact of these characteristics and ensure that the RPPI reflects price changes over time rather than changes in property characteristics. The hedonic time dummy method estimates the impact of each characteristic on price. These estimates allow to separate the changes in the composition of property transactions over time from the pure time effect on prices. Thus, it keeps the quality of property transactions constant over time.

The RPPI is calculated using the following regression model in matrix notation:

$$\ln(p_{\tau}) = \beta_{\tau} X_{\tau} + \delta_{\tau} D_{\tau} + \varepsilon_{\tau} \quad (1)$$

where:

τ indicates a window containing multiple periods (e.g. four quarters)

$\ln(p_{\tau})$ is a vector of log-transformed transaction prices containing all transactions within a window of time periods.

X_{τ} is a matrix of explanatory variables representing property characteristics, such as location and floor area, for each transaction in τ . The dimension of X_{τ} is equal to the number of property transactions in window τ times the number of property characteristics.

β_{τ} is a vector of coefficients for each characteristic in X_{τ} .

D_{τ} is a matrix of time dummy variables that has a value equal to one, if the transaction is transacted in period t , and zero otherwise. Hence, the dimension of D_{τ} equals the number of observations in window τ times the number of time periods (quarters) in τ .

δ_{τ} is the window specific vector of time dummy coefficients, and

ε_{τ} denotes the vector of error terms.

In equation (1), the constant is omitted for readability reasons.

The hedonic time dummy method has the advantage of pooling transactions over several periods (four quarters) and allowing the regression model to consider changes in the impact of property characteristics on price over time.

For example, the RPPI for apartments is calculated with a window of four quarters; hence, the window length (τ) is four. In this case, a separate regression model is run for each window in which the shadow prices of the characteristics are estimated. Table 3 below illustrates this concept for the period 2018Q1 to 2019Q2.

Table 3. Example of Rolling Window

2018Q1	2018Q2	2018Q3	2018Q4		
	2018Q2	2018Q3	2018Q4	2019Q1	
		2018Q3	2018Q4	2019Q1	2019Q2

Only the time dummy coefficients are used for the index compilation. The index is constructed by taking the exponential of the time coefficient from the initial time window (first row in bold), which serves as the base value. For each subsequent period, the index value is updated by multiplying it by the ratio of the time coefficients from the current period t and previous period $t-1$, capturing the relative change between periods, as shown in Equation (2).

$$P_t = \frac{\exp(\delta_t)}{\exp(\delta_{t-1})} * P_{t-1} , \quad (2)$$

where P_t is the price index of the period t , and $\exp(\delta_t)$ is the exponentiated coefficient for period t . The ratio of the exponent of the last two quarters are then multiplied by the previous index value.

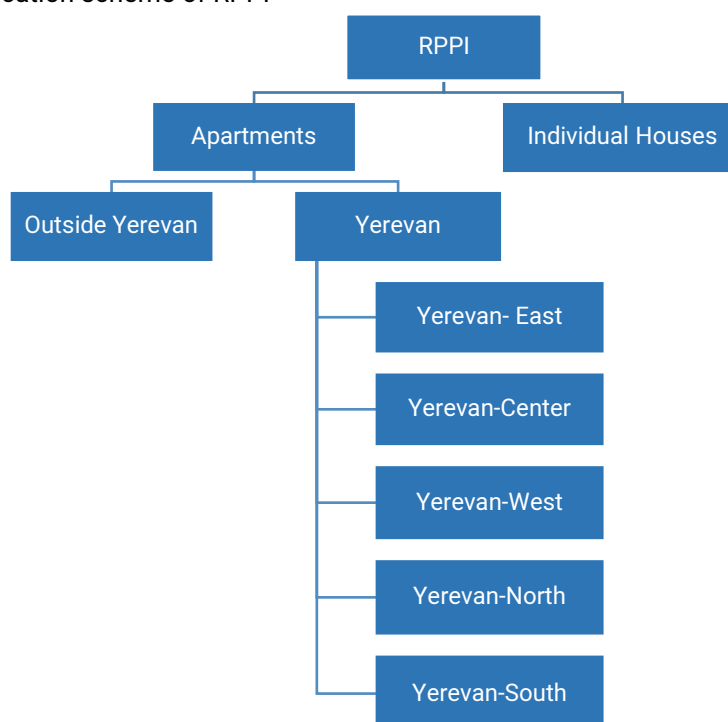
Because the explanatory property characteristics are included in the regression model (Equation (1)), the index captures the adjusted price change, representing the average movement of residential property prices while accounting for quality differences across properties in the sample.

AGGREGATION

Stratification

To provide more detailed information on the development of the Armenian housing market, elementary indices are constructed and then aggregated into a national index. The elementary indices cover apartments and houses as well as regional strata. This approach allows the RPPI to capture the price dynamics specific to each segment. The aggregation of these elementary indices is weighted by their expenditure weights to reflect each segment's market share. This ensures that the overall RPPI is representative of the overall market composition in Armenia. Figure 1 illustrates the stratification scheme for the RPPI in Armenia.

Figure 1. Stratification scheme of RPPI



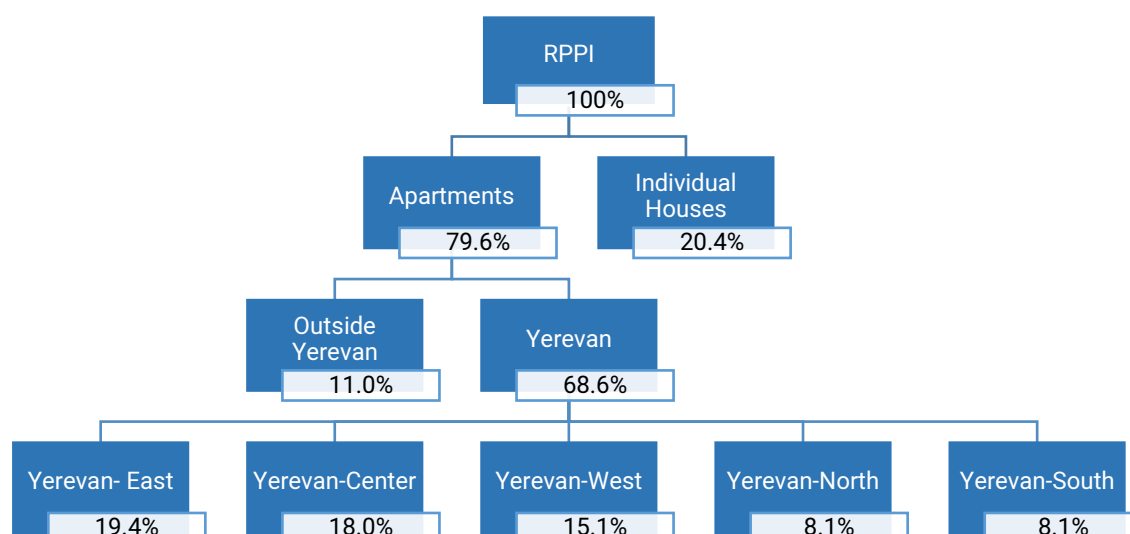
Note. See Appendix A for the spatial distribution of Yerevan sub-strata.

For houses, the index is currently experimental and therefore subject to revision. Once more explanatory characteristics for houses are available, a more disaggregated stratification will also be compiled for houses.

The expenditure weights are based on transaction value relative to stock value. This ensures that the impact of each stratum in the index reflects its current economic importance. The weights are updated annually (based on the previous year) to reflect changes in property demand and thus offer a more timely representation of the current composition of the housing market.

Figure 2 depicts the contribution of each elementary index to the total RPPI for Armenia for 2025.

Figure 2. Weights for 2025



Aggregation to the national RPPI

After stratification and calculating elementary indices, the CBA produces a national RPPI by aggregating the weighted sub-indices for apartments and houses.

For the aggregation, a Laspeyres-type formula is used:

$$I^{0Q4,t} = \sum_{i=1}^n \omega_i^0 * P_i^{0Q4,t}, \quad (3)$$

where:

$I^{0Q4,t}$ is the unchained index link measuring the national residential property price change from the last quarter (Q4) of the previous year (time period 0) to quarter t, expressed as an index with Q4 of the previous year = 100

ω_i^0 is the expenditure weight of stratum i , based on the previous year's transaction values, with $\sum_{i=1}^n \omega_i^0 = 1$

$P_i^{0Q4,t}$ is the price index of stratum i from the last quarter (Q4) of the previous year to quarter t (Q4 of the previous year = 100)

In order to derive the index value for quarter t, the aggregated change since the last quarter of the previous year needs to be chained:

$$RPPI_t = RPPI_{0Q4} * I^{0Q4,t},$$

where:

$RPPI_t$ is the chained RPPI in quarter t

$RPPI_{0Q4}$ is the chained RPPI of the last quarter of the previous year (0)

Reference year of the RPPI

The RPPI for Armenia will be referenced to a new base year every five years. The first base year for the index is 2018. The rolling of the base year forward to a more recent reference allows the index to be compared with a period that better reflects the current price level. Consequently, the value of the RPPI represents the percentage change in property prices since the last base year, which enables a more up-to-date interpretation of price trends.

Additional Indicators

In addition to the RPPI, the Central Bank of Armenia provides supplementary indicators for additional information on Armenia's housing market. The additional indicators aim to complement the RPPI by providing information on transaction value, and transaction volume (number of transactions).

The additional indicators published on the CBA's website are updated quarterly and are as follows:

Transaction Value

This indicator measures the total transaction value of all residential property transactions recorded in each quarter, expressed in Armenian Dram (AMD). It shows the total market liquidity within each quarter, indicating the overall level of investment activity in the housing market, covering both apartments and houses. In addition to the absolute transaction value per quarter, the indicator presents the year-on-year percentage change relative to the corresponding quarter of the previous year.

Transaction Volume

This indicator shows the number of transactions recorded in each quarter. It provides insight into the frequency of property transactions and is also presented as a percentage change relative to the same quarter of the previous year.

ABBREVIATIONS

Abbreviation	Definition
AMD	Armenian Dram
CBA	Central Bank of Armenia
CCRA	Cadastre Committee of the Republic of Armenia
RPPI	Residential Property Price Index

APPENDIX A

SPATIAL DISTRIBUTION OF YEREVAN SUB-STRATA

