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Residential Property Price Index (RPPI)

Technical manual

Tbilisi 2021

The presented technical manual is elaborated by the National Statistics Office of Georgia according to the internationally acclaimed methods and practices and is based on the following handbooks:

1. Handbook on the Residential Property Price Indices

Responsible organizations: International Labor Organization (ILO), International Monetary Fund (IMF), Organization for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE), and World Bank;

<https://ec.europa.eu/eurostat/documents/3859598/5925925/KS-RA-12-022-EN.PDF>

2. Residential Property Price Index (RPPI) Practical Compilation Guide

Responsible organization: International Monetary Fund (IMF).

<https://www.imf.org/en/Data/Statistics/RPPI-guide>

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1. INTRODUCTION

The residential property price index (RPPI) measures the price evolution for residential properties in Georgia.

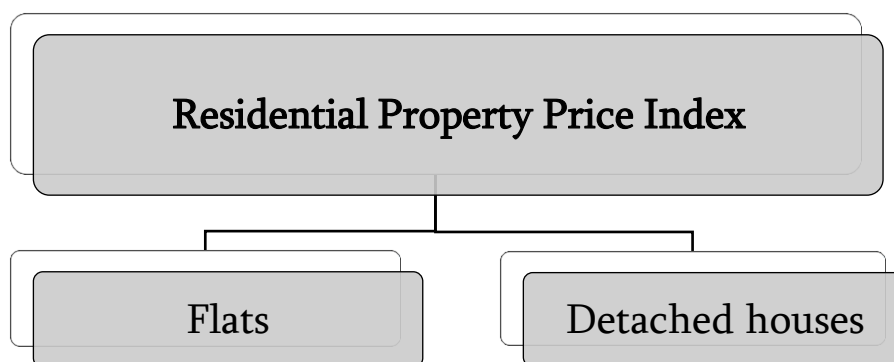
Property price indexes are used by central banks and other policy making institutions, as well as analysts, researchers and other users within and outside of the country. RPPI is used for the following purposes:

1. To assess development and risks in the real estate market;
2. To understand and evaluate the links between residential real estate markets and financial soundness.

2. INDEX COVERAGE

The coverage of the RPPI is limited to the capital city (Tbilisi) and covers only the market of new dwellings for both multi-dwelling buildings (flats) and detached houses.

Figure 1: structure of the RPPI



3. DATA SOURCES AND PRICE COLLECTION

The National Statistics Office of Georgia collects data on dwellings for sale from the real estate advertising websites to obtain the necessary microdata to allow for the compilation of the RPPI. The data is obtained automatically using web scraping for both flats and detached houses. The obtained data contains information on prices and characteristics (area, number of rooms, floor number, condition, balcony, garage, central heating, etc.) of dwellings that are advertised for sale in current period. Data is scraped at the end of each month.

The RPPI is compiled on a quarterly basis based on data for dwellings that were listed online during the current quarter.

4. VALIDATION PROCEDURES

RPPI validation procedures are conducted in two stages:

The first stage of data validation takes place at the end of current quarter, before the index compilation. At this stage, analysis of the scraped data is conducted using the R-software and includes the following operations: removing duplicates, missing data and outliers, categorization and grouping of some variables, analysis of distribution using histograms, etc.

During **the second stage** of data validation the index figures are analyzed. This includes logical control of the index levels, comparison of index series between different sub-indices and other checks.

5. WEIGHTS

Indices for flats and detached houses are aggregated into a total index for using sub-index weights. The weight of a particular sub-index is obtained by summing up the values of dwellings within the corresponding strata, which are based on the one last year announcement data from the websites. The sub-indices for flats and detached houses are then aggregated into the Total RPPI. The weights are updated annually.

6. INDEX CALCULATION

Several methods are developed internationally to compile an RPPI¹. National Statistics Office of Georgia uses the so called “characteristics hedonic approach”. According to the approach, an RPPI measures the price evolution of a “typical” dwelling. This “typical” dwelling is estimated by averaging the key characteristics of all the properties in a stratum for a price reference period. The price reference period for the current year is the 4th quarter of the previous year.

The key characteristics of the dwellings are needed to assure that price index reflects only the price change of a dwellings and not a change in one of its characteristics (quality change). For property price indexes this is particularly challenging since the same dwelling, generally, is only sold once every couple of years (sometimes every couple of decades) unlike other price indices where the same product is always available on the market. Given the infrequent sales and the heterogeneity of residential properties, quality adjustment techniques are required to derive

¹ For more details, please refer to the Handbook on the Residential Property Price Indices: <https://ec.europa.eu/eurostat/documents/3859598/5925925/KS-RA-12-022-EN.PDF>

measures of a pure price change. This means that the quality of the RPPI relies heavily on data on detailed price-determining characteristics of each property.

6.1 Specification of the Characteristics Hedonic Model

To adjust for the quality change of dwellings from quarter to quarter a “characteristics hedonic method” is used. As stated above, this method measures the price evolution of a “typical” dwelling. A log-linear econometric specification is used to ensure the constant quality for each stratum and the regression is estimated using ordinary least squares. A “shadow” price is then estimated for each variable (characteristic of a dwelling) based on the regression. The “shadow price” corresponds to the “contribution” of each characteristic in the total dwelling price. For example, the sum of the "shadow prices" of the average characteristics estimated in the reference quarter reflects the total value of the "typical" dwelling in the reference quarter. The "shadow prices" are evaluated separately for each quarter. Finally, the RPPI is calculated by comparing the price of the “typical” property in the current quarter with the price of the same “typical” property in the reference quarter.

6.2 Mathematical basis of the hedonic model

The log-linear specification for each stratum is the following:

$$\ln(p_n^t) = \beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^t + \varepsilon_n^t$$

Where:

- $\ln(p)$ - logarithm of the price;
- t - period (quarter);
- n - number of dwellings in period t ;
- β_0^t - intercept in period t ;
- β_k^t - “shadow” price of characteristic k in period t ;
- z_{nk}^t – value of characteristic k in period t and for n dwellings;
- ε_n^t - random error term for period t and n dwellings.

Separate regressions are estimated on the data of the reference period (0) and the current period (t) for each stratum to obtain the estimated parameters ($\hat{\beta}$) for each quarter in a stratum. This gives, after exponentiating, the predicted prices of the dwellings, for the reference period (0):

$$\hat{p}_n^0 = \exp(\hat{\beta}_0^0) \exp \left[\sum_{k=1}^K \hat{\beta}_k^0 z_{nk}^0 \right]$$

And for the current period (t):

$$\hat{p}_n^t = \exp(\hat{\beta}_0^t) \exp \left[\sum_{k=1}^K \hat{\beta}_k^t z_{nk}^t \right]$$

The index is then compiled as the exponentiated sum of the difference between the estimated regression coefficients of the current period (t) and the reference period (0). For the characteristics parameters (β_k) the resulting differences are then multiplied by the characteristics of the typical dwelling in the reference period (\bar{z}_k^0):

$$I_t = \exp(\hat{\beta}_0^t - \hat{\beta}_0^0) \exp \left[\sum_{k=1}^K (\hat{\beta}_k^t - \hat{\beta}_k^0) \bar{z}_k^0 \right]$$

6.3 Calculation of average characteristics

The average characteristic for a numerical variable (such as area, number of rooms, etc.) is obtained by taking the mean of characteristics of all dwellings in strata. For example, such an average characteristic could be “2.2 rooms”, “55.4 m² area”, “4.3 floors”, etc.

For categorical variables (such as balcony, garage, etc.) the model uses dummy variables that take values of “1” (if the given dwelling possesses a specific characteristic) or “0” (if the dwelling does not possess this characteristic). Characteristics of the “typical dwelling” for such variables is obtained by calculating the relative frequencies of all possible options. For example, in the given period 82 percent of the total number of apartments for sale had balconies. In this case, the mean value (or mean characteristic) of the variable representing "balcony" is calculated as follows:

$$\text{average characteristic} = 0.82 \times 1 + 0.18 \times 0 = 0.82.$$

The average characteristics (\bar{z}_k^0) of a typical dwelling are updated annually.

Table 1: characteristics used for RPPI calculation in Georgia*

| Flats | Detached houses |
|--|---|
| <ul style="list-style-type: none"> • Area • Completion status (in the process of construction/newly built) • Floor number • Number of floors in the dwelling • Condition (Black frame/white frame/green frame) • Garage • Basement • Natural gas • Storeroom • Central heating | <ul style="list-style-type: none"> • Area • Condition (Black frame/white frame/green frame) • Land (garden) area • Number of rooms • Drinking water • Balcony • Garage • Basement • Natural gas • Central heating |

* The geographical location of a dwelling is used for stratification and therefore, is excluded from price-determining characteristics lists.

7. CHAINING

The average characteristics of the fourth quarter (i.e. the reference quarter) of the previous year are used to compile the index for the four quarters in the current year. The fourth quarter, therefore, acts as a link quarter for index time series (a chain). An example is given in the table below (using synthetic data).

Table 2: Chain linking

| Quarter | Typical Dwelling Index (2018Q4 =100) | Typical Dwelling Index (2019Q4 =100) | Typical Dwelling Index (2020Q4 =100) | Chained Index (2019=100) | Comment |
|---------|---|---|---|------------------------------|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 2019Q1 | 100.5 | | | 97.9 = (100.5/102.7)×100 | Each index of column "2" is divided by the column average (index reference period is changed from "2018Q4 = 100" to "2019 average = 100") |
| 2019Q2 | 101.5 | | | 98.9 = (101.5/102.7)×100 | |
| 2019Q3 | 105.4 | | | 102.7 = (105.4/102.7)×100 | |
| 2019Q4 | 103.2 | 100.0 | | 100.5 = (103.2/102.7)×100 | |
| 2020Q1 | | 99.1 | | 99.6 = 99.1 × | Each index of column "3" is |

| Quarter | Typical Dwelling Index (2018Q4 =100) | Typical Dwelling Index (2019Q4 =100) | Typical Dwelling Index (2020Q4 =100) | Chained Index (2019=100) | Comment |
|---------|---|---|---|--------------------------------|--|
| | | | | (100.5/100) | |
| 2020Q2 | | 99.5 | | 100.0 = 99.5 × (100.5/100) | multiplied by the chained index in 2019Q4 (index reference period is changed from "2019Q4 = 100" to "2019 average = 100" |
| 2020Q3 | | 101.2 | 101.7 = 101.2 × (100.5/100) | | |
| 2020Q4 | | 100.8 | 100.0 | 101.3 = 100.8 × (100.5/100) | |
| 2021Q1 | | | 100.4 | 101.7 = 100.4 × (101.3/100) | Each index of column "4" is multiplied by the chained index in 2020Q4 (index reference period is changed from "2020Q4 = 100" to "2019 average = 100" |
| 2021Q2 | | | 100.8 | 102.2 = 100.8 × (101.3/100) | |
| 2021Q3 | | | 99.8 | 101.1 = 99.8 × (101.3/100) | |
| 2021Q4 | | | 100.5 | 101.8 = 100.5 × (101.3/100) | |

8. DISSEMINATION

Every quarter, a press release for the RPPI is published through the Geostat's website (www.geostat.ge). It contains information about quarterly and annual changes of the index, as well as dynamics of index levels.

Along with the press release, different time series are published on Geostat's website every quarter:

1. The percentage changes to the previous quarter;
2. The percentage changes to the same quarter of the previous year;
3. The index levels to the long term basis (Average of 2020 = 100).

The published figures are rounded to four digits and are final. Time series data are published on the website along with the corresponding graphs.

The data are also available by using PC-Axis - data dissemination software, created by Statistics Sweden. It is a complex system of data dissemination that gives the user of statistical information an opportunity to obtain different types of information in different formats (text, tables, graphs, etc.) from Geostat's website (www.geostat.ge).

Information about RPPI is also disseminated through mobile phone app on the Android and iOS platforms.

Figure 2: Stages of calculation of the RPPI

