



REPUBLIC OF ARMENIA

TECHNICAL ASSISTANCE REPORT—RESIDENTIAL PROPERTY PRICE INDEX STATISTICS MISSION

September 2023

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TECHNICAL ASSISTANCE REPORT

REPUBLIC OF ARMENIA

Report on Residential Property Price Index
(RPPI) Mission (July 10–21, 2023)

SEPTEMBER 2023

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Table of Contents

Acronyms and Abbreviations	2
Summary of Mission Outcomes and Priority Recommendations.....	3
Section I. Detailed Technical Assessment and Recommendations.....	5
A. Introduction	6
B. Institutional arrangements and resources.....	6
C. Data sources.....	7
D. Compilation methods.....	8
E. Dissemination.....	12
F. Officials Met During the Mission.....	13
Appendices	14
Appendix A: Sample Regression Results	14
Appendix B: Stratification for Apartments in Yerevan.....	15

Acronyms and Abbreviations

ArmStat....Statistical Committee of the Republic of Armenia

CBA.....Central Bank of Armenia

CCRA.....Cadastre Committee of the Republic of Armenia

RPPI.....Residential Property Price Index

TA.....Technical Assistance

Summary of Mission Outcomes and Priority Recommendations

- 1. A technical assistance (TA) mission was conducted from July 10 to July 21, 2023, to assist the authorities in Armenia with the development of a Residential Property Price Index (RPPI).** Both the Statistical Committee of the Republic of Armenia (ArmStat) and the Central Bank of Armenia (CBA) fully participated during the mission. The mission was conducted under the auspices of the Data for Decisions (D4D) Trust Fund. A previous mission, which covered both CPI and RPPI, visited Armenia in January 2020. The following tasks were completed: (i) examined the quality of the register data from the Cadastre Committee of the Republic of Armenia (CCRA), (ii) contributed to capacity building by providing practical training on RPPI compilation, (iii) examined the institutional arrangements for the development of the RPPI, (iv) assisted with the calculation of experimental indices for apartments following international best practice, (v) advised on the dissemination strategy for the RPPI, and (vi) agreed on a workplan for the further development of the RPPI.
- 2. The authorities are strongly committed to developing a publicly available RPPI for Armenia.** Reliable property price indices and other indicators of real estate markets are essential for the assessment of developments and risks in property markets and understanding the linkages between property markets and financial soundness, as well as to IMF surveillance.
- 3. Significant progress had already been made by the CBA in developing the methods for compiling the RPPI.** The mission focused on reviewing each aspect of data compilation and making appropriate recommendations. In advance of arrival, the mission was provided with a sample of two quarters of transactions data from the register maintained by the CCRA. This allowed the mission to make some initial assessments of data quality. There was a focus on increasing the capacity and knowledge of the authorities. The mission provided practical training, using the register data from the CCRA, on the methodological approach to compiling the RPPI.
- 4. The institutional arrangements for the compilation and publication of the RPPI should be clarified.** This was first discussed during a previous mission in January 2020 and the consensus then was that the CBA should compile the index and ArmStat should publish the index. While both ArmStat and the CBA can be official compilers of statistics, it is felt that the CBA are best placed to assign resources, develop the methods, and publish the index. The CBA should assign appropriate resources for the implementation of the agreed workplan. With appropriate resources, the RPPI can be developed and published by October 2024. A Steering Group of stakeholders (CBA, ArmStat and CCRA) should meet regularly to guide the development of the RPPI.
- 5. Experimental quality-adjusted hedonic indices for apartments were compiled during the mission.** The mission recommended using the time dummy hedonic method with a four-quarter window length to compile quality-adjusted indices. The experimental indices for apartments developed during the mission – comprising six regional sub-indices, one index for Yerevan and one national index – were compared with a stratified median approach. The resulting hedonic indices contained less volatility; however, they exhibited a similar trend. Stability checks on the estimated shadow prices for each rolling window and each stratum were performed. Overall, the estimated coefficients have plausible signs and are reasonably stable over time.

6. ArmStat and CBA should request the transactions data for houses from the CCRA. The CCRA have provided transactions data for apartments to ArmStat, who also share the data with the CBA. To ensure complete coverage of the residential property market, the transactions data on houses should also be provided to ArmStat and CBA. The property characteristics information relevant for houses, such as plot size, should also be provided.

7. The CBA should develop experimental indices for houses. When the data is received from the CCRA, a similar approach can be used for houses as was used for apartments i.e. excluding non-market transactions, outlier detection, index calculation etc. However, given that different characteristics influence the price of houses, the specification of the regression model used for houses will differ from that used for apartments.

8. The authorities should develop a new statistical product to disseminate the RPPI. The authorities can publish the national RPPI and relevant sub-indices. An advance publication schedule should be published providing the dates for the upcoming releases. Users should be consulted during the process of designing the new statistical product to ensure users' needs are met. The statistical release should include descriptive statistics on the volume, value and mean/median prices of residential property transactions. Given that the CCRA dataset is a census of residential property transactions, there is a significant opportunity to supplement the publication of the price indices with information on the underlying residential property market. Users would benefit hugely from receiving this additional information.

TABLE 1. Priority Recommendations

Target Date	Priority Recommendation	Responsible Institution
Oct 31, 2023	<i>Clarify the institutional arrangements for the compilation and publication of the RPPI</i>	ArmStat & CBA
Oct 31, 2023	<i>Request the transactions data for houses from the CCRA</i>	ArmStat & CBA
Mar 31, 2024	<i>Develop experimental indices for houses</i>	CBA

9 Further details on the priority recommendations and the related actions/milestones can be found in the action plan under Detailed Technical Assessment and Recommendations.

Section I. Detailed Technical Assessment and Recommendations

TABLE 2. RPPI Workplan for Armenia, 2023–2024

Priority	Action/Milestone	Target Completion Date
Topic: Institutions arrangements and resources		
H	Clarify the institutional arrangements for the compilation and publication of the RPPI	Oct 31, 2023
H	CBA should assign appropriate resources for the implementation of the workplan.	Oct 31, 2023
H	A Steering Group of stakeholders should be setup and meet regularly to guide the development of the RPPI.	Oct 31, 2023
Topic: Data sources for the RPPI		
H	The authorities should use the CCRA dataset for the compilation of the RPPI.	Completed
H	ArmStat and CBA should request the transactions data for houses from the CCRA.	Oct 31, 2023
H	ArmStat and CBA should request further back data on all residential property transactions from the CCRA.	Oct 31, 2023
H	ArmStat and CBA should review the data sharing agreement with the CCRA.	Dec 31, 2023
Topic: Compilation methods for the RPPI		
M	Non-market transactions should be excluded	Completed
M	Transactions from the social housing program should be excluded	Completed
M	Missing characteristics should be filled using information from historical transactions within the same building.	Completed
M	Old property zones, which are used for 2020 transactions, should be updated to coincide with the new property zones used from 2021.	Completed
M	Some property characteristics should be merged into homogenous groups.	Completed
M	The authorities should use Cook's Distance for outlier detection.	Completed
M	The stratification for houses should be considered and tested when the data is received from the CCRA.	Dec 31, 2023
M	The time dummy hedonic method with a four-quarter window length should be used to compile quality-adjusted indices.	Completed
M	The CBA should apply robustness checks to the experimental RPPI for apartments.	Dec 31, 2023
M	The CBA should develop experimental indices for houses.	Mar 31, 2024
Topic: Dissemination		
M	The authorities should develop a new statistical product to disseminate the RPPI.	Jul 31, 2024

Priority	Action/Milestone	Target Completion Date
M	Include descriptive statistics on the volume, value and median prices of residential property transactions in the statistical release.	Jul 31, 2024
M	A detailed methodological document should be drafted and published on the authorities' website.	Sep 30, 2024
M	The RPPI should be published for the first time at a launch event for users.	Oct 31, 2024

A. INTRODUCTION

9. A TA mission was conducted from July 10-21, 2023, to assist the authorities in Armenia with the development of a RPPI. The mission was conducted under the auspices of the Data for Decisions (D4D) Trust Fund. A previous mission, which covered both CPI and RPPI, visited Armenia in January 2020. A pre-mission meeting was held on March 13, 2023, attended by one official from ArmStat. The objectives for the mission were discussed and agreed. An agenda was drafted and circulated to the relevant stakeholders in advance of the mission, including to the CBA.

10. A team of six staff from the Price Statistics Division in Armstat and two representatives from the Statistics Department in the CBA attended the meetings each day. The President and a Council Member from ArmStat and the Head of Statistics at the CBA also attended meetings. An online meeting was held with the CCRA during the first week of the mission. There was a strong commitment from all participants to develop the RPPI for Armenia. The strong cooperation between ArmStat and the CBA was particularly notable.

11. Significant progress had already been made by the CBA in developing the methods for compiling the RPPI. The mission focused on reviewing each aspect of data compilation and making appropriate recommendations. In advance of arrival, the mission was provided with a sample of two quarters of transactions data from the register maintained by the CCRA. This allowed the mission to make some initial assessments of data quality. The mission benefited hugely from the ability of the CBA to implement recommendations directly in the R-code during the course of the meetings. By the middle of the second week, an experimental index for apartments (including regional sub-indices) was compiled. The index for apartments incorporated international best practice using the dataset from the CCRA.

12. There was a focus on increasing the capacity and knowledge of the authorities. The mission provided practical training, using the register data from the CCRA, on the methodological approach to compiling the RPPI. While the CBA possess all the required skills to calculate the index, the mission will continue to support the authorities, as necessary, as the agreed workplan is being implemented.

B. INSTITUTIONAL ARRANGEMENTS AND RESOURCES

13. The institutional arrangements for the compilation and publication of the RPPI should be clarified. This was first discussed during a previous mission in January 2020 and the consensus then was that the CBA should compile the index and ArmStat should publish the index. However, due to the technical nature of the compilation, it is recommended that the institution that calculates the RPPI should

also launch and publish the index. While both Armstat and the CBA can be official compilers of statistics, it is felt that the CBA are best placed to assign resources, develop the methods, and publish the index.

14. The CBA should assign appropriate resources for the implementation of the workplan.

With appropriate resources, the RPPI can be developed and published by October 2024. The CBA have already made significant progress developing the index for apartments. Further progress is dependent on the CCRA providing the transactions data for houses.

15. A Steering Group of stakeholders should be setup and meet regularly to guide the

development of the RPPI. It is recommended that the group meet quarterly or more frequently as required and consist of representatives from the ArmStat, the CBA and the CCRA. The group should be able to set and monitor project milestones. The President of ArmStat was supportive of the recommendation and expressed his willingness to write to the CBA and the CCRA to formally create the Steering Group.

Recommended Actions:

- The institutional arrangements for the compilation and publication of the RPPI should be clarified.
- The CBA should assign appropriate resources for the implementation of the workplan.
- A Steering Group of stakeholders should be setup and meet regularly to guide the development of the RPPI.

C. DATA SOURCES

16. The authorities should use the CCRA dataset for the compilation of the RPPI. It was evident from working with the data that it is a high-quality data source. In particular, the declared price is a good indicator of the transaction price negotiated between the buyer and seller. While properties are often transacted in US dollars in Armenia, the price recorded in the dataset is denominated in Armenian Dram. It is a very timely dataset, with the CCRA confirming that almost all transactions for the reference quarter can be transmitted to ArmStat and the CBA within 28 days. The dataset also contains the necessary property characteristics for the structure and location e.g. floor area, region / district, property zone (a variable used for the assessment of property tax and highly correlated with price), construction material, floor level for apartments and year of construction. In addition, the CCRA have already provided back data for the period Q1 2020 to Q2 2023.

17. ArmStat and CBA should request the transactions data for houses from the CCRA. The CCRA have provided transactions data for apartments to ArmStat, who also share the data with the CBA. To ensure complete coverage of the residential property market, the transactions data on houses should also be provided to ArmStat and CBA. The property characteristics information relevant for houses, such as plot size, should also be provided.

18. ArmStat and CBA should request further back data on all residential property transactions from the CCRA. The CCRA have provided data covering the period 2020–2023 to ArmStat. By providing further back data, this would allow for the compilation of a longer time series for the RPPI. Covering a longer time series would be highly valued by users. To date, the CCRA have indicated their willingness to provide data for the period 2018–2019, while indicating there is significant fall off in the quality of the data previous to 2018. Before incorporating the data for 2018–2019 into the RPPI calculations, the CBA should carry out a thorough assessment of the data quality.

19. ArmStat and CBA should review the data sharing agreement with the CCRA. In light of the additional data requests and the recommended institutional arrangements for the further development of the RPPI, there will be a need to review the data sharing agreement with the CCRA. If it is decided that the CBA should compile and publish the RPPI, it would be appropriate for the transactions data to be sent directly from the CCRA to the CBA. The agreement should include the legal basis for data sharing, a detailed data specification, the mode and timing of the regular data transfer, key contact points, etc.

20. Since 2017, the CBA have been collecting data on the advertisements of residential property. The CBA have made use of web-scraping to collect the data from real estate websites. While the priority is to continue working with the CCRA data, the CBA can use the web-scraped data for analysis and research purposes. For example, the data could be used to calculate price indices based on the collected asking prices and these can be compared to the indices calculated using declared prices to the CCRA. The data can also be used for the estimation of rental indices. The mission recommended that this research work does not distract from the key objective, which is compile and publish the RPPI using the CCRA dataset.

Recommended Actions:

- The authorities should use the CCRA dataset for the compilation of the RPPI.
- ArmStat and CBA should request the transactions data for houses from the CCRA.
- ArmStat and CBA should request further back data on all residential property transactions from the CCRA
- ArmStat and CBA should review the data sharing agreement with the CCRA.

D. COMPILATION METHODS

21. Data inspection was performed by visualizing key characteristics in the dataset. To provide information on the quality of the CCRA dataset and to gain insights into the relationship between characteristics, data visualization plots (histograms, bar charts, scatter plots etc.) and descriptive statistics (e.g., mean and median price per region) were produced during the mission.

22. Non-market transactions should be excluded from the CCRA dataset. Lower and upper thresholds for price per square meter were set during the mission to exclude non-market transactions and data entry errors from the dataset. The price per square meter for market transactions within Yerevan was set to range between 50,000 to 5,000,000 AMD. Outside of Yerevan, transactions below 15,000 AMD and above 5,000,000 AMD per square meter were excluded.

23. Transactions from the social housing program should be excluded from the RPPI. The existence of social programs that provide certain groups affordable housing is unrelated to the house price development in Armenia and should be excluded from the compilation of the RPPI. As the social housing programs are transacted using a constant price per square meter, these observations were identified by multiple transactions within the same building that exhibit the same square meter price. Following this approach, during the 2020–2023 period, approximately 2,000 out of around 50,000 observations were excluded. This approach risks identifying too many transactions as social housing, as developers might price multiple apartments with the same price per square meter. However, given the small number of observations identified as social housing, this risk seems limited. It is recommended to verify the number of social housing units identified with this approach against official announcements.

24. Missing characteristics should be filled using information from historical transactions within the same building. Information about the year of construction, building material, and building height are sometimes missing from the CCRA dataset. In such cases, previous transactions within the same building can be used to fill these missing gaps. By applying this approach, approximately 3,000 out of 4,000 observations with missing information were filled during the mission. Only a small number of non-building specific information were missing in the dataset.

25. Old property zones, which are used for 2020 transactions, should be updated to coincide with the new property zones used from 2021. The property zones are one of the variables used by the authorities in Armenia to determine the property tax liability for each homeowner. Generally, the more desirable the property, e.g., central Yerevan, the lower the property zone. In 2021, the property zones were reassessed and updated. To ensure consistent zone levels are used in the dataset over time, transactions from 2020 were updated to the new property zones by applying the same approach as for the missing building characteristics. From a total of 11,248 observations in 2020, 1,768 were unique in 2020 and could not be updated. Some 3,101 observations were updated to a new zone level, and 6,379 observations kept the same zoning. Since the majority of the updated zones remained unchanged, the 1,768 observations that were unique in 2020 can be included with the old zone levels.

26. Some property characteristics should be merged into homogenous groups. Due to the low number of transactions per quarter for some categories in (i) year of construction, (ii) building material, (iii) building level, and (iv) property zones, these characteristics should be grouped into similar groups. It is recommended to group them according to historically meaningful categories and groupings that prevail common price segments. It was recommended to group property zones with only a few observations with their next closest property zone based on median price per square meter.

27. The authorities should use Cook's Distance for outlier detection. A number of different outlier detection methods were demonstrated during the mission using two quarters of data from the center of Yerevan. For detecting outliers in the dataset, the mission recommended to use Cook's Distance. It should be applied by running a regression model including all relevant characteristics for calculating the Cook's Distance of each observation, and then rerunning the regression model excluding the observations prevailing a high Cook's Distance value. The suggested threshold for outlier determination is 4 divided by the number of observations used in the regression. It is recommended to apply the outlier detection separately for each strata and each rolling window, consisting of 4 quarters of data. Using this approach, the percentage of outliers ranges between four and seven per cent based on a sample data analyzed during the mission. Figure 1 shows a scatter plot of the sample data before and after Cook's Distance was applied.

28. Six strata for apartments were constructed for the compilation of regional sub-indices in Armenia. The data was not available to develop strata based on a split between new and existing properties. Five regional strata for apartments were used within Yerevan and a sixth strata was used for apartments in the remainder of Armenia. Within Yerevan, neighboring districts were aggregated to devise the strata (see Appendix B for more information). The stratification is then used for aggregating to the overall index for apartments in Yerevan and for the country as a whole. Table 3 shows the number of observations in each stratum by year. The aggregation weights are based on the expenditure volume of transactions from the previous year. The weights for 2020 are shown in Table 4. When the data is received from the CCRA, the stratification used for houses needs to be considered separately, as apartments typically exist in Yerevan, whereas houses are predominantly in more rural areas.

Figure 1: Applying Cook's Distance for outlier detection using sample data

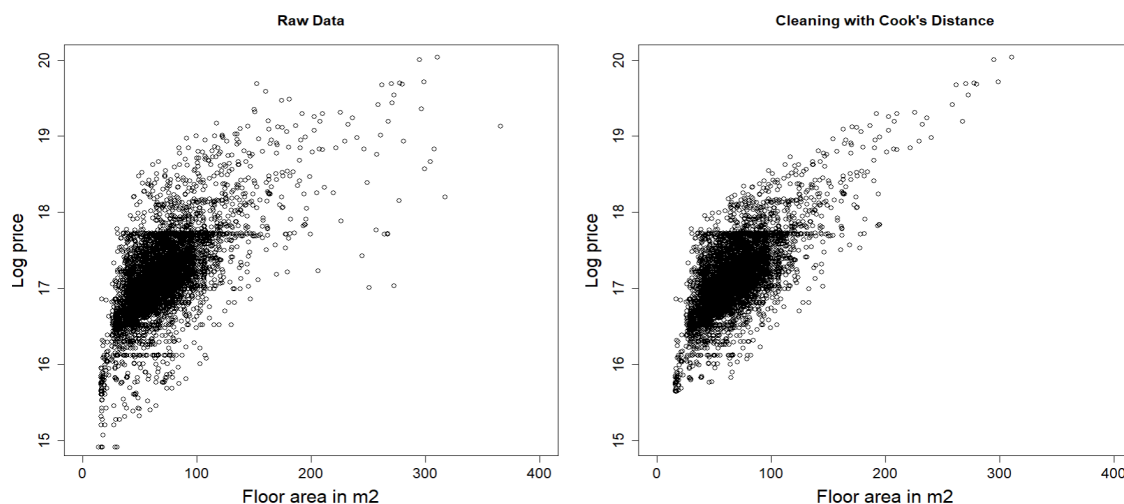


TABLE 3. Number of Observations Per Year and Strata

Strata / Year	Outside Yerevan	Yerevan-Center	Yerevan-East	Yerevan-North	Yerevan-South	Yerevan-West
2020	3767	1151	1172	2520	1161	1477
2021	5272	1613	1604	3415	1483	1951
2022	5111	1985	1966	3527	1440	2134
2023	2305	627	648	1196	578	675

TABLE 4. Expenditure Weights by Strata for 2020

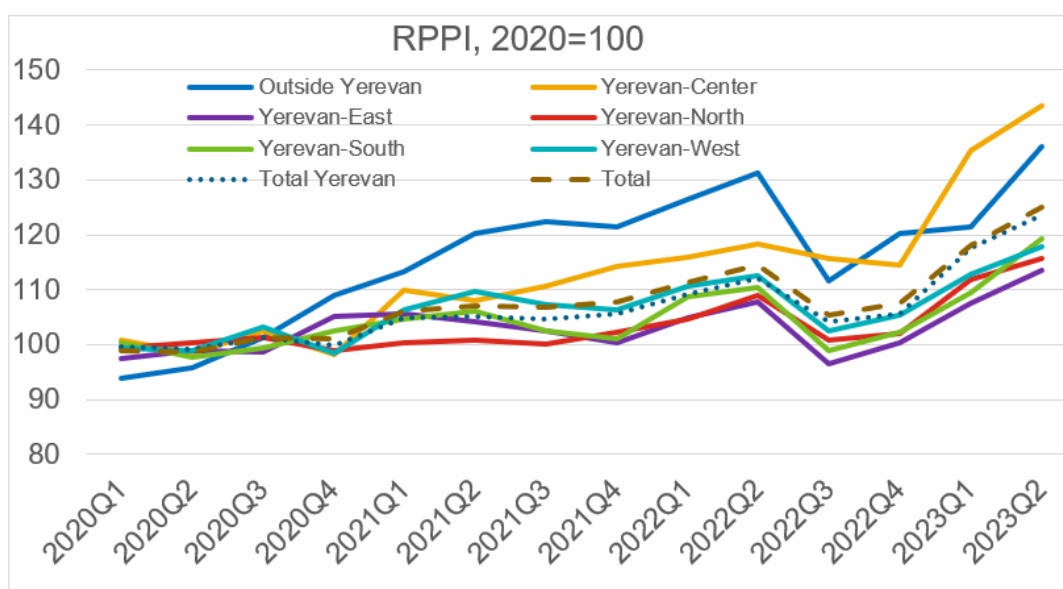
Stratum Name	Weights (Expenditure)	No. of observations (% of Total)
Outside Yerevan	12.6%	33.5%
Yerevan-Center	22.4%	10.2%
Yerevan-East	10.9%	10.4%
Yerevan-North	31.2%	22.4%
Yerevan-South	9.6%	10.3%
Yerevan-West	13.3%	13.1%

29. **Experimental quality-adjusted hedonic indices for apartments were compiled during the mission.** The mission recommended using the time dummy hedonic method with a four-quarter window length to compile quality-adjusted indices. The suggested hedonic model uses the log price as the dependent variable and is regressed on the characteristics (i) floor area, (ii) four bands of construction year, (iii) three categories of floor level (base, below 10 stories, and above), (iv) three different

construction material categories (brick, stone, and others), and (v) 15 different property zone levels. The missing information on building specific variables that could not be filled with historical transactions, are included in the regression with an additional category labeled ‘unknown’. A sample output based on one window for the city center of Yerevan is shown in Appendix A.

30. The CBA should apply robustness checks to the experimental indices. The experimental indices for apartments developed during the mission are shown in Figure 2. These consist of six regional sub-indices, one index for Yerevan and one national index. These hedonic indices were compared with a stratified median approach showing that the hedonic indices have a similar trend but less volatility. Stability checks on the estimated shadow prices for each rolling window and each stratum were performed. Overall, the estimated coefficients have plausible signs and are reasonably stable over time. The model specification used in each stratum needs to be refined by including additional variables, such as building level, or excluding some of the included variables. In addition, the CBA should compare the resulting indices with results that exclude observations with unknown building characteristics and explore further regression diagnostics.

Figure 2: Experimental indices for apartments, 2020Q1–2023Q2



31. The CBA should develop experimental indices for houses. When the data is received from the CCRA, a similar approach can be used for houses as was used for apartments i.e., excluding non-market transactions, outlier detection, index calculation etc. However, given that different characteristics influence the price of houses e.g., plot size, the specification of the regression model used for houses will differ from that used for apartments.

Recommended Actions:

- Non-market transactions should be excluded.
- Transactions from the social housing program should be excluded.
- Missing characteristics should be filled using information from historical transactions within the same building.

- Old property zones, which are used for 2020 transactions, should be updated to coincide with the new property zones used from 2021.
- Some property characteristics should be merged into homogenous groups.
- The authorities should use Cook's Distance for outlier detection.
- The stratification for houses should be considered and tested when the data is received from the CCRA.
- The time dummy hedonic method with a four-quarter window length should be used to compile quality-adjusted indices.
- The CBA should apply robustness checks to the experimental RPPI for apartments.
- The CBA should develop experimental indices for houses.

E. DISSEMINATION

32. The authorities should develop a new statistical product to disseminate the RPPI. The mission examined good practice by reviewing the dissemination strategy of another country. The authorities can publish the national RPPI and regional sub-indices. An advance publication schedule should be published providing the dates for the upcoming releases. Users should be consulted during the process of designing the new statistical product to ensure users' needs are met. It should be noted that the CCRA currently publish an index that is based on simple mean prices. Given the potential for confusion among users if more than one index is disseminated, the authorities should consider whether it is appropriate for the CCRA to continue publishing their index. The Steering Group can consider this issue and a consensus reached among the stakeholders.

33. The statistical release should include descriptive statistics on the volume, value and mean/median prices of residential property transactions. Given that the CCRA dataset is a census of residential property transactions, there is a significant opportunity to supplement the publication of the price indices with information on the underlying residential property market. Users would benefit hugely from receiving this additional information.

34. A detailed methodological document should be drafted and published on the authorities' website. The mission presented an example of a methodological document from another country. A methodological document is an important step for ensuring transparency and providing detailed information for users on the steps for data compilation. For example, the document should include information on the data source, coverage of the index, data quality and cleaning, outlier detection, stratification, weighting information, and methods for index compilation and aggregation.

35. The RPPI should be published for the first time at a launch event for users. A launch event is important to bring users' attention to the publication of the newly developed RPPI and explain the methodological basis for the index. A press release and other communication documents should be prepared in advance of the event.

Recommended Actions:

- The authorities should develop a new statistical product to disseminate the RPPI
- The statistical release should include descriptive statistics on the volume, value and median prices of residential property transactions.
- A detailed methodological document should be drafted and published on the authorities' website.
- The RPPI should be published for the first time at a launch event for users.

F. OFFICIALS MET DURING THE MISSION

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Appendices

APPENDIX A: SAMPLE REGRESSION RESULTS

TABLE 5. Sample Regression output for Yerevan Center (2022Q2–2023Q1)

Term	Estimate	Std Error	Statistic	P-value
(Intercept)	17.60	0.077	228.505	0.000 ***
Floor_Area	0.007	0.000	31.16	0.000 ***
Zone 1	0.000	0.000	0.000	0.000
Zone 2	-0.318	0.028	-11.116	0.000 ***
Zone 3	-0.514	0.032	-16.033	0.000 ***
Zone 4	-0.579	0.032	-17.869	0.000 ***
Zone 5	-0.784	0.058	-13.487	0.000 ***
Construction material brick (reference)	0.000	0.000	0.000	0.000
Construction material concrete	-0.293	0.034	-8.663	0.000 ***
Construction material stone	-0.272	0.054	-5.037	0.043 *
Construction material unknown	-0.343	0.092	-3.711	0.000 ***
Floor 1 (reference)	0.000	0.000	0.000	0.000
Floor 2-16	0.125	0.045	2.733	0.006 **
Floor 16+	0.617	0.105	5.850	0.259
Floor Unknown	-0.283	0.055	-5.175	0.000 ***
Construction year before 1960 (reference)	0.000	0.000	0.000	0.000
Construction year 1961 – 1970	-0.056	0.042	-1.316	0.188
Construction year 1971 – 1991	-0.082	0.054	-1.524	0.127
Construction year 1992 – 2013	0.053	0.055	0.961	0.336
Construction year 2014 +	-0.105	0.057	-1.834	0.066
2022Q2 (reference)	0.000	0.000	0.000	0.000
2022Q3	-0.036	0.033	0.918	0.359
2022Q4	-0.101	0.032	0.170	0.865 ***
2023Q1	0.120	0.030	1.255	0.210 ***
Residual standard error: 0.4231 on 1715 degrees of freedom				
Multiple R-squared: 0.5819 Adjusted R-squared: 0.5775				
F-statistic: 132.6 on 18 and 1715 DF, p-value: < 2.2e-16				

Term	Estimate	Std Error	Statistic	P-value
Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

APPENDIX B: STRATIFICATION FOR APARTMENTS IN YEREVAN

