Property Price Indicators in Indonesia: Measurement and Recent Developments

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ABSTRACT

Reliable property price indicators are essential for monitoring housing market dynamics, assessing household wealth, and supporting monetary and financial stability policy. In many emerging economies, including Indonesia, however, compiling transaction-based property prices is constrained by the lack of comprehensive administrative data. This challenge needs to be addressed multi-source approach to property price statistics. This paper documents Indonesia's experience in developing a comprehensive property price monitoring system, including the use of big data, built around four complementary indicators covering primary residential, secondary residential, and commercial property markets. In the absence of transaction-level administrative data or a centralized land price registry, Bank Indonesia initially relied on developer and appraisal surveys to monitor primary and secondary housing markets. These survey-based indicators were subsequently complemented by a monthly, big-data-based Residential Property Price Index (RPPI) constructed using online property listing data and hedonic time-dummy methods to improve timeliness, frequency, and quality adjustment. In parallel, commercial property prices have been monitored through a dedicated survey-based Commercial Property Price Index (CPPI). The paper presents the institutional framework, data sources, and methodologies applied across market segments, with particular emphasis on issues of periodicity, quality adjustment, weighting, and index chaining. By aligning its approaches with international guidelines from the IMF, Eurostat, and OECD, and by leveraging big data and public-private data cooperation with online property platforms, Indonesia has established a robust and adaptable property price monitoring system despite structural data limitations. The experience offers practical lessons for central banks and statistical offices seeking to develop property price indicators in a data-constrained environment.

Keywords: Property Price Index; Residential Property; Commercial Property; Survey; Hedonic Method; Indonesia.

JEL Code: C43, C55, R31

I INTRODUCTION

Property prices play a central role in the transmission of monetary policy, the assessment of financial stability risks, and the monitoring of household and corporate balance sheets. Developments in residential and commercial property prices influence credit growth, collateral values, investment decisions, and consumption through wealth effects. Reliable property price indicators are therefore an essential component of macroeconomic and macroprudential surveillance.

In advanced economies, property price indicators are commonly compiled using comprehensive administrative records of property transactions, enabling the application of transaction-based and repeat-sales methods. In many emerging economies, however, such data are incomplete, fragmented, or not statistically accessible. Property transactions are often recorded across multiple local jurisdictions, private notaries, or informal arrangements, limiting their coverage, consistency, and suitability for official statistical purposes. In these environments, the direct implementation of transaction-based indicators may be impractical or statistically unreliable. Thus, surveys, appraisal-based methods, and asking-price data, are alternatively used to support property price measurement.

Indonesia exemplifies these challenges. As a large archipelagic country with substantial regional heterogeneity, Indonesia does not maintain a comprehensive national registry of property transaction prices suitable for index construction. While land registration systems exist, transaction prices are not centrally recorded in a standardized or timely manner, and access to private market information remains limited. These conditions complicate the construction of nationally representative transaction-based residential and commercial property price indicators.

In response, Bank Indonesia has adopted a gradual and pragmatic approach to property price measurement. Rather than relying on a single data source or methodology, Bank Indonesia has developed a multi-source monitoring framework that applies different indicators to distinct market segments, reflecting differences in pricing mechanisms, data availability, and policy relevance across residential and commercial property markets. This approach is consistent with the conceptual principles outlined in international guidance, including clear market segmentation, appropriate quality adjustment, transparent weighting schemes, and stable index aggregation and chaining procedures (Hill, 2011; Eurostat, 2013; IMF, 2019).

This paper advances the proposition that in limited administrative data environments, no single property price index can simultaneously achieve statistical representativeness, timeliness, and policy relevance. Rather than attempting to force a single indicator to perform all analytical function, a system of complementary indicators may provide a more robust and operationally feasible approach to property market monitoring.

The paper makes three main contributions:

- **Conceptual contribution**: It proposes a multi-indicator monitoring framework that distinguishes between benchmark (survey- and appraisal-based) and signal indicators (big data-based), offering a practical design for countries with limited administrative data.

- **Methodological contribution**: It documents the sampling designs, weighting schemes, quality adjustment methods, and aggregation formulas applied across four complementary indicators, highlighting their respective trade-offs.
- **Policy contribution**: It demonstrates how different indicators serve distinct analytical and policy functions, ranging from long-term trend assessment to early detection of turning points, thereby strengthening the use of property price indicators for monetary policy analysis, macroprudential surveillance, and financial stability monitoring.

Within this framework, Bank Indonesia's property price monitoring system is structured around four complementary indicators, each designed to fulfil a distinct analytical role. These indicators are not intended to substitute for one another, but to operate as an integrated framework that balances continuity, representativeness, and responsiveness under persistent limited administrative data.

Three indicators serve primarily as benchmark measures, providing stable and internally consistent reference points for long-term price developments:

- **The primary residential RPPI**, compiled from developer surveys, captures supply-side pricing behaviour in newly built housing and reflects construction costs and developer pricing strategies.
- **The appraisal-based secondary residential RPPI,** provides a consistent benchmark for price movements in the existing housing stock, offering continuity in the absence of transaction-level data.
- **The Commercial Property Price Index (CPPI)**, captures price dynamics across major commercial property segments, with relevance for monitoring business-cycle conditions, corporate balance sheets, and financial stability risks.

One indicator serves primarily as signal measure, designed to enhance timeliness and sensitivity to short-term market dynamics:

- **The big data-based secondary RPPI**, derived from online property listings and estimated using hedonic time-dummy methods, provides high-frequency and quality-adjusted signals of secondary market price movements and potential turning points.

This separation between benchmark and signal indicators reflects a thoughtful methodological choice. Benchmark indicators prioritize statistical continuity and interpretability, while signal indicators prioritize informational timeliness and market responsiveness. Together, they enable cross-validation of price movements, improve detection of cyclical turning points, and support a wider range of policy applications than any single index could achieve in isolation.

Although grounded in Indonesia's institutional and data environment, the issues addressed in this paper are not country specific. Many emerging and developing economies face similar constraints, including fragmented administrative records and heterogeneous local property markets. The experience presented here therefore offers broader methodological insights into how property price statistics can be constructed and interpreted in limited data settings through transparent design, careful market segmentation, and explicit recognition of statistical trade-offs.

The development of this framework has also relied on institutional cooperation. In particular, the integration of big data-based indicators has been made possible through public–private collaboration with major online property platforms, enabling access to large-scale listing data that complement traditional survey and appraisal sources. By combining methodological alignment with established RPPI and CPPI principles and pragmatic cooperation with private data providers, Bank Indonesia has established a robust and adaptable property price monitoring system. Indonesia's experience may therefore offer practical insights for central banks and statistical offices in other data-constrained economies seeking to strengthen the measurement and policy use of property price statistics.

The remainder of the paper proceeds as follows. Section II describes Bank Indonesia's property price indicators. Section III outlines the index construction methodologies and recent results. Section IV discusses key trade-offs, limitations, and future improvements, while Section V concludes with implications for policy and international practice.

II BANK INDONESIA'S PROPERTY PRICE INDICATORS

Indonesia's property price statistics are built based on a multi-source data framework designed to address structural data limitations while ensuring broad market coverage and policy relevance. Given the absence of a comprehensive transaction-based property registry, Bank Indonesia applies different data collection methods across market segments, each with its own sampling design, respondent profile, and methodological framework. This approach reflects established RPPI and CPPI compilation principles, recognizing the heterogeneity of property markets and the need for segment-specific statistical solutions.

Figure 1 Multisource Data Collection of Indonesia's Property Price Indicators

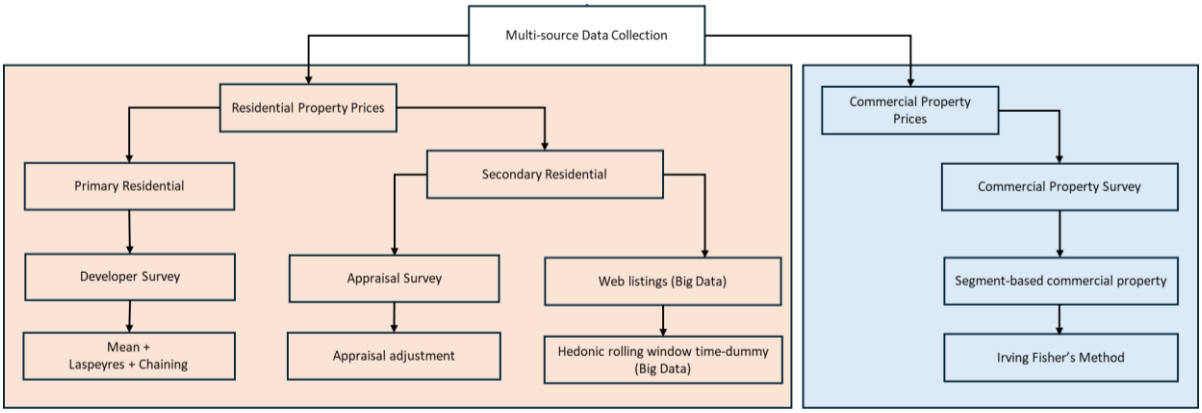


Figure 1 summarizes this multi-indicator framework, illustrating the segmentation of residential and commercial property markets, the underlying data sources, and the corresponding index compilation methodologies adopted by Bank Indonesia. The figure highlights how survey-based, appraisal-based, and big-data-based approaches are combined within a unified statistical framework to address limited administrative data while maintaining methodological consistency.

The selection of data sources and samples is based not only by geographic considerations but also by the characteristics of the property types being measured. New residential developments, existing housing stock and commercial properties exhibit distinct pricing mechanisms, market

participants and data availability. Therefore, Bank Indonesia employs developer surveys for the primary residential market, appraisal-based surveys and big data listings for the secondary residential market, and a dedicated commercial property survey for non-residential segments. Taken together, this data design supports four complementary property price indicators.

II.1 Developer Survey (SHPR Primer): Residential Property Primary Market

The primary residential property market in Indonesia is monitored through the *Survei Harga Properti Residensial (SHPR) Primer*, which serves as the core data source for the quarterly Residential Property Price Index (RPPI) for newly built houses. Conducted continuously since 1994, the survey provides one of the longest continuous series on residential property prices in Indonesia. Developer-based asking prices are collected on a quarterly basis and compiled using established RPPI principles, reflecting standard approaches to housing price measurement in the absence of comprehensive transaction data (IMF, 2019).

The SHPR Primer adopts a purposive sampling approach, reflecting the absence of a complete and regularly updated registry of residential property developers. Many developers are not formally registered in centralized administrative databases, and project-level activity varies significantly across regions. In such contexts, probability sampling is often not feasible, and targeted survey approaches are commonly applied in property price statistics (Eurostat, 2013; IMF, 2019).

Probability sampling is not feasible in this context, as there is no complete or regularly updated registry of residential property developers in Indonesia, and many developers are not formally registered with government agencies or industry associations. The survey therefore targets developers that are actively engaged in ongoing housing construction and operate at a scale sufficient to support consistent quarterly reporting. Eligibility criteria include continuous production activity and minimum project size requirements, ensuring that reported prices reflect prevailing primary market conditions rather than sporadic or one-off transactions. This approach prioritizes continuity and consistency of price observations over time, in line with official housing price statistics practices (Statistics Canada, 2024)

The survey is conducted quarterly across 18 major urban regions, which together account for more than half of Indonesia's gross domestic product and represent the western, central, and eastern parts of the country. Approximately 1,000 developers participate in each survey round. Prices are reported for newly built houses classified into three size categories (small, medium, and large) allowing for basic quality adjustment through stratification, in line with recommended practices for matched-model and stratified index compilation in the Eurostat RPPI Handbook (Eurostat, 2013).

This design enables the primary RPPI to capture supply-side price developments associated with construction costs, developer pricing strategies, and regional growth patterns. While primary market price data may exhibit some degree of price smoothing during periods of weak demand, the *SHPR Primer* provides a stable and consistent indicator of residential property price developments. Recent refinements, including expanded coverage to satellite areas and simplified questionnaires, have further strengthened representativeness and data quality, consistent with the quality and coverage considerations outlined in the IMF RPPI Handbook (IMF, 2019).

II.2 Appraisal-Based Survey (SHPR Sekunder): Residential Property Secondary Market

To monitor price developments in the secondary residential market, Bank Indonesia introduced the *Survei Harga Properti Residensial (SHPR) Sekunder* in 2011. The secondary market captures post-construction price dynamics, house mobility, and wealth effects that are not reflected in primary market indicators. Accordingly, the *SHPR Sekunder* provides a consistent benchmark for tracking price movements in existing landed houses. An appraisal-based approach is adopted to compile secondary house prices, reflecting the limited availability of reliable transaction data and the practical challenges associated with implementing repeat-sales methods (Eurostat, 2013). Repeat-sales approaches require frequent and consistently recorded resales of the same property, conditions that are not met given the low incidence and uneven regional distribution of secondary market transactions in Indonesia. In addition, the absence of a comprehensive transaction registry constrains the identification of repeat observations, while quality changes between transactions, such as renovations or extensions, violate the constant-quality assumption underlying repeat-sales indicators. Together, these factors limit the reliability and coverage of repeat-sales methods, making appraisal-based valuation a more practical and internally consistent approach for monitoring secondary market price movements.

Under the *SHPR Sekunder*, secondary residential properties are appraised by evaluating representative houses using comparable properties. Appraisers primarily apply the market price approach, supported by the cost approach when market data are limited. Comparable properties are selected based on recent transactions or credible asking prices, ensuring consistency in legal status and prevailing market conditions. To enhance comparability, systematic adjustments are made for location, zoning, land characteristics, building condition, and other relevant attributes. These adjustments help ensure that observed price differences reflect underlying market dynamics rather than data limitations or measurement noise.

The survey is conducted quarterly in 10 major cities (detailed locations are provided in Appendix A2) and appraises approximately 560 secondary landed houses each quarter. In the absence of a complete and regularly updated sampling frame of secondary houses offered for sale, a purposive sampling approach by housing type and region is applied. This approach is consistent with international RPPI guidance, which recognizes the use of targeted observations in heterogeneous property markets where probability sampling is not feasible (Eurostat, 2013; IMF, 2019).

II.3 Big Data-Based: Residential Property Secondary Market

International RPPI guidance recognizes that, in the absence of comprehensive and reliable transaction data, appraisal-based methods provide a practical and consistent framework for compiling residential property price indicators, particularly in heterogeneous and data-constrained housing markets (Eurostat, 2013; IMF, 2019). In this context, ongoing refinements to appraisal-based approaches, such as clearer valuation guidelines, improved stratification by housing type and location, and more frequent assessments, have enhanced their ability to capture underlying price trends while maintaining consistency over time. These refinements strengthen the role of appraisal-based indicators as stable benchmarks for monitoring secondary housing market developments where transaction-based methods are not feasible.

At the same time, international guidance and academic literature increasingly highlight the complementary role of alternative data sources, including property advertisements and information obtained from real estate agents. (Energerg & Laufer, 2017) show that indicators derived from multiple listing sources effectively track housing price dynamics, while Kolbe et al. (2021) find that asking-price indicators provide early signals that are useful for nowcasting. More recent studies further demonstrate that indicators derived from online search activity and digital housing platforms exhibit strong predictive power for subsequent house price movements and help distinguish between demand and supply driven fluctuations in housing markets (Møller, Pedersen, & Schütte, 2022; Anerberg & Ringo, 2024).

Building on these developments, Bank Indonesia introduced a monthly big data–based Secondary RPPI in 2018 to complement existing appraisal-based indicators, aiming to ensure timely, granular, and quality-adjusted measurement of secondary housing prices and address the limitations of survey- and appraisal-based approaches. The index is constructed using property listing data obtained through non-disclosure agreements with major online property portals and processes approximately 40,000 monthly listings from 12 major cities (monthly listing data available on Appendix B1), focusing on advertisements explicitly marked as "for sale." Detailed property characteristics (see Appendix A3) allow for quality adjustment using a hedonic rolling time-dummy regression framework, consistent with international RPPI best practices (Eurostat, 2013; IMF, 2019).

II.4 PPKom Survey: Commercial Property Market

Commercial property prices in Indonesia are monitored through the *Survei Perkembangan Properti Komersial (PPKom)*, launched in 1996. This quarterly survey reflects Bank Indonesia's effort to track price developments in non-residential property markets that are closely linked to business activity, investments cycles, and financial stability. The survey covers a broad range of commercial property segments, including offices, retail space, apartments, hotels, warehouses, industrial land, and convention halls.

The PPKom survey employs a stratified sampling design, with stratification based on geographic region and commercial property segment. Approximately 3,000 respondents are surveyed each quarter, comprising property owners, managers, and marketing agents whose portfolios and activities are representative of each segment. A panel framework is maintained to ensure continuity of observations over time, with respondent replacement governed by strict eligibility criteria to preserve data consistency and market representativeness.

Over time, the PPKom survey has evolved into a structured Commercial Property Price Index (CPPI), supported by methodological refinements such as segment-specific indicators and the application of Laspeyres and Irving Fisher formulations for short-term price measurement. This design explicitly accounts for the heterogeneity of commercial property markets across segments and regions, while ensuring comparability of price movements over time.

II.5 How the Four Property Prices Indicators Work Together

Taken together, the four property price indicators developed by Bank Indonesia form an integrated monitoring framework explicitly designed to reflect the structural characteristics of Indonesia's property markets. Rather than relying on a single proxy, each indicator is tailored to a specific market segment and data environment, addressing distinct analytical needs while reinforcing

overall system robustness. Survey- and appraisal-based indicators provide stability, historical continuity, and robust benchmarks, while big-data-based indicators enhance timeliness and sensitivity to short-term market conditions.

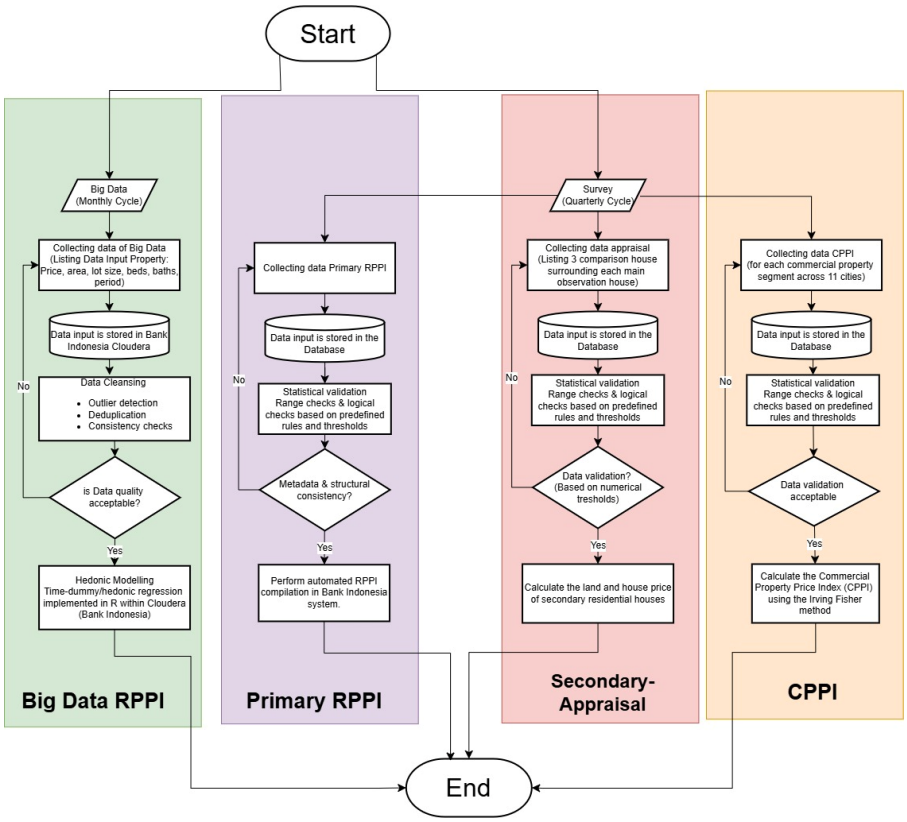
- **The primary market RPPI**, based on the *SHPR Primer*, provides a long-standing and consistent measure of supply-side price developments in newly built housing, reflecting construction costs, developer pricing behaviour, and regional growth patterns.
- **The appraisal-based secondary market RPPI**, based on the *SHPR Sekunder,* complements this by capturing post-construction price dynamics in the secondary residential market, offering a stable benchmark for longer-term trends in household wealth and resale market conditions.
- **The big data-based secondary market RPPI** further enhances secondary market monitoring by introducing a high-frequency, quality-adjusted indicator derived from digital property listings, improving timeliness and sensitivity to short-term market movements.
- **The Commercial Property Price Index (CPPI)**, constructed from the *PPKom* survey, extends coverage to non-residential property markets that are closely linked to business investment, corporate balance sheets, and financial stability risks.

Together, these indicators balance continuity and innovation. Survey and appraisal-based measures provide stability, historical depth, and institutional continuity, while big data methods introduce greater granularity and timeliness. The framework is explicitly designed to enable cross-validation across indicators, improve the identification of turning points, and support a wide range of policy applications, including monetary policy analysis, macroprudential surveillance, and financial stability assessment. This integrated framework enables Bank Indonesia to monitor property price developments comprehensively despite the absence of transaction-based administrative data.

II.6 Data Processing and Preparation for Property Price Index Compilation

Bank Indonesia compiles multiple property price indicators, covering primary residential markets, secondary residential markets; online listings–based big data; and commercial property segments, using a harmonized processing framework that transforms heterogeneous raw microdata into validated, quality-consistent datasets appropriate for index construction (Figure 2).

Figure 2 Multi Indicator Framework in Property Price Indicators



Across all data sources, compilation begins with quarterly acquisition of unit-level or listing-level information capturing prices and key structural characteristics of each property. Raw data are stored in centralized databases maintained by Bank Indonesia and subjected to metadata and structural consistency checks to ensure conformity with predefined schemas, variable definitions, and reporting formats. These procedures verify completeness, internal coherence, and adherence to standard coding structures before further processing of property price index compilation.

Subsequently, statistical validation is applied using rule-based thresholds, range checks, and logical consistency checks to detect outliers, miscoding, and implausible price movements. Observations that fail validation are corrected through follow-up where possible or excluded according to standardized protocols. The resulting datasets represent clean and standardized microdata that form the basis for price measurement.

For survey-based indicators (primary RPPI, appraisal-based secondary RPPI, and CPPI), validated microdata is used to derive price relatives or growth rates at the most disaggregated level, which are then aggregated to, segment, city, and national indicators. In the secondary market, appraisal microdata incorporates comparable-based assessments of land and structure values to approximate market-consistent price developments in the resale segment. In the CPPI, segment-level price indicators are constructed using the Irving Fisher index method, combining Laspeyres- and Paasche-type measures to obtain superlative indicators that are robust to changes in market structure.

For the big data RPPI, additional data cleansing steps, including duplicate removal, outlier detection, and cross-variable consistency checks, are complemented by hedonic regression

techniques. Time-dummy or pooled hedonic models are estimated to isolate pure price changes while controlling for quality and compositional shifts in property characteristics. Estimated quality-adjusted price relatives derived from these models are then used to construct the big data RPPI.

Through this integrated processing framework, Bank Indonesia ensures that all property price indicators are based on validated, standardized, and quality-consistent microdata, while allowing each index to exploit the specific strengths of its underlying data source. The resulting indicators jointly support structural analysis, cyclical monitoring, and macro-financial surveillance of Indonesia's property markets.

II.7 Alignment with International Statistical Standards

The methodological references cited throughout Sections II.1 to II.6 reflect the conceptual foundations guiding the development of Indonesia's property price indicators. Rather than invoking international standards for formal compliance, these references situate the framework within established Residential and Commercial Property Price Index (RPPI and CPPI) principles and clarify methodological choices made under limited administrative data available.

The Residential Property Price Index (RPPI) Handbook (Eurostat, 2013) and the IMF Residential Property Price Index Technical Manual (IMF, 2019) provide the primary conceptual basis for several design features adopted in Indonesia's system. These include explicit segmentation between primary and secondary housing markets, stratification by structural characteristics, the use of fixed-weight aggregation with periodic updates, and chaining procedures to preserve temporal consistency. Both handbooks recognize that, in the absence of comprehensive transaction registries, alternative data sources, such as developer surveys, appraisal-based valuations, and asking-price data, may be employed to approximate market price developments. References in Sections II.1 to II.3 therefore draw on this guidance to contextualize the use of purposive sampling, appraisal-based approaches, and hedonic time-dummy estimation under practical constraints.

Similarly, methodological decisions in the commercial property segment reflect established CPPI compilation principles (Eurostat, 2013; IMF, 2019). The separation of lease and sale markets, the application of segment-specific weighting schemes, and the use of superlative index formulas, such as the Fisher index (Hill, 2011), are consistent with recommended approaches for handling heterogeneity in commercial property markets. Citations in Section II.4 therefore clarify the theoretical rationale for these aggregation and weighting choices.

In addition, references to recent academic literature (Energerg & Laufer, 2017; Kolbe, Schulz, Wersing, & Werwatz, 2021; Møller, Pedersen, & Schütte, 2022; Anerberg & Ringo, 2024) support the complementary use of digital listing data as timely indicators of housing market developments. These studies provide empirical evidence that asking-price and platform-based data can contribute to nowcasting and early detection of market turning points, reinforcing the analytical role assigned to the big data-based RPPI.

III INDEX CONSTRUCTION AND RESULT

This section outlines how each indicator is constructed and highlights the methodological trade-offs embedded in the chosen formulas.

III.1 Primary Residential Market – Residential Property Price Index (RPPI)

Price developments in the primary residential market are captured through the Residential Property Price Index (RPPI) compiled from the developer-based *Survei Harga Properti Residensial (SHPR) Primer*[1]. The index applies a **stratified mean approach with Laspeyres aggregation**, using house size categories as the primary quality adjustment mechanism. Regional indicators are aggregated into a national series using fixed weights based on mortgage collateral values. This approach is consistent with international RPPI recommendations (Eurostat, 2013; IMF, 2019) and ensures continuity and comparability over time.

General Formulation:

1. Price change at the unit level:

$$\Delta p_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} \tag{1}$$

where $P_{i,t}$ denotes the price of unit i in quarter t.

2. Stratum-level Index (by size category s):

$$\Delta p_{s,t} = \frac{1}{N_{s,t}} \sum_{i \in s} \Delta p_{i,t} \tag{2}$$

where $N_{s,t}$ is the number of units in size category s.

3. Regional RPPI (Laspeyres aggregation):

$$I_t^{region} = \sum_s w_s \cdot \Delta p_{s,t} \tag{3}$$

where w_s denotes the fixed weight for size category s.

4. Chained national index:

$$CI_t^y = CI_{Q4}^{y-1} \times I_t^y \tag{4}$$

where CI_{Q4}^{y-1} is the chained index for the fourth quarter of the previous year.

The results indicate that price movements in the primary residential market are characterized by pronounced rigidity. Growth rates remain confined to a narrow range, and price contractions are rarely observed, reflecting developers' tendency to maintain asking prices during periods of weakening demand (Figure 2). During the COVID-19 period, medium and large housing segments exhibited relatively resilient price growth, while the small housing segment experienced a more pronounced slowdown. This asymmetric pattern is consistent with the introduction and

[1] The primary residential property price indicators generated from the Residential Property Price Survey (SHPR) are published through the quarterly Residential Property Survey Reports, which can be accessed at the following link: https://www.bi.go.id/en/publikasi/laporan/Pages/SHPR_Tw_III_2025.aspx.

extension of the housing VAT incentive (PPN-DTP), which were explicitly targeted at supporting demand in more price-sensitive segments.

In contrast to the relative stability of prices, housing units sold (demand) and housing units built (supply) display notable cyclical volatility with recurrent downturns. Periods of weaker growth in units sold during economic slowdowns are often followed by adjustments in construction activity, suggesting that developers adjust supply after observing demand conditions, rather than contemporaneously or in advance. Periods of moderating demand are typically associated with subsequent moderation in new supply, while demand recoveries tend to precede improvements in construction activity. Taken together, these patterns indicate that cyclical fluctuations in the primary housing market are reflected more visibly in transaction volumes and construction activity than in observed price movements, consistent with developers' tendency to smooth prices and manage production in response to changing market conditions.

Overall, the primary RPPI provides a stable benchmark for supply-side price developments but is inherently less responsive to short-term demand fluctuations. These characteristic underscores its complementary role within Bank Indonesia's broader property price monitoring framework, where more flexible indicators (such as big data-based Secondary RPPI) capture higher-frequency market dynamics.

Chart 1 Indonesia Primary RPPI

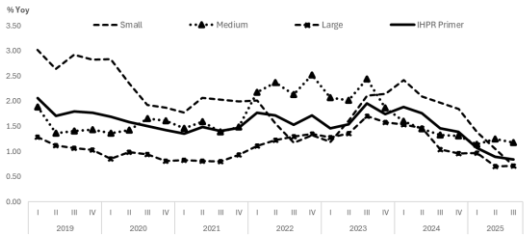


Chart 2 Growth of Housing Units Sold and Housing Units Build

III.2 Secondary Residential Market – Appraisal-based index

Secondary residential property prices are monitored through an appraisal-based survey (*SHPR Sekunder*), which serves as a price movement indicator rather than a fully weighted national RPPI[2]. Given the limited number of appraisal observations, covering a core set of valuation attributes (see Appendix A2), and the absence of a comprehensive transaction registry, the appraisal-based series can only capture the changes of the prices. This interpretation is consistent with international guidance for property price measurement in data-constrained markets (Eurostat, 2013; IMF, 2019).

The appraisal-based indicator applies a dual valuation framework comprising the Market Data Approach and the Cost Approach, in line with International Valuation Standards (IVS) and the Uniform Standards of Professional Appraisal Practice (USPAP). The Market Data Approach is based on comparative analysis, using transaction or offer information from comparable properties to estimate market value (IVS 105: Valuation Approaches and Methods). In implementing this approach, appraisers adjust observed prices for differences in location (such

[2] Secondary residential property prices derived from appraisal-based assessments are disseminated internally, as they are still under development.

as accessibility, environmental quality, and amenities), zoning regulations, and physical characteristics (such as land dimension, shape, elevation, and building condition) to ensure comparability and consistency with market value assumptions. Rigorous verification and analytical procedures are required, encompassing physical inspections to identify similarities and discrepancies (USPAP Standards Rule 1-4).

The Cost Approach complements the Market Data Approach and is based on the economic principle of substitution, whereby a rational buyer would not pay more for a property than the cost of acquiring land and constructing an equivalent structure, adjusted for depreciation. This approach operationalizes valuation through the formula:

$$Property\ Value = Land\ Value + (Building\ Value - Building\ Depreciation).$$

This approach is particularly relevant when market comparability is limited or when valuing properties with specialized characteristics. By integrating these two approaches, the appraisal methodology achieves a comprehensive valuation framework that encapsulates both market-driven dynamics and intrinsic cost-based considerations, thereby enhancing the reliability and robustness of RPPI estimations in accordance with globally recognized valuation principles.

Chart 3 Year-on-Year Residential Property Price Developments in Java

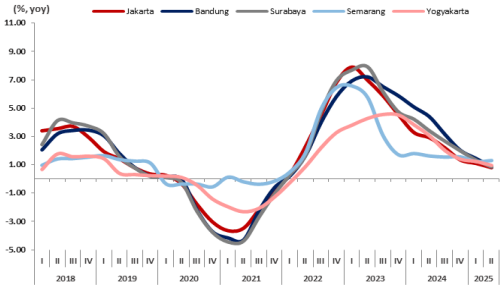
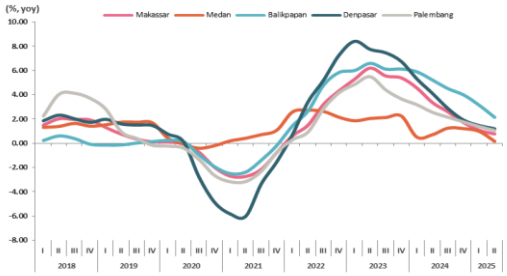


Chart 4 Year-on-Year Residential Property Price Developments Outside Java



Recent results (Chart 2 and 3) indicate a continued moderation in secondary residential market price growth across most surveyed cities. In Q2 2025, year-on-year growth decelerated in several major urban areas, with the sharpest slowdowns observed in Bandung within Java and Balikpapan outside Java. At the same time, localized resilience remains evident in certain cities, such as Semarang, where price growth recorded a marginal increase. These patterns point to a broad-based cooling of secondary market activity while highlighting persistent regional heterogeneity in price dynamics.

Within Bank Indonesia's four-indicator property price monitoring framework, the appraisal-based series provides a stable and internally consistent benchmark for tracking longer-term trends in the secondary housing market. Its strength lies in continuity and expert judgment, complementing the higher-frequency and more responsive signals derived from big data-based indicators.

III.3 Secondary Residential Market – Big Data-based index

The compilation methodology of the big data-based secondary RPPI integrates econometric techniques with large-scale property listing data to produce monthly indicators that capture price

movements while controlling for variations in property characteristics[3]. This approach is designed to enhance timeliness, granularity, and sensitivity to short-term market dynamics, complementing survey and appraisal-based indicators.

Given the complexity and volume of listing data, rigorous data cleaning is a prerequisite for index compilation. The cleaning process includes: i) correcting erroneous entries; ii) standardizing address formats derived from free-text fields; and iii) removing duplicate listings that appear across different months with varying prices. Initial outlier filtering is conducted using the Median Absolute Deviation (MAD) test applied to price per square meter relative to land and building size. In addition, logical constraints are imposed, excluding listings with implausible characteristics, such as land size above 600 m^2, more than 10 bedrooms, or more than 8 bathrooms.

Following this initial cleaning, further outlier detection is performed using Cook's Distance, which identifies influential observations based on the joint contribution of leverage and residual magnitude. Observations exceeding the threshold $D_i > \frac{4}{n}$ are excluded, where Cook's Distance is defined as:

$$D_i = \frac{\sum_{j=1}^{n} \left(\hat{Y}_j - \hat{Y}_{j(i)}\right)^2}{(p+1)\hat{\sigma}^2} \tag{5}$$

where D_i is Cooks's Distance for observation i, $\hat{Y}_j$ is the fitted response value, $\hat{Y}_{j(i)}$ is fitted response value obtained when observation i was removed, p is number of predictors and $\hat{\sigma}^2$ is mean squared error from the regression model.

Once the dataset is refined, price indicators are estimated using a hedonic regression model with a semi-log specification to account for the non-normal distribution of housing prices:

$$\ln(p_n^t) = \beta_0^t + \sum_{\tau=1}^{T} \delta_\tau Dumm_n^\tau + \sum_{k=1}^{K} \beta_k^t z_{nk}^t + \varepsilon_n^t \tag{6}$$

where p_n^t denotes the asking price of property n at time t, $Dumm_n^\tau$ are time-dummy variables capturing pure price changes, and z_{nk}^t represents property characteristics such as size and location.

To maintain temporal consistency and avoid historical revisions, the model is estimated a 12-month rolling window. Each month, the oldest observation is dropped and the newest observation added, and monthly indicators are chained accordingly. Regional indicators are then aggregated into a national RPPI using fixed weights based on the distribution of mortgage collateral values across regions:

$$\frac{p^{\tau+1}}{p^1} = \exp\left(\hat{\delta}_1^\tau\right) \times \frac{\exp\left(\hat{\delta}_1^{\tau+1}\right)}{\exp\left(\hat{\delta}_2^\tau\right)} \tag{7}$$

Finally, regional indicators are aggregated into the national RPPI using fixed weights based on the distribution of mortgage collateral values across regions:

$$I_t^{national} = \sum_r w_r \cdot I_{r,t}^{region} \tag{8}$$

[3] The secondary residential property price index derived from a big data-based index is disseminated internally, as the underlying data are confidential and subject to a cooperation agreement with the service provider.

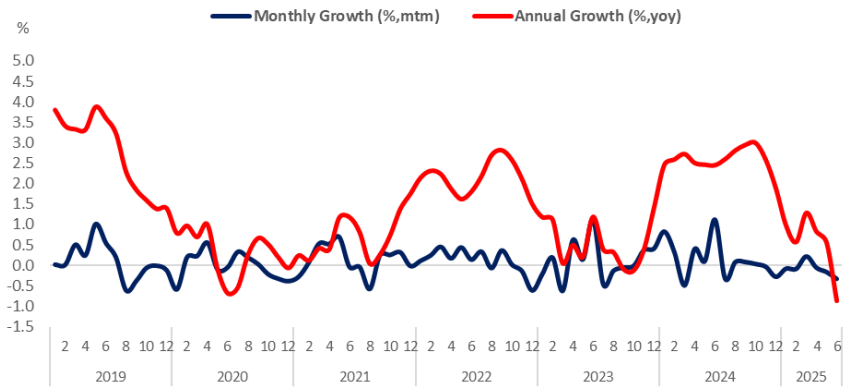
This integrated approach ensures that the big data-based RPPI reflects both market dynamics and quality adjustments, providing a robust and policy-relevant indicator for monitoring secondary housing prices.

The big data-based RPPI exhibits price movements that are broadly consistent with those observed in the primary RPPI and the appraisal-based secondary RPPI, but with substantially higher volatility and more frequent variation (Chart 4). Unlike survey and appraisal-based measures, where price declines are rarely recorded, the big data RPPI captures short-term downward price adjustments. In Q2 2025, secondary housing prices declined by 0.87% (yoy), reversing growth recorded in the previous period, while monthly price changes showed a deepening contraction. These developments indicate continued weakening demand in the secondary housing market and demonstrate the value of high-frequency listing data in detecting short-term price movements and potential turning points.

Rather than replacing appraisal-based measures, the big data RPPI serves as a complementary analytical indicator. Together, the two approaches balance stability and responsiveness: appraisal-based indicators provide continuity and longer-term benchmarks, while big data-based indicators deliver timely signals of market adjustment providing continuity and longer-term benchmarks, and big data-based indicators offering timely signals of market adjustment.

Chart 4 is showing monthly and annual growth rates derived from hedonic indicators based on online property listings. Compared with survey- and appraisal-based indicators, the big-data RPPI exhibits higher volatility and captures short-term price adjustments, providing early signals of changes in secondary housing market conditions.

Chart 5 Secondary RPPI Big Data (Big data-based)



III.4 Commercial Property Price Index (CPPI)

The Commercial Property Price Index (CPPI) in Indonesia is designed to monitor price dynamics across major commercial property segments using data from the quarterly *Survei Perkembangan*

Properti Komersial (PPKom)[4]. To ensure reliable and comparable measurement, the compilation methodology aligns with international standards recommended by the Eurostat[5].

The CPPI covers seven commercial property segments which are offices, retail space, hotels, warehouses, industrial land, convention halls, and, previously, apartments across eleven key regions that together represent the core of Indonesia's commercial property market. These segments capture a broad range of ownership-based market activities that are closely linked to business investment, corporate balance sheets, and financial stability conditions.

To reflect market heterogeneity, the CPPI is constructed using a hierarchical aggregation framework. At the most granular level, price indicators are computed at the category level using the Irving Fisher formula, which combines Laspeyres and Paasche indicators to mitigate short-term compositional effects. Category-level indicators are aggregated into segment-level indicators using weights based on the value of stock, defined as supply multiplied by price. Segment indicators are then aggregated into regional indicators and, finally, into the national CPPI, using a Laspeyres-type aggregation with fixed weights.

Starting in the second quarter of 2019, Bank Indonesia implemented several methodological and scope enhancements to improve the accuracy and representativeness of commercial property price measurement:

- **Coverage adjustment**: Exclusion of apartment-for-sale units from monitored commercial property types.
- **Weighting revision**: Transition from market capitalization to *value of stock* as the weighting basis.
- **Index formula update**: Adoption of the Irving Fisher index in place of pure Laspeyres formulation.
- **Base year update**: Change of reference base year from 2012 = 100 to 2017 = 100.

These refinements align Indonesia's Commercial Property Price Index (CPPI) framework with international best practices, ensuring improved comparability and analytical robustness. The CPPI are composite indicators calculated using the Irving Fisher formula with *value of stock* as the weight. The weighting variable is defined as:

$$\textit{Value of Stock} = \textit{stock (supply)} * \textit{price} \tag{9}$$

Commercial Property Price Index

$$IP_n = \frac{\sum(IW_n \times W_{wn})}{\sum W_{wn}} \tag{10}$$

where:

[4] Commercial property price indicators compiled from the Survei Perkembangan Properti Komersial (PPKom) are published in the quarterly Commercial Property Survey reports, which can be accessed at the following link: https://www.bi.go.id/en/publikasi/laporan/Pages/PPKom_Triwulan_II_2025.aspx.

[5] According to the Eurostat CPPI Handbook, the compilation of Commercial Property Price Indicators involves classifying commercial properties into several segments, including wholesale and retail trade buildings, office buildings, industrial buildings, hotels and hospitality buildings, hospital or institutional care facilities, leisure, culture and education buildings, technical infrastructure buildings, other non-residential buildings, and other related structures; furthermore, among the recommended index formulas that may be applied, the Fisher Ideal Index, proposed by Irving Fisher, serves as one of the suitable methods for constructing CPPI due to its balanced combination of Laspeyres and Paasche characteristics, yielding a theoretically robust measure of price change.

$$IW_n = \frac{\sum(IS_n \times W_{sn})}{\sum W_{sn}}; IS_n = \frac{\sum(IH_{n(F)} \times W_{kn})}{\sum W_{kn}} \quad (11)$$

the Fisher index for each category:

$$IK_{n(F)} = \sqrt{IK_{n(L)} \times IK_{n(P)}}\,; \quad (12)$$

with:

$$IK_{n(L)} = \sum \frac{p_n \times q_0}{p_0 \times q_0} \times 100\,; IK_{n(P)} = \sum \frac{p_n \times q_n}{p_0 \times q_n} \times 100 \quad (13)$$

IP_n = Commercial property price index in period n

IW_n = Commercial property price index per region in period n

W_{wn} = Weight value of stock per region in period n

IS_n = Commercial property price index per segment in period n

W_{sn} = Weight value of stock per segment in period n

$IK_{n(F)}$ = Commercial property price per category Fisher method

$IK_{n(L)}$ = Commercial property price per category Laspeyres method

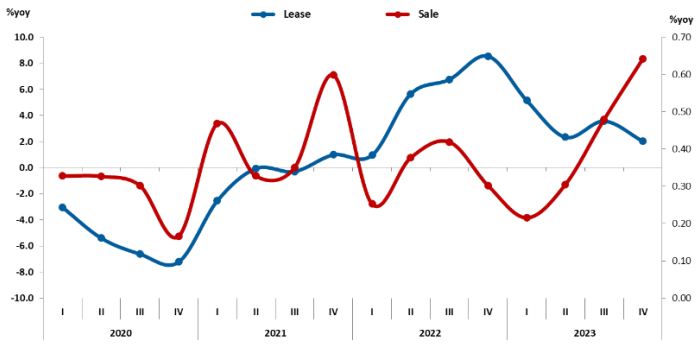
$IK_{n(P)}$ = Commercial property price per category Paasche method

W_{kn} = Market capitalization per category in period n

The results reveal a clear divergence between sale and lease markets (Chart 5). Sale prices remained broadly flat throughout the observation period, including during the COVID-19 shock, indicating strong price rigidity in ownership-based commercial properties. In contrast, lease prices experienced sharp declines during the pandemic, followed by a rebound and subsequent moderation as economic activity recovered.

This divergence suggests that leasing markets adjust more rapidly to changes in business conditions, occupancy rates, and rental negotiations, while sale prices respond more slowly. As a result, lease price dynamics act as a key transmission channel for economic shocks and recoveries within Indonesia's commercial property sector. Within Bank Indonesia's broader property price monitoring framework, the CPPI therefore provides critical insights into corporate real estate conditions and complements residential property indicators by capturing business cycle sensitive price adjustments.

Chart 6 Indonesia CPPI



IV DISCUSSION

IV.1 Why Multi Indicator Preferable Under Limited Administrative Data

The central methodological insight emerging from Indonesia's experience is that, with limited administrative property data, the optimal statistical design is not a single index but a system of complementary indicators. A single property price index would not be able to simultaneously satisfy the core statistical objectives of representativeness, timeliness, stability, and policy relevance. Each data source and compilation method could face trade-offs among these objectives. Attempting to force a single indicator to perform all functions risks either sacrificing statistical credibility or obscuring economically meaningful signals.

In data-rich environments, transaction-based and repeat-sales indicators can approximate these objectives within a unified framework. In limited administrative data environments, however, the absence of comprehensive administrative records makes such unification infeasible. Survey-based indicators tend to provide continuity and internal consistency but exhibit price rigidity and limited sensitivity to short-term market dynamics. Appraisal-based indicators offer expert-informed valuation but smooth cyclical movements and delay the detection of turning points. Big data-based indicators derived from online listings enhance frequency and responsiveness, but face challenges related to representativeness, duplication, and spatial heterogeneity.

The multi-indicator framework adopted by Bank Indonesia reflects an explicit recognition of these structural trade-offs. Rather than seeking to approximate an unattainable "ideal" index, the framework assigns different statistical roles to different indicators. Benchmark indicators are designed to provide stable reference points for long-term price trends and structural developments, while signal indicators are designed to extract timely information about short-term market adjustments and emerging turning points.

This separation of roles transforms data limitations into a structured analytical design problem, in which statistical objectives are explicitly mapped to distinct data sources and index methodologies. Divergence across indicators is not interpreted as a statistical inconsistency, but as economically meaningful information generated by differences in market segments, pricing mechanisms, and pricing behaviour.

The resulting framework prioritizes complementarity over substitution. Each indicator contributes partial information, and the combined system delivers a richer and more robust representation of property market dynamics than any single index could achieve in isolation.

IV.2 Roles and Trade-offs Across Property Price Indicators

To operationalize the multi-indicator framework, each property price indicator is assigned a distinct statistical role based on its underlying data source, compilation method, and policy use-case. Rather than ranking indicators by perceived "quality", the framework evaluates them in terms of their functional trade-offs across key statistical objectives. Table X summarizes the core roles, strengths, and limitations of each indicator within Bank Indonesia's property price monitoring system.

Table 1 Roles and Trade-offs across Indonesia's Property Price Indicators

Indicator / Market Segment	Data Source	Freq	Primary Role	Key Strength	Known Limitation / Bias	Best Policy Use
Primary RPPI (Developer Survey) / Residential – Primary	Developer survey	Q	**Benchmark**	Long historical continuity; stable measurement of supply-side pricing	Price rigidity; limited quality adjustment; insensitive to short-term demand	Structural trend analysis; construction sector assessment; policy calibration
Secondary RPPI (Appraisal) / Residential – Secondary	Appraisal survey	Q	**Benchmark**	Expert-informed valuation; consistent long-term trend	Smoothing of cycles; limited geographic representativeness	Household wealth monitoring; medium-term risk assessment
Secondary RPPI (Big Data) / Residential – Secondary	Online property listings	M	**Signal**	High frequency; quality-adjusted; early turning-point detection	Asking-price bias; duplication; spatial heterogeneity	Market surveillance; cyclical monitoring; early-warning indicator
CPPI (PPKom Survey) / Commercial	Commercial property survey	Q	**Benchmark**	Captures corporate-cycle sensitivity; lease vs sale dynamics	Segment aggregation masks heterogeneity	Business cycle analysis; financial stability; corporate balance sheet risk

IV.3 Interpreting Divergence and Cross-Validation Across Indicators

A central advantage of the multi-indicator framework is that divergence across property price indicators can be interpreted as economically meaningful information rather than as statistical inconsistency. Because each indicator is designed to capture different segments of the market, pricing mechanisms, and pricing behaviour, differences in their movements reflect genuine heterogeneity in property market dynamics.

In the residential sector, divergence between the primary RPPI and secondary market indicators is expected during periods of demand contraction. Developer-based prices in the primary market tend to exhibit downward rigidity, as developers adjust quantities and incentives rather than headline prices. In contrast, secondary market prices, particularly those derived from online listings, respond more rapidly to changes in buyer sentiment, financing conditions, and liquidity constraints. A widening gap between primary and secondary RPPIs therefore signals shifts in market clearing conditions rather than measurement error.

Divergence between appraisal-based and big data-based secondary RPPIs provides further analytical insight. Appraisal-based valuations smooth short-term fluctuations and reflect expert assessments of underlying market value, while big data-based indicators capture real-time adjustments in asking prices and marketing behaviour. When both indicators move in the same direction, confidence in the underlying price trend is strengthened. When they diverge, the discrepancy serves as an early-warning signal of changing market conditions or emerging turning points.

In the commercial property sector, divergence between sale and lease price indicators is particularly informative. Sale prices tend to adjust slowly due to infrequent transactions, valuation anchoring, and long investment horizons. Lease prices, by contrast, respond more directly to occupancy rates, cash flow conditions, and short-term business expectations. As a

result, lease price dynamics act as a more sensitive transmission channel for macroeconomic shocks, while sale prices provide a slower-moving indicator of structural market conditions.

IV.4 Key Challenges and Limitations in Property Price Measurement in Indonesia

As with any property price system developed under incomplete administrative coverage, certain design boundaries remain inherent to the current framework. These constraints do not diminish the analytical value of the indicators, but they shape the interpretation of results and guide ongoing refinements.

The compilation of property price indicators in Indonesia operates within structural and methodological conditions typical of large and heterogeneous emerging economies. These conditions mainly reflect the evolving availability and coverage of property market data, particularly the limited use of comprehensive, transaction-based administrative records, rather than constraints in institutional capacity. To address this environment, Bank Indonesia applies a multi-indicator framework that combines survey-based, appraisal-based, and big data-based approaches, allowing different sources to complement one another while balancing stability, representativeness, timeliness, and sensitivity to market conditions.

- **Primary Residential Market (SHPR Primer)**

  The primary RPPI provides a long-standing and consistent benchmark for monitoring supply-side pricing behaviour in newly built housing. Current quality adjustment incorporates stratification by house size and selected structural characteristics, including the number of bedrooms and bathrooms. However, more granular attributes, such as neighbourhood quality, environmental risk exposure, accessibility, and the increasing inclusion of furnished components in new developments, are not yet systematically integrated into the quality-adjustment framework.

  Ongoing refinements therefore focus on expanding metadata collection and progressively enriching quality controls. In addition, developer pricing behaviour, particularly the tendency to maintain asking prices during periods of weak demand, results in relatively smooth price trajectories. While this characteristic supports stability and continuity, it may moderate short-term responsiveness to cyclical demand fluctuations.

- **Secondary Residential Market (Appraisal-Based RPPI)**

  The appraisal-based SHPR Sekunder offers a consistent and internally coherent benchmark for monitoring secondary housing markets in the absence of comprehensive transaction records. By design, appraisal-based valuation emphasizes structural comparability and expert-informed assessment. This contributes to stability in longer-term trend analysis.

  At the same time, appraisal-based indicators may reflect cyclical turning points with some delay, as valuation practices tend to smooth short-term fluctuations. Geographic coverage and representativeness are shaped by purposive sampling. To enhance analytical robustness, Bank Indonesia continues to expand city coverage, refine validation protocols, and explore the incorporation of supplementary information, such as renovation activity and depreciation indicators, to better approximate quality changes over time.

- **Secondary Residential Market (Big Data-Based RPPI)**

  The big data–based RPPI substantially enhances timeliness, granularity, and short-term sensitivity. Its strengths lie in frequency, scale, and the ability to implement hedonic quality adjustment using rich structural attributes.

  Areas of ongoing development include deeper treatment of spatial heterogeneity, systematic standardization of location-quality indicators, and improved management of duplicate listings across digital platforms. Coverage is currently concentrated in major urban markets, reflecting data availability. Methodological improvements focus on enhanced geospatial enrichment, algorithmic deduplication, and broader platform integration, with the objective of progressively strengthening representativeness and analytical consistency.

- **Commercial Property Price Index (CPPI)**

  In the commercial segment, heterogeneity across property types and between lease and sale markets introduces structural complexity. Aggregation across segments can moderate visible submarket divergence, while weighting structures influence the measured dynamics of composite indices.

  In response, ongoing refinements include deeper segment-level analysis, assessment of alternative weighting structures, and continued alignment of classification frameworks to enhance granularity and facilitate cross-country comparability.

These considerations illustrate that property price measurement under incomplete administrative coverage is an evolving process of methodological calibration. Rather than representing weaknesses, the identified boundaries define the design space within which statistical innovation operates. Through continuous improvements in data integration, metadata enrichment, and methodological refinement, Bank Indonesia seeks to progressively enhance the robustness, interpretability, and policy relevance of its property price indicators, while maintaining coherence within the multi-indicator framework .

IV.5 Ongoing and Future Methodological Improvements

Methodological development of Indonesia's property price indicators is pursued as a process of continuous refinement rather than structural redesign. The objective is to progressively strengthen data quality, analytical precision, and financial integration while preserving the conceptual coherence of the multi-indicator framework .

Current improvements focus on enhancing the robustness of data processing pipelines, particularly for the big data–based Residential Property Price Index (RPPI). Refinements include clearer and more standardized outlier detection procedures, strengthened duplicate identification across platforms and time periods, and improved cross-variable consistency checks. These measures aim to reduce compositional volatility and improve stability in high-frequency price signals.

Further methodological development concentrates on enriching spatial stratification. The integration of more granular geospatial information, such as standardized location coding, geographic coordinates, and neighbourhood descriptors extracted from structured and semi-structured listing data, is being expanded to better capture intra-urban price heterogeneity.

Enhanced spatial precision is expected to improve both hedonic estimation and the interpretability of city-level price movements.

Integration with financial-sector information represents another area of development. Mortgage financing constitutes the dominant funding channel for primary housing purchases, and mortgage-related indicators, such as loan volumes, collateral valuations, and exposure distributions, are increasingly incorporated as complementary analytical inputs. Further refinement of weighting structures using financial exposure data is being assessed to strengthen the connection between property price developments, credit conditions, and macro-financial surveillance.

Methodological enhancements also extend beyond price indices. Greater emphasis is being placed on complementary quantity- and market-activity indicators, including transaction proxies, time-on-market measures, and segment-level demand signals, to support more nuanced interpretation of cyclical dynamics, particularly during periods when asking prices adjust gradually.

Looking ahead, continued improvement in administrative data infrastructure may create opportunities for selective integration of transaction-level records where feasible. Such developments would enhance weighting precision and potentially support further methodological extensions. Importantly, these advancements are intended to reinforce rather than replace the existing multi-indicator framework, whose strength lies in the complementarity between stable benchmark indicators and more responsive signal measures.

Through ongoing enhancement of data integration, spatial granularity, and methodological rigor, Bank Indonesia aims to progressively deepen the analytical value and policy relevance of its property price monitoring system while maintaining consistency and institutional continuity.

V CONCLUSION

This paper argues that in environments characterized by limited administrative transaction data, the objective of property price measurement is not to approximate an ideal single index, but to design a coherent system of complementary indicators. A single property price index is unlikely to simultaneously fulfil the core statistical objectives of representativeness, timeliness, stability, and policy relevance. Under persistent limited administrative data, a multi-indicator framework that distinguishes between stable benchmark measures and more responsive signal indicators provides a more robust and operationally feasible framework for monitoring residential and commercial property markets.

Indonesia's experience illustrates that policy-relevant property price statistics can be developed even in the absence of comprehensive transaction-based registries. By combining developer surveys, appraisal-based valuation, and big data–based hedonic estimation, Bank Indonesia has established an integrated monitoring framework that balances continuity with responsiveness. Rather than relying on a single proxy for market conditions, the system leverages complementary indicators to capture different segments of the property market, distinct pricing mechanisms, and varying behavioural responses. This complementarity enhances interpretability and strengthens the analytical value of property price information for monetary policy, macroprudential surveillance, and financial stability assessment.

Four transferable lessons emerge from this experience.

- **structural limited administrative data** should be treated as a design constraint rather than a temporary obstacle; statistical systems must be optimized for imperfect data environments rather than waiting for ideal administrative infrastructure.
- **separating benchmark indicators from signal indicators** allows statistical agencies to reconcile the competing objectives of stability and timeliness without compromising historical continuity.
- **divergence** across indicators does not necessarily imply statistical inconsistency; it may instead reflect genuine heterogeneity across market segments and pricing behaviours. Interpreted appropriately, such divergence provides additional analytical insight rather than confusion.
- **integration of survey-based and big data-based** sources enhances both cross-validation and early detection of cyclical turning points, strengthening the policy relevance of property price statistics.

Looking forward, Bank Indonesia will continue to strengthen its property price monitoring framework through incremental enhancements in data integration and methodological practice. Priorities include further expansion of big data-based RPPIs, continued improvement in data cleaning and deduplication procedures, incorporation of more granular spatial information, and deeper analytical use of mortgage-related data and collateral valuations as complementary indicators. These initiatives are intended to reinforce the existing multi-indicator framework and further enhance the timeliness, interpretability, and policy relevance of property price statistics.

Indonesia's experience demonstrates that robust property price measurement under limited administrative data should not necessarily be viewed as a second-best compromise, but a structured and adaptable statistical strategy. The emphasis on complementarity, transparency, and methodological coherence offers practical guidance for central banks and statistical agencies facing similar institutional and data environments.

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Appendix

A. Variable Definitions

Table A.2 Definitions of Variables on Primary RPPI

Variable	Description	Unit
House size	• Small (building up to 36) • Medium (building area > 36 to 70) • Large (building area > 70)	m^2
Number of bedroom	-	unit
Number of bathroom	-	unit
House selling price	Listed selling price of a residential unit by payment method (cash, installment cash, or mortgage). Discounted prices are excluded unless applied uniformly within the reference quarter.	IDR/unit
Land selling price	Selling price of land associated with residential units sold during the reference quarter; vacant land prices may be used as a proxy.	IDR/ m^2
Housing units sold	Residential units recorded as sold upon payment of a down payment (DP), excluding booking fees.	unit
Housing units constructed	Residential units recorded as constructed once the house foundation is completed.	unit
Geographic coverage	The Residential Property Price Survey (SHPR) for primary markets, known as the Primary RPPI Survey, targets property developers in 18 cities, including Jabodebek-Banten, Bandung, Semarang, Surabaya, Medan, Padang, Palembang, Bandar Lampung, Yogyakarta, Banjarmasin, Denpasar, Manado, Makassar, Pontianak, Batam, Balikpapan, Samarinda, and Pekanbaru. The survey results are converted into a residential property price index (RPPI) for each city and a national index (combined 18 cities).	-

Table *A*.3 Definitions *o*f Adjustment Variables on Secondary Appraised RPPI

Variable	Explanation
Time	Transaction time differences are adjusted based on inflation factor
Location	Accessibility, boundary, location image
Ownership	Land ownership status (AJB, Girik, HGB, Freehold, Right of Use)
Shape	Land plot shape (rectangle, square, trapezoid, or irregular)
Elevation	Land height
Area	Land size affects price (smaller = mode expensive)
Land Preparation	Related to contour affecting price
Land Position	Position within area (main road, primary road, secondary road, alley, dead-end)
Variable	**Definition**
Geographic coverage	The survey covers secondary residential properties located across ten major cities in Indonesia, Jakarta, Surabaya, Makassar, Semarang, Medan, Bandung, Balikpapan, Denpasar, Palembang, and Yogyakarta.

Table A.4 Definitions of Variables on Secondary RPPI (Big Data)

Variable	Definition	Unit
Price	Asking price of the residential property as listed on the online property portal.	IDR
Building area	Total floor area of the residential property.	Square meters
Lot size	Total land area of the residential property. Observations are restricted to houses with a land area of less than 601 m^2.	Square meters
Bedroom	Number of bedrooms in the residential property, categorized as 1–2, 3, 4, and more than 4 bedrooms.	Category
Bathroom	Number of bathrooms in the residential property, categorized as 1, 2, 3, and more than 3 bathrooms.	Category

Period	Advertisement period of the residential property, recorded in year–month format (YYYYMM).	Year–month
Geographic coverage	The sample design prioritizes coverage and representativeness by collecting detailed property listings from 12 key regions for landed houses, Jakarta, Surabaya, Bandung, Semarang, Medan, Makassar, Denpasar, Yogyakarta, Bogor, Bekasi, Depok, and Tangerang (including South Tangerang), and from five cities in Jakarta for apartment units.	-

Table A.5 Definitions of Commercial Property Features

Item	Description
Geographic coverage	The Commercial Property Price Index (CPPI) is derived from commercial property data collected in Greater Jakarta (Jakarta, Bogor, Depok, and Bekasi), Banten, Bandung, Makassar, Surabaya, Semarang, and Medan. Since 2017, survey coverage has been expanded to 11 cities: Jakarta; Bodebek (Bogor, Depok, and Bekasi); Banten; Bandung; Makassar; Medan; Semarang; Surabaya; Balikpapan; Denpasar; and Palembang.
Property types covered	Office buildings, shopping centres, apartments, hotels (3-, 4-, and 5-star), industrial estates, convention halls, and warehouse complexes.
Main index	Commercial Property Price Index (CPPI), measuring price developments in the commercial property market.
Additional indicators	Commercial Property Supply Index and Commercial Property Demand Index, capturing supply-side and demand-side market conditions.
Data source	Bank Indonesia commercial property survey.
Frequency	Quarterly.

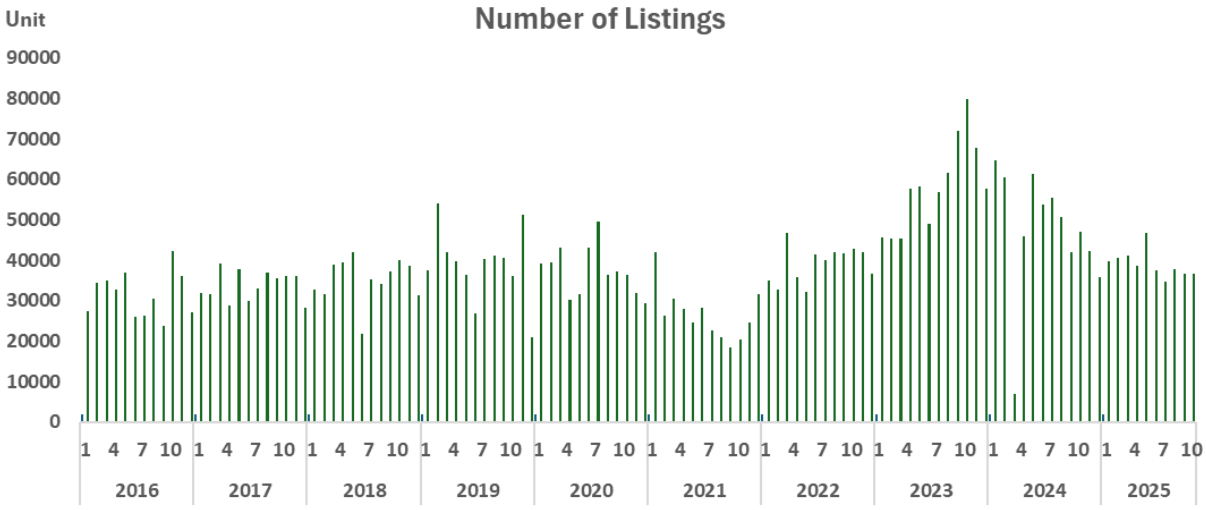
Table A.6 Definitions of Commercial Property Segment

Segment	Explanation
Office	High-rise office buildings, including leased office spaces, office units sold under a strata-title scheme, and owner-occupied or owner-operator leased properties.
Retail	Stores located within shopping centers designed as malls, generally three floors or more, forming an integrated building structure. This excludes shop houses (ruko) and other external retail units. Surveyed retail units are

Segment	Explanation
	typically located near the main lobby, represent commonly leased tenant types, and do not include anchor tenants. Retail properties observed include both sale and rental categories
Apartment	The most sold or rented unit types within each apartment complex. Both sale and rental apartment segments are surveyed.
Star-rated hotels (3-, 4-, and 5-star)	The most frequently booked room types, such as deluxe or superior, recorded using walk-in rates (not online prices) based on the average of the last three months within the current quarter.
Industrial land	Areas specifically developed and organized for industrial activities and managed by Industrial Estate Companies as regulated under Government Regulation No. 20 of 2024.
Convention halls	Multifunctional event spaces capable of accommodating at least 1,000 participants in a classroom layout. These include stand-alone facilities, hotel facilities, and office-building facilities.
Warehouse complexes	Various types of warehouses such as Standard Factory Buildings (SFB), Customized Industrial Buildings (CIB), and 3-in-1 warehouses. The minimum development area for inclusion is 10 hectares.

B. Supplementary Figures

Graph B.1 Number of Listings (monthly)



Graph B.2 Annual Change of CPPI by Segment