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Orava Residential REIT – External Audit of Valuation Model

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Assignment

The object and contents of the external audit

- Orava Asuinkiinteistörahasto Oyj, also known as Orava Residential REIT, Orava Rahasto, Orava fund, or Orava, has requested an external audit statement from Realia Management Oy (Realia).
- The purpose of the audit is to ascertain independently the balanced and quality and the true and fair treatment of the data and the results in respect to all parties involved.
- Realia has also performed previous external audits, dated 10.6.2012 and 16.9.2013.
- The object of audit is the automated property valuation model by the Orava fund.
- The purpose of the automated valuation model is to define a market value for the properties owned by the Orava fund. The audit of the model is thus limited to the use of the model for the defining of market value for the aforementioned portfolio at the time of the audit.
- The audit is based on the data and information obtained from Orava and other sources, in part verified against each other.

Contents

- The audit includes the processes from data collection to result reporting. The following are analysed: the quality of data and other source material; modification and imputing of data; models and their qualities; modelling; and result reporting. A deeper analysis is performed on randomly selected models and models where potential issues have been detected.
- The audit is based on valuation Orava valuation model 2014:08. For a more thorough evaluation, the current model is also compared against previous models to establish continuity.

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About regression models

The Orava property valuation model is based on a hedonic regression using a transformed log-linear ordinary least squares method.

- When using any advanced modelling techniques with real world implications there are often trade-offs between model effectiveness and ease of understanding. In regression analysis, the use of linear-estimators (ordinary least squares) with their possible transformations is commonplace due to their established position in the scientific community.
- The use of linear estimators hinges upon several assumptions concerning the modelling data. Many of these assumptions are often violated to some degree for convenience. When estimating the quality of the model, much of the effort needs to be directed towards defining the degree and effect of these violations. These violations are also a reason why potential outliers should be treated with additional suspicion, as they may be an indication of a serious model specification error.
- In theory, the use of robust estimators provides superior results over industry standard linear or log-linear regressions in cases where data is suspect. However, those with even rudimentary skills in regression analysis have a much better chance of recognising a good or a seriously faulty regression when it follows industry practice, and therein lies the power of (transformed) linear regressions over lesser-known variants. Even those considered to be top professionals in the field appreciate the simplicity and ease of use and often rely on linear models due to the intuitiveness of the modelling, thus reducing the risk of human error in model specification.

In the case of Orava, the need for transparency outweighs the few benefits that alternative models can provide. Thus, the currently used ordinary least squares model is considered the preferred form of the regression.

Furthermore, the following properties of the model can be considered important in evaluating a model:

- unbiasedness
- efficiency
- a reasonable level of coefficient of determination, or R^2
- coefficients within expected bounds
- an acceptable level of heteroscedasticity
- a low level of autocorrelation
- reasonable variance of residuals

The above are key properties of the model in establishing the quality of the regression model. However, in the application of regression theory, one must also take into account the real world constraints. In real property modelling, the unquantifiable number of variables affecting price formation can prove challenging. Micro-locational aspects are particularly problematic, while some, such as the size property, are more easily quantifiable. Thus, many of the challenges in data collecting and its subsequent modelling are evident in the properties of the final regression model.

When the primary use for the model is price estimation, biasness is by far the most important property of the model. A non-biased model would suggest that a sample run for a set of typical properties is likely to achieve a figure, which, on average, is no higher or lower in value than their true price. Typically, a more obvious problem in real property modelling is heteroscedasticity, suggesting that there are variables that have not been taken into account in the model in their correct form or that there may be an underlying misspecification related to eg. error terms. Problems with heteroscedasticity can manifest themselves in unexpected ways. Nonetheless most of the problems related to heteroscedasticity are typically seen at the very far reaches of the modelling sets, ie. in properties with extremely large or small floor area, or properties with exceptional locational attributes.

Automated valuation

- The human intuition and the heuristic ability to weigh in important factors in value formation cannot be overlooked. In addition, while automated models are more likely to consider indications of micro-trends and typical market fluctuations as market evidence for a lasting trend, human intuition is more perceptual to the long-term trend and more likely to attribute weak evidence to a temporary fluctuation in the property cycle.
- The most obvious difference between automated valuation and traditional valuation is in cases of lacking market evidence. Professional valuers are more likely to define market value according to the latest strong market evidence. However, an automated valuation model will typically extrapolate the last known trend even if there is no solid evidence for the continuation of the trend.
- Strength of an automated valuation model is the ability to divide the value into smaller denominators whereby value is created through sums of its parts through hedonic analysis. It is also better at modelling micro-trends that might otherwise go unnoticed.
- Regression analysis requires a functioning market in its typical state. In the event of exogenous events with considerable impact on the market dynamics, for example a severe recession, a traditional valuation is a more suitable method for the defining of market value.
- It is to be noted that the actual, eventual sale price is the market price. However, this market price can be either over- or underpriced compared to the market average. To understand the nature of a market value estimate one should not expect the sales price to be exactly the same as the estimated value as this would be a highly unlikely event due to natural variation in price formation. Therefore, single events of actual sales price evidence cannot be considered a testament to the accuracy of the market value estimate. This is regardless of which specific valuation model or method has been used.
- According to IVS, the definition of market value is the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion.

While both types of valuation are acceptable as long as certain quality criteria are met, they are ultimately alternative views on the same value. Depending on the area under analysis, quality of data and the state of the market, one or the other method may be more accurate. However, as both values are likely to be within acceptable bounds of valuation accuracy, assuming a typical market situation, it is best to take both methods of market value estimation as supporting evidence of true market price.

Orava automated valuation model

- As Orava Residential REIT is a holder of assets that can be described as rather typical apartments in relation to the available database, the effect of a relatively small statistical population, possible heterogeneity and the failure in capturing value of potential outliers is somewhat mitigated.
- Due to theoretical and practical challenges in real property modelling and its testing, it is important that a benchmark is used. In the case of Orava Residential REIT, the portfolio is also valued by an independent valuer (Realia or Newsec) to which the results can be compared, allowing opportunity for the discovery of potential problems.
- The Orava model is a relatively short spanning temporal analysis, a 2-year quarterly based dummy model, where recent data is given sufficient emphasis by default.

Changes since previous audit

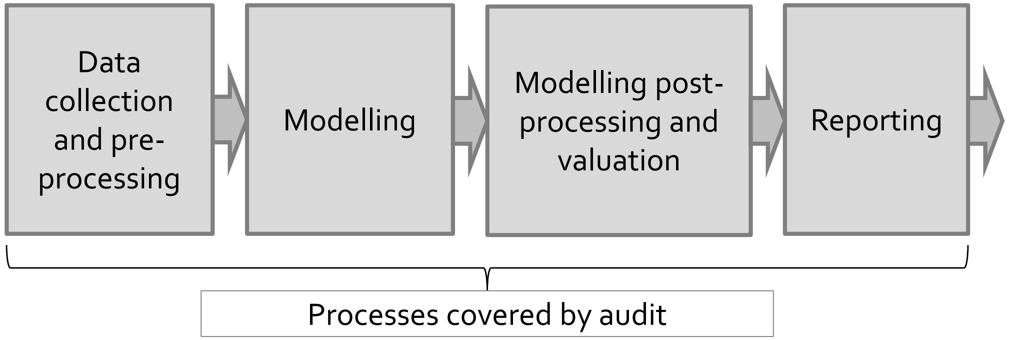
- Addition of apartment dummy to which a sales or asking price evidence for the apartment in question is attached.
- New assets in Heinola, Helsinki, Jyväskylä, Järvenpää, Kerava, Kirkkonummi, Kokkola, Kotka, Lahti, Lohja, Nurmijärvi, Oulu, Pori, Porvoo, Riihimäki, Savonlinna, Tampere, Turku, Vantaa and Varkaus.

Information on Orava models

- There are 53 assets (defined for the purpose of this audit as combinations of individual apartment assets at a single location) for which value is estimated through modelling. These assets reside in Espoo (1), Hamina (1), Heinola (1), Helsinki (1), Hämeenlinna (1), Jyväskylä (3), Järvenpää (2), Kerava (1), Kirkkonummi (1), Kokkola (1), Kotka (4), Lahti (5), Lohja (2), Nurmijärvi (3), Oulu (5), Pori (2), Porvoo (1), Riihimäki (1), Salo (1), Savonlinna (1), Sipoo (1), Tampere (4), Tornio (2), Turku (1), Vantaa (3) and Varkaus (4).
- There can be more models than there are assets. For example, the Sipoo asset has both row house and block of flats apartments and is thus modelled using separate models.
- The models employ ordinary least square linear regression model where the dependent variable has undergone a natural logarithm transformation. The dependent variable is price per square meter in all models.
- Independent variables are the following: size in square meters, age, condition, the existence of sauna, time of observation, lot ownership, type of building, location approximation based on postal codes and a square kilometre proximity dummy to the primary object of modelling. In addition, if single apartments have been sold from the asset location or there is a sales transaction for the apartment being valued, these are included as sales evidence adjusted by the prevailing bargaining range estimate.
- The models use asking price data from which an average asking price estimate can be formed.
- Asking price estimate is corrected in post-processing by a bargaining range estimate. This results in a sales price estimate.

Processes and audit

The following depicts an approximation of the automated valuation process as followed by Orava Residential REIT.



It is possible to automate the data acquisition to remove many of the outliers and data entries with missing information. However, with the data available to Orava, this would lead to a severely truncated dataset with diminished regressional properties. For a sufficiently comprehensive dataset, data entries with missing information need to be imputed requiring additional labour and creating a potential source of bias.

There is little user discretion in data acquirement process. The process steps of data acquirement have been observed and the quality of the data affirmed by the auditor on the computer owned by a member of the Orava organisation in 2012. No discrepancies have been detected in regards to data collection, and the methodology has remained unchanged.

Data collection

- Orava Residential REIT has an agreement with Oikotie.fi for data sourcing. The data consist of information for creating real property display ads on Oikotie.fi, filled in by respective property owners or agents.
- The data is downloaded directly from Oikotie.fi once per hour and entered into a database. A dump file is created and downloaded from the database, which is then filtered for the latest month and analysed locally.
- In addition, other sources of data are used to support the quality of available market information. Property related data is sourced from Population Register Centre and geocoding information from Oikotie.fi. Various sources are used to gather sales transaction information and these are included in the modelling as evidence after correcting for the bargaining range estimated (see part Post-processing / Bargaining range considerations).

Data pre-processing

- Unrepresentative data is stripped by setting bounds for acceptable values that observations may have, and thus obvious outliers are identified and removed. Each new observation is analysed manually for possible erroneous or missing parameters. Municipal regulated Hitas-properties are removed from the dataset.
- In pre-processing the data, majority of incomplete data is imputed when feasible. This is done with all modelled areas, but paying special attention to areas where observations are scarce. As imputing data is a somewhat arbitrary process and there is a possibility that this would introduce bias if not done with the utmost care. However, for the purpose of a functioning valuation model, imputing is preferable to using a smaller, potentially less representative dataset.

- For imputing missing data, the primary source for the missing inputs are previous validated observations from the same location/building. For the rest of the missing values further information is collected manually using various online services.
- In the source data, building year variable requires careful consideration as it is used ambiguously, referring to building year, renovation year or extension completion year.
- Dummy creation is done according to strict inclusion rule set, which is adhered to throughout the AVM creation process.
- In model valuation of multitenant apartment blocks (multi-storey), only asking price data for multi-storey is used. Should the property under valuation be of any other type, data for terraced houses and semidetached and detached houses is added to the dataset.

Observed issues

There may be multiple listings of the same apartment in the dataset. These observations are not removed and thus those properties that are typically overpriced and possibly re-listed will be overemphasised. The problem of multiple listing is due to dual challenges of labour intensity and the identification problem; it can be hard to specify whether a re-listed apartment is in fact the same apartment. The inclusion of multiple-listed properties is likely to introduce a bias towards a higher level of modelled asking price compared to the true asking price of the modelling population. The effect of the bias is mitigated by employing the bargaining range adjustment in the post-processing phase.

The observing of the process covers data acquisition, data quality checking, imputation of missing data, removal of potential outliers, and finally data entry into the regression. The observation was done to the extent whereby it is possible to ascertain the quality, fairness and objectivity of practices. In particular, special attention was directed to areas where arbitrary measures can be taken.

Evaluation of models and parameters

Analysis of models

- There is weak evidence that some of the models may be biased by a margin due to model specification that is sensitive to sample restriction. However, taking an average of the estimated bias of the models, the result was very close to zero (non-biasness). Thus sample restriction biasness appears to be dataset specific, not inherent to the model, and having a negligible total effect on the portfolio.
- A far greater potential problem than a bias of the model in relation to the dataset is the available dataset that may or may not be representative of the whole market that the model covers.
- The significance of the above-mentioned problems are greatly diminished by aggregating modelled asset prices at portfolio level where potential negative and positive biases will in part cancel each other out. The portfolio is further tested against independent valuation and no significant bias has been detected.
- Standard error of estimation is typical to real property price modelling and varies depending on the heterogeneity of the area and the scope of the available dataset.
- There is strong evidence of some degree of heteroskedasticity in almost all of the models. This is a typical feature of log-linear OLS in real estate regressions. The effect of heteroskedasticity appears to be largely contained, but nevertheless remains an additional source of uncertainty.
- There is evidence of a considerable amount of multicollinearity in multiple models, usually with lat-lon and postal code dummies and to a lesser degree with other variables. Whilst high levels of multicollinearity may affect the stability of the model to an unknown degree, typically the effect can be considered non-consequential when the model's sole use is to analyse the dependent variable, in this case price per sqm.

Analysis of the independent variables

Model coefficient parameters are analysed. Significance of model coefficients can be tested with null hypothesis that the coefficient is zero, i.e. it has no effect. A low p-value indicates that null hypothesis can be rejected. Typically, p-values ranging 0.05 to 0.20 are considered threshold values below which the coefficient should be for it to be considered non-zero with a sufficient probability. If the value of the parameter has been established in previous models, a high p-value does not directly indicate a non-optimised model. Rather, for the given observations, the coefficient may indeed be close to zero – a useful information on its own – or the unexplained variance may not allow for the successful extraction of weak hedonic signals.

- Size variable: the variable is significant in all of the models. This suggests that the size parameter has a strong effect on price formation. There is some multicollinearity present in almost all of the models due to the cubic transformation and/or locational dummies. This may cause increased model instability to a small degree.
- Condition variable: parameters are generally significant and helpful in determining the price estimation. There are some unexpected signs indicating a problem with input in the dataset or the variable is capturing value from an unidentified or unintended source. However, the effect on the price formation is typically quite small. In modelling, unexpected but non-significant coefficients can be zeroed without repercussions.
- Age variable: a cubic transformation has been performed. In all the models, at least one of the age variables was significant. In most of the models all of the age variables, including the polynomial transformation pairs, were significant. There is multicollinearity present between the variables due to the cubic transformation, however it is generally lower than with the size variable.

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Evaluation of models and parameters

- Sauna variable: In most models, the parameter is significant. Typically, a slight positive coefficient is expected. In some models, the coefficient is negative or non-significant, but more problematically, in some models the positive coefficient is considerably high (over 0.2). In these cases, the sauna dummy can be considered a proxy to apartment's amenities and condition as better outfitted apartments often correlate with the inclusion of a sauna and newer apartments are more likely to have a sauna than older ones.
- Time-variables: the significance is largely dependent on two factors. First is the amount of observations, second is the amount of change in value along the passing of time. The low significance should not be an issue; rather, it is the result of natural price variation in a relatively stable market.
- Latitude and Longitude variable: in many models these two dummy variables were insignificant but with somewhat large parameters with opposite signs. Typically, the model is self-correcting and thus often a non-issue, but sporadic observations on the skewed 2D-plane may have an adverse effect on the model formation and possibility of presenting otherwise high quality observations as outliers.
- Area-variable: due to the possible homogeneity of the postal codes when compared against each other, heterogeneity within the areas, and a small number of observations in respective areas, it is expected that not all area variables pass the significance test.
- Lot ownership: lot ownership has been added to the model to improve value formation due to the ownership status of the lot. In some models, this dummy has been dropped according to pre-set inclusion specification limit of 15 observations and negative sign assumption.
- Sales variables: The use of sales dummies has proven to be ultimately a good guide towards more accurate pricing. Issues with the use of sales dummies may arise when there are only a few sales observations as this may bring more stochastic qualities to the model and individual observations may end up having a considerable weight in the model. This is to say that should the observation be clearly under-/overvalued compared to the market average, it will also have a clear impact on the valuation of the asset.

  Also, there is a possibility that these dummies in-advertently capture value that relates to the bargaining range, ie. difference between actual sales price and asking price that has not been taken into ac-count through bargaining range estimation. As it is not at the discretion of the modeller (Orava) to choose arbitrarily these observations due to reasons of transparency, these kinds of temporary value fluctuations are a regrettable feature of the models. As more sales data are included, these over-/undervalued instances will be gradually averaged out, bringing the model result closer to a market average value.

Sensitivity analysis

With a limited number of observations, it can be challenging to pinpoint whether a price deviation shown by a valuation model is due to short-term price trends (property micro-cycles), or whether they are merely fluctuations made visible by an artificially restricted dataset. As the dataset at hand represents only a fraction of the true market, there is less room for price-trend interpretation, and more room for error. For the purposes of sensitivity analysis, it is identified that the model results are most sensitive to the number of observations, and here we consider the effects of individual observations on the price function formation. The sensitivity analysis is formed by splitting the data set into two groups. These groups will have only half of the observations of the whole dataset. Ten model runs were performed and subsequent analysis made.

- The sensitivity analysis has two purposes: one, it is an estimation of variance due to dataset restriction. Should the model price estimate vary considerably, this is usually a sign of the model being very susceptible to a lack of observational data. Second, the restricted runs provide and estimation of inherent biasness of the model. Should the average estimation value of the runs amount to other than the run of the whole dataset, there is a possibility of a misspecification that is susceptible to the extent of available data.
- The sensitivity runs have been produced using a slightly different method and thus the results of 2014, 2013 and 2012 audits are not directly comparable.
- The sensitivity analysis results table is presented on the next page.

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Sensitivity analysis

	% max +/-10%	d(min)	d(max)	d(avg)
Espoo & Kauniainen, Venevalkamantie 3	0.0 %	-2.1 %	1.5 %	0.0 %
Hamina, Lavatie 6	10.0 %	-5.2 %	11.0 %	2.2 %
Heinola, Keskuskatu 30	0.0 %	-6.0 %	4.2 %	-0.4 %
Helsinki, Koirasaarentie 1	0.0 %	-5.2 %	1.4 %	-0.4 %
Hämeenlinna, Aulangontie 39	0.0 %	-5.4 %	4.8 %	0.1 %
Jyväskylä, Schaumanin puistotie 22	20.0 %	-17.4 %	3.3 %	-4.9 %
Jyväskylä, Seppäläntie 4C	0.0 %	-6.6 %	1.5 %	-2.5 %
Jyväskylä, Seppäläntie 4A	0.0 %	-8.4 %	5.1 %	-0.5 %
Järvenpää, Piennartie 16	0.0 %	-4.6 %	3.2 %	-1.1 %
Järvenpää, Vakka 5	0.0 %	-7.9 %	4.2 %	-2.1 %
Kerava, Palosenkatu 7 (PT)	0.0 %	-3.1 %	3.6 %	-0.1 %
Kirkkonummi, Rajakalliontie 3	0.0 %	-6.6 %	1.7 %	-2.1 %
Kokkola, Merikotkantie 9-17	5.0 %	-7.1 %	11.8 %	0.4 %
Kotka, Alahovintie 1	0.0 %	-6.4 %	7.3 %	-0.2 %
Kotka, Alahovintie 7	0.0 %	-4.0 %	5.0 %	0.2 %
Kotka, Kirkkokatu 2	0.0 %	-4.6 %	4.2 %	-0.1 %
Kotka, Vuorenrinne 19	0.0 %	-6.4 %	7.7 %	0.5 %
Lahti, Huvikatu 8	0.0 %	-2.4 %	4.2 %	1.1 %
Lahti, Pihtikatu 5	0.0 %	-5.9 %	8.8 %	0.4 %
Lahti, Poikkikatu 4	10.0 %	-8.2 %	15.2 %	0.8 %
Lahti, Rullakatu 4	0.0 %	-4.1 %	4.2 %	-1.0 %
Lahti, Vuoksenkatu 4	5.0 %	-11.1 %	9.0 %	0.1 %
Lohja, Lähdehaankuja 2	45.0 %	-7.7 %	40.9 %	10.4 %
Lohja, Metsätähtikuja 8	0.0 %	-5.4 %	1.8 %	-2.6 %
Nurmijärvi, Pikkutikankuja 4	0.0 %	-2.9 %	1.7 %	-0.7 %
Nurmijärvi, Puurata 15	0.0 %	-5.6 %	4.6 %	0.2 %
Nurmijärvi, Puurata 17	0.0 %	-3.2 %	7.0 %	0.3 %
Oulu, Jatulikivenkatu 1	0.0 %	-8.8 %	3.2 %	-0.8 %
Oulu, Koskitie 14	25.0 %	-3.9 %	23.8 %	5.9 %
Average (non-weighted)	8.3 %	-9.8 %	11.1 %	0.3 %

	% max +/-10%	d(min)	d(max)	d(avg)
Oulu, Pappilantie 5	50.0 %	-1.5 %	24.8 %	9.1 %
Oulu, Pesätie 22	30.0 %	-3.9 %	21.9 %	6.9 %
Oulu, Seilitie 1	0.0 %	-5.2 %	3.9 %	-0.2 %
Pori, Katkojantie 1	55.0 %	-57.3 %	36.2 %	0.3 %
Pori, Katkojantie 3	55.0 %	-57.3 %	34.8 %	0.2 %
Pori, Presidentinpuistokatu 1	0.0 %	-9.7 %	7.8 %	-1.6 %
Porvoo, Kaivokatu 29 (rv. 60, as)	0.0 %	-5.9 %	7.1 %	0.4 %
Porvoo, Kaivokatu 29 (rv. 93, KT)	0.0 %	-7.6 %	10.0 %	0.5 %
Porvoo, Kaivokatu 29 (rv. 93, LT)	0.0 %	-6.1 %	6.7 %	0.0 %
Riihimäki, Huhtimonkatu 1	0.0 %	-3.1 %	6.5 %	0.4 %
Salo, Ristinkedonkatu 33	0.0 %	-8.6 %	8.3 %	0.9 %
Savonlinna, Välimäentie 5-7	10.0 %	-14.9 %	10.2 %	0.5 %
Sipoo, Kirkkoniityntie 28 (KT)	20.0 %	-3.9 %	32.8 %	4.1 %
Sipoo, Kirkkoniityntie 28 (RT)	20.0 %	-7.1 %	36.2 %	5.6 %
Tampere, Auttilankatu 2	0.0 %	-3.9 %	-0.2 %	-2.0 %
Tampere, Pirttisuonkuja 1	0.0 %	-9.0 %	3.6 %	-2.5 %
Tampere, Pirttisuonkuja 2	0.0 %	-6.8 %	-1.4 %	-3.8 %
Tampere, Pirttisuonkuja 2 (RT)	0.0 %	-4.0 %	2.6 %	-1.6 %
Tampere, Tutkijankatu 2	0.0 %	-4.0 %	6.9 %	-0.3 %
Tornio, Aarnintie 13	10.0 %	-57.1 %	12.2 %	-2.2 %
Tornio, Aarnintie 7	10.0 %	-8.3 %	14.1 %	2.3 %
Turku, Michailowinkatu 2	0.0 %	-7.3 %	3.4 %	-2.1 %
Vantaa, Kylmäojantie 15	0.0 %	-6.6 %	0.6 %	-2.3 %
Vantaa, Maauunintie 14	0.0 %	-3.2 %	3.1 %	0.0 %
Vantaa, Rasinrinne 13	0.0 %	-7.8 %	3.3 %	-0.4 %
Varkaus, Kosulankatu 6	65.0 %	-36.5 %	93.3 %	4.1 %
Varkaus, Unnukankatu 12	15.0 %	-15.9 %	18.8 %	0.5 %
Varkaus, Parsiuskatu 6	20.0 %	-20.5 %	21.8 %	-0.3 %
Varkaus, Ahlströminkatu 12	0.0 %	-8.4 %	8.2 %	0.6 %

Sensitivity analysis

Some of the models showed a possible slight bias based on data selection. Due to data attrition, variance of the modelling run was particularly evident in areas with an already constrained dataset. What is notable, however, is when averaging all split model results, they very close to that of the full set, or average valuation by independent valuers (the AVM portfolio average is +0,3 % split vs. whole). Thus, the model is not restricted to the good fit of the data as a whole, and is hence automatically corrected over time due to the relatively short temporal data span of the model (2 years).

While as a whole, the area data can be considered sufficiently extensive at this moment, the sensitivity nevertheless proves that the model is suffering from an inherent high sensitivity to the number of observation and lies close to the minimum observation boundary. Should the data quality be compromised, ie. by a reduction of samples, the dataset must be supplemented with additional sources. On a portfolio level, small changes in the extent of the data can be considered to have an acceptable impact on the quality of the valuation model.

Evaluation of accuracy against independent valuation

In order to evaluate the accuracy of the Orava model, the model results are compared to property valuations carried out by an independent party. The latest independent valuation is selected. Assets have been valued either by Realia Management Oy or by Newsec, whichever valuation has a later date of value.

Comparison criteria

Realia has set the criteria against which to test the accuracy. As no sub-portfolios have been defined by Orava or allocated by Realia, the criteria for sub-portfolios can be ignored. For the 2014:08 models, all defined criteria are met.

- For the whole portfolio, irrespective of the size of the portfolio, the sum of individual asset values must be within 5 % of the sum of asset values as valued by an independent valuer.
- For a sub-portfolio, the sum of values must be within 7.5 % of the sum of values as valued by an independent valuer.
- Single property assets (combination of multiple apartments at the same address) must be valued within 15 % of the equivalent valuation by an independent valuer. Of the entire set of property assets, at least 80 % must pass this criteria.

The criteria have been defined by Realia and accepted by Orava.

Accuracy evaluation

	Orava vs. independent diff.
Espoo & Kauniainen, Venevalkamantie 3	+2.0 %
Hamina, Lavatie 6	-0.3 %
Heinola, Keskuskatu 30	-15.3 %
Helsinki, Koirasaarentie 1	-3.4 %
Hämeenlinna, Aulangontie 39	+6.4 %
Jyväskylä, Schaumanin puistotie 22	+2.2 %
Jyväskylä, Seppäläntie 4C	+4.5 %
Jyväskylä, Seppäläntie 4A	+2.6 %
Järvenpää, Piennartie 16	+4.7 %
Järvenpää, Vakka 5	+5.5 %
Kerava, Palosenkatu 7 (PT)	+8.6 %
Kirkkonummi, Rajakalliontie 3	+5.3 %
Kokkola, Merikotkantie 9-17	+9.2 %
Kotka, Alahovintie 1	-2.0 %
Kotka, Alahovintie 7	+14.9 %
Kotka, Kirkkokatu 2	+2.3 %
Kotka, Vuorenrinne 19	-5.5 %
Lahti, Huvikatu 8	+10.4 %
Lahti, Pihtikatu 5	+3.6 %
Lahti, Poikkikatu 4	-12.7 %
Lahti, Rullakatu 4	+12.0 %
Lahti, Vuoksenkatu 4	-4.9 %
Lohja, Lähdehaankuja 2	-14.6 %
Lohja, Metsätähtikuja 8	+6.7 %
Nurmijärvi, Pikkutikankuja 4	+4.1 %
Nurmijärvi, Puurata 15-17	-0.9 %
Portfolio level	+0.1 %

	Orava vs. independent diff.
Oulu, Jatulikivenkatu 1	+4.6 %
Oulu, Koskitie 14	+2.3 %
Oulu, Pappilantie 5	-9.0 %
Oulu, Pesätie 22	+2.5 %
Oulu, Seilitie 1	+5.4 %
Pori, Katkojantie 1-3	+7.2 %
Pori, Presidentinpuistokatu 1	+6.0 %
Porvoo, Kaivokatu 29 (rv. 60, as)	+14.6 %
Porvoo, Kaivokatu 29 (rv. 93, KT)	+19.2 %
Riihimäki, Huhtimonkatu 1	-26.9 %
Salo, Ristinkedonkatu 33	-12.5 %
Savonlinna, Välimäentie 5-7	-16.1 %
Sipoo, Kirkkoniityntie 28	-2.2 %
Tampere, Auttilankatu 2	+0.0 %
Tampere, Pirttisuonkuja 1	+4.1 %
Tampere, Pirttisuonkuja 2	+1.5 %
Tampere, Tutkijankatu 2	-3.9 %
Tornio, Aarnintie 13	-13.7 %
Tornio, Aarnintie 7	-12.1 %
Turku, Michailowinkatu 2	-0.1 %
Vantaa, Kylmäojantie 15	-1.0 %
Vantaa, Maauunintie 14	+9.0 %
Vantaa, Rasinrinne 13	-1.6 %
Varkaus, Ahlströminkatu 12	-20.6 %
Varkaus, Kosulankatu 6	-13.5 %
Varkaus, Parsiuskatu 6-8	-33.1 %

Note: positive sign = Orava valuation level above independent

Presentation of model evaluation

- For ease of presentation, the evaluation criteria are presented in the table on the next page.
- The object of the audit is to evaluate whether the automated valuation model is sufficiently accurate and objective for market valuation of the Orava Residential REIT portfolio, a matter of pass or fail. The portfolio valuation model, however, consists of several models and these models furthermore consist of different variables, each with their own properties.
- Thus, the evaluation of the automated valuation model is the evaluation of its parts giving emphasis to critical criteria.

The criteria

- Critical limit for number of observation; whether the model is close to the minimum dataset for an accurate value estimate.
- Data fit; quality of the input data, data fit in relation to the model, the existence of significant outliers, residual fit, etc.
- Unbiasness; approximation whether the estimated value, on average, equals the full population average as implied by tests and analysis.
- R^2; how well the model captures value.
- Homoscedasticity; normality of error residuals. Note that heteroscedasticity is present in all models due to the nature of OLS regression. The table presents the models where there is evidence that heteroscedasticity is higher than what is expected and may have a marked effect on value formation.
- Other properties of model; such as multicollinearity, coefficient significance, residuals, goodness of fit.
- Note that the criteria include both quantitative and qualitative
- 100 % suggests the absense of identified problems.
- Model criteria have been weighted by their estimated market values to attain the weighted average of the criteria on a portfolio level.

Weighted criteria score

The weighted total criteria score is 96.0 %. The figure works as a benchmark and suggests that there are some issues with the model. While in no terms an absolute baseline, a functioning model ought to receive a score of minimum 85 % when used for market valuing purposes. One must understand that any of the evaluation criteria can become critical to the functioning of the model should the underlying quality be out of the ordinary to a considerable degree. Thus, the weighted score is merely for the reader’s consideration and for facilitating the understanding of potential issues.

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Model evaluation summary

Model	Observation n. criticality	Data fit	Unbiasness	R^2	Homoscedasticity	Other properties
weight →	●●●●●	●●●	●●●●●	●●●	●●●	●●●
Lahti, Pihtikatu 5	100 %	99 %	100 %	100 %	100 %	99 %
Lahti, Poikkikatu 4	100 %	100 %	100 %	100 %	100 %	99 %
Tornio, Aarnintie 13	61 %	100 %	100 %	100 %	100 %	43 %
Hämeenlinna, Aulangontie 39	100 %	70 %	100 %	100 %	100 %	79 %
Hamina, Lavatie 6	100 %	100 %	100 %	100 %	100 %	84 %
Sipoo, Kirkkoniityntie 28, KT	74 %	100 %	79 %	100 %	100 %	84 %
Sipoo, Kirkkoniityntie 28, RT	90 %	100 %	71 %	100 %	100 %	80 %
Nurmijärvi, Puurata 15	95 %	100 %	100 %	100 %	100 %	100 %
Nurmijärvi, Puurata 17	97 %	100 %	100 %	100 %	100 %	100 %
Espoo, Venevalkamantie 3	87 %	85 %	100 %	100 %	50 %	82 %
Vantaa, Rasinrinne 13	100 %	92 %	100 %	100 %	100 %	100 %
Tornio, Aarnintie 7	74 %	100 %	100 %	100 %	100 %	67 %
Vantaa, Kylmäojantie 15	100 %	96 %	100 %	100 %	100 %	100 %
Kotka, Vuorenrinne 13	98 %	100 %	100 %	100 %	100 %	90 %
Lahti, Vuoksenkatu 4	100 %	99 %	100 %	100 %	100 %	100 %
Lohja, Lähdehaankuja 2	98 %	100 %	40 %	100 %	85 %	67 %
Salo, Ristinkedonkatu 33	94 %	100 %	100 %	100 %	100 %	90 %
Kerava, Palosenkatu 7	100 %	100 %	100 %	100 %	100 %	100 %
Heinola, Keskuskatu 30	100 %	100 %	100 %	100 %	100 %	73 %
Kotka, Alahovintie 1	100 %	100 %	100 %	100 %	100 %	92 %
Pori, Katkojantie 1-3	83 %	99 %	100 %	100 %	100 %	35 %
Varkaus, Kosulankatu 6	100 %	100 %	92 %	100 %	100 %	16 %
Varkaus, Unnukantie 12	98 %	100 %	100 %	100 %	72 %	61 %
Varkaus, Parsiuskatu 6	100 %	100 %	100 %	100 %	70 %	55 %
Porvoo, Kaivokatu 29 (rv 60, as)	100 %	100 %	100 %	100 %	100 %	82 %
Porvoo, Kaivokatu 29 (rv. 93, KT)	87 %	100 %	100 %	100 %	100 %	100 %
Jyväskylä, Schaumanin puistotie 22	100 %	100 %	71 %	100 %	100 %	89 %
Nurmijärvi, Pikkutikankuja 4	95 %	91 %	100 %	100 %	100 %	99 %
Kokkola, Merikotkantie 9-17	85 %	100 %	100 %	100 %	100 %	91 %

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Model evaluation summary

Model	Observation n. criticality	Data fit	Unbiasness	R^2	Homoscedasticity	Other properties
criteria → / weight →	●●●●●	●●●	●●●●●	●●●	●●●	●●●
Kotka, Kirkkokatu 2a	100 %	100 %	100 %	100 %	100 %	90 %
Lahti, Rullakatu 4	100 %	100 %	100 %	100 %	100 %	99 %
Lahti, Huvikatu 8	100 %	99 %	100 %	100 %	100 %	99 %
Oulu, Seilitie 1	98 %	100 %	100 %	100 %	100 %	98 %
Oulu, Koskitie 14	100 %	100 %	65 %	100 %	100 %	88 %
Oulu, Pesätie 22	87 %	100 %	58 %	100 %	100 %	86 %
Oulu, Jatulikiventie	86 %	100 %	100 %	100 %	100 %	97 %
Oulu, Pappilantie	79 %	100 %	46 %	100 %	100 %	72 %
Pori, Presidentinpuistokatu 1	100 %	100 %	100 %	100 %	100 %	76 %
Turku, Michailowinkatu 2	100 %	100 %	100 %	100 %	100 %	90 %
Tampere, Tutkijankatu 2	100 %	100 %	100 %	100 %	100 %	100 %
Tampere, Pirttisuonkuja 1	88 %	100 %	100 %	100 %	100 %	90 %
Järvenpää, Vakka 5	100 %	100 %	100 %	100 %	100 %	100 %
Järvenpää, Piennartie 16	100 %	100 %	100 %	100 %	100 %	100 %
Kirkkonummi, Rajakalliontie 3	100 %	100 %	100 %	100 %	100 %	100 %
Lohja, Metsätähtikuja 6	88 %	89 %	100 %	80 %	100 %	66 %
Vantaa, Maauunintie 14	100 %	93 %	100 %	100 %	100 %	100 %
Tampere, Auttilankatu 2	100 %	100 %	100 %	100 %	100 %	100 %
Helsinki, Koirasaarentie 1	100 %	70 %	100 %	100 %	100 %	89 %
Riihimäki, Huhtimonkatu	100 %	100 %	100 %	100 %	100 %	100 %
Savonlinna, Välimäentie 5-7	92 %	100 %	100 %	100 %	100 %	87 %
Varkaus, Ahlströminkatu 12	100 %	100 %	100 %	100 %	59 %	76 %
Kotka, Alahovintie 7	100 %	100 %	100 %	100 %	100 %	91 %
Tampere, Pirttisuonkuja 2	88 %	100 %	75 %	100 %	100 %	90 %
Tampere, Pirttisuonkuja 2 rt	89 %	100 %	75 %	100 %	100 %	90 %
Jyväskylä, Seppäläntie 4C	99 %	100 %	100 %	100 %	100 %	99 %
Jyväskylä, Seppäläntie 4A	99 %	100 %	100 %	100 %	100 %	96 %
Weighted average	96 %	96 %	96 %	99 %	98 %	90 %

Modelling post processing and valuation

The regressional value estimate is used to attain the asking price value of each apartment where the values of single apartments are aggregated without any corrections for quantity. Should a need arise to divest all apartments in a short period of time a corrective multiplier is required.

The estimated value is the asking price estimate, including the implied bargaining range. The implied bargaining range is removed by using an estimate of the range, which is then subtracted from the asking price estimate. This estimate of bargaining range has been produced by comparing actual transaction prices from Statistics Finland and data from Oikotie.fi, which are then adjusted by two months for improved match.

After correcting for bargaining range, no further value modifications are made apart from possible rounding. As the assets are valued as the sum of individual apartments, should the divestment of a large number of apartments take place in the same region or to a single buyer, a correctional discount multiplier should be applied. This multiplier is dependent on the likely buyers' profile and the ability of the local demand to absorb apartments that are put to sale.

About calibration

It is acceptable to have a coefficient calibration for the model to reach market valuation estimate. The only such coefficient used is bargaining range. The average estimated model values are very close to market value valuation by independent parties and therefore no further level-correction is deemed necessary or appropriate.

Considerations related to the bargaining range

- The bargaining range is the price difference between the asking price and the price for which the property eventually sells for.
- In the model it was identified that there is a potential source of bias in the asking price level related to multiple listings. However, this is mitigated by the estimated bargaining range. The bargaining range is calculated using the modelled asking price and actual sales data for the area. Thus, whatever bias is introduced in the asking price level will be largely removed through employing the bargaining range correction for actual market value. However, care should be taken as this bargaining range is implied and these computational values are applicable to the Orava valuation model only.
- The bargaining range is a considerable source of uncertainty. Should the bargaining range be known with considerable precision, the time-period sufficiently short to mediate changes, and the area divided into relatively homogenous areas and applied only within these areas, many potential problems should not manifest.
- Optimally, the bargaining range would be estimated for each homogenous area. Due to the restrictions imposed by the data quality, the area data is aggregated and subsequently divided into two groups: large cities and smaller cities or towns. For each area model, one of the two bargaining correction ranges is used. The use of averages does not pose problems in valuing at the whole portfolio level.
- The source for the used data for the estimation of bargaining range is Oikotie.fi and Statistics Finland.

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AVM reporting | Audit notes and list of attachments

Reporting

From the point of view of this audit, the purpose of reporting is to convey the market value as objectively and accurately as possible at the level of detail and depth deemed suitable considering the audience.

The following must be stated clearly and objectively:

- The process in its rudimentary form how the market value estimate is attained.
- Market value, per individual asset (a combination of apartments at a single location), per portfolio, in local currency and as %-change.
- Historical data of market value to the extent where potential fluctuations in estimated short-term price trends can be discerned.
- The current and historical bargaining range estimations.
- Applicable, easy-to-understand indicators of model quality and their explanations, such as standard errors and goodness of fits.
- In addition, the inclusion of an audit summary, if available and deemed suitable.

More detailed information on the models and model formation is available on the Orava Residential REIT website (note: at the moment provided only in Finnish). This information should be considered as complimentary to the analysis made in this audit report. On 27.10.2014, no erroneous information was detected on the website regarding automated valuation processes.

The auditors have gone through the materials. Orava Residential REIT are committed to reporting objectively and accurately and are in line with the aforementioned reporting criteria.

Audit notes

The audit covers the automated valuation process of these assets in their respective areas including a cursory analysis of all models and a more detailed analysis of selected models.

In the audit numerous were observed. None were severe enough to question whether the model is functional, rather the degree of accuracy. However, the share of the models with identified issues is limited when contrasted against the whole portfolio. In addition, these issues have not been observed to create bias and thus any deviation in models typically cancel each other out when the model results are averaged at portfolio level. The slowing down of the property markets, a major source of uncertainty, has not had a noticeable adverse effect on the valuation accuracy so far.

Identified issues are also considered in the AVM process. No arbitrary changes are made in the formation of AVM processes, but the identified issues are collected and used to improve future versions of the model. According to the observations and analysis made by the auditor, newer models are improvement over the previous models when the purpose is to attain an objective and accurate estimate of market value for the portfolio.

List of attachments

The inclusion of following attachments is at the discretion of Orava:

- AVM process charts
- Employed models
- Extensive set of statistical tests, descriptions and analyses
- Detailed process of bargaining range estimate formation
- Input data description sheet
- Summary of the audit statement in Finnish

Audit statement

- We have audited the automated valuation model of Orava Residential REIT as of 27th of October 2014 and the related data, processes, reporting and work methods at the time of audit.
- A prerequisite for applicability of the model is a normal and functioning market. For the purposes of this audit, a normal and functioning market is defined as a market situation where predictability to a conventional degree is possible. Should the market observations be atypical in their quantity or quality, or the market situation is considered volatile, predictability cannot be considered conventional.
- The audit is based on examining and testing the functioning of the valuation models, reviewing the model forming process and studying applied work methods. A deeper analysis of the models was done sampling based and on models where potential issues were detected by the auditor. The conclusions are based on the data and information obtained from Orava and other sources, in part verified against each other.
- There are certain issues in the used models. These are covered in the previous sections of the audit. In the current form of the automated valuation model, with comparable data, the valuation of the Orava portfolio is sufficient in accuracy, balance and fairness in valuing market value at complete portfolio level.
- While Realia's responsibility is to offer a statement based on the audit, the final responsibility of the automation valuation model lies with Orava Residential REIT.
- The audit covers data acquisition, data pre-processing, modelling, model post-processing and reporting of result.
- We have found the extent and quality of data to be sufficient quality for the formation of the models as at 27.10.2014. Should the quality of data, as a whole, remain at the same level, and employing equal practices, we have reason to believe that future models will continue to provide a fair and balanced estimate of market value.
- We have found the processes, methods and work practices in forming the automated valuation model to be of sufficient standard to attain an objective measure of market value within standard valuation accuracy.

The auditors have independently ascertained the quality, balance and the true and fair treatment of the data and the results in respect to all parties involved.

The auditors have found the processes and models to follow good practices, to be of reasonable accuracy for the purposes of market value estimation, and the result reporting to be objective and fair in nature.

Helsinki 27.10.2014

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