Variations in Valuations: Will identical data input lead to identical output of valuation results?

Keywords: valuation, appraisal based index, confirmation bias

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**Introduction**

This paper investigates whether reliable valuation results may be expected when valuers, in carrying out a valuation task, use an identical data set as well as an identical valuation method. The hypothesis is that under such circumstances an identical output of property values of different valuers is to be expected. Earlier work has suggested that valuations are not always as accurate as they should be. Earlier work also suggests that valuations may incorporate elements of cognitive bias, which contribute to this inaccuracy. This paper reports an empirical investigation which was undertaken with professional valuers of a well-known reputation and comprises a mock valuation task. Several professionals drawn from well-known agencies were asked to carry out two different property valuations with two different methods according to the guidelines of the Dutch ROZ-IPD Index. The valuers received identical input in the form of a complete data set of quantitative and qualitative variables. It appears from this research that despite the fact that identical input information was provided, the valuation results of these valuers show large differences. In contrast to what was to be expected the hypothesis was rejected. The paper examines the causes for the differences in value opinion, which depend on the way in which valuers process information. Implications of these findings are discussed in the paper. It is concluded that the results of this experiment may support the presence of anchoring, search limitation and data adjustments, which lead to cognitive bias.

**Motivation**

Since the introduction of the ROZ/IPD property index in the Netherlands the importance of this index for the property sector in general and especially the participating funds has increased considerably. Several underlying conditions can be mentioned such as:

i. The increasing importance attached to transparency by the property sector.

ii. Investors of the specific funds are judged on the returns of the funds in comparison to the ROZ-IPD benchmark return.

iii. The increasing use of ALM studies by pension funds for which long term time series of historic returns need to be available.

Where for other asset categories indices are composed on the basis of demand and supply, this is not possible for a property index. The limited number of transactions and the uniqueness of property require a different method of performance measurement, which is based on valuations.
The performance of property assets is determined on the basis of direct return (in which the net income is compared to the original valuation value of the asset (object)) and indirect return, which is based on the appreciation or depreciation of the asset (object).

This leads to the conclusion that the valuation of the object influences both the direct as well as the indirect return. When the valuation with respect to performance measurement is of such importance, is obvious that valuations need to be comparable as well as consistent and reliable.

Within the current system of valuation executed on behalf of the ROZ-IPD two valuation models are permitted namely 'gross/net initial yield' and 'discounted cash flow' (DCF). Furthermore the ROZ-IPD prescribes various premises, which valuers must apply in the execution of these valuations.

In this context the central questions of this research are:

i. whether valuations for the ROZ-IPD index are reliable, and

ii. whether increasing uniformity of the ROZ-IPD valuation guidelines is necessary - which will lead to an improvement in comparability, consistency and reliability of the valuation results.

**Differences in valuations**

Before the above questions can be answered we will first focus on the fact that differences can originate on several levels during the valuation process, which may lead to different valuation results. By focussing on these levels it can be investigated on which level differences in valuations results arise, whether these differences can be accounted for and how they can be solved.

Differences in valuation results can be distinguished, amongst others, on the following levels.

- Differences in input
- Differences in arithmetic
- Differences in models

Differences in input arise when valuers use different information for the input variables in their valuation models. These can be subdivided in market data (endogenous) and technical data (exogenous). Market input data concern information based on the specific expertise of the valuer such as market rents, yields, cap rates, the estimation of the vacancy, etc., as well as information provided by the client concerning rental contracts and specific factors which influence value. Technical input data concern information which is necessary for the applied...
calculation model and which are of major influence on the calculated value, but which cannot be considered as direct market data. The level of the inflation and the rise of a cost index are examples of this.

Differences in arithmetic can be described as differences in the arithmetical approach of a specific problem by the valuer himself or by the arithmetical model used. The choice of the way a specific arithmetical problem eventually is applied in the calculation model will depend on the knowledge and insight of the valuer himself. An example is the way in which a ground lease is processed in the calculation, as an element of the cash flow or as a one-time correction at the end of the calculation.

Differences in model can be described as differences in technique within the same valuation method. For example within the 'income valuation method' calculation on the basis of the Yield model may lead to other results than calculations on the basis of the DCF model. Theoretically the valuation results should be more or less identical, not depending on the model chosen. However the possibility that the different calculation models will lead to not identical valuation results cannot be ruled out completely.

**Research experiment and test results**

An experimental valuation task was set up to answer the above questions concerning the reliability of ROZ-IPD valuations and the uniformity of the ROZ-IPD valuation guidelines. The valuation task was presented to several valuers with the request to compute both the Yield valuation as well as the DCF valuation on the basis of the ROZ-IPD guidelines [1].

A complete data set for his case was provided, which contained all necessary input data. Therefore all valuers started with identical information. This is important because in this way it can easily be established whether the calculations applied by various valuers lead to identical outcomes or whether in their results variations arise. In this case there are no differences on the basis of input variables. Primarily the experiment searched for the occurrence of arithmetical calculation differences and secondly for differences in models.

The valuation task consisted of two sub cases concerning an office building and a residential apartment building (see appendix). Valuers were asked to conduct a market value appraisal.
The outcome of the valuation task of both cases resulted in a wide variation in the estimated values. The variation in results is presented in Table 1 and in Graph 1 and 2 on the next page.

**Table 1. Variations in valuation results**

<table>
<thead>
<tr>
<th>CASE</th>
<th>SPREAD BETWEEN VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DCF model</td>
</tr>
<tr>
<td>Office</td>
<td>19%</td>
</tr>
<tr>
<td>Apartment building</td>
<td>14%</td>
</tr>
</tbody>
</table>

On the basis of these results the following conclusions can be drawn:

1) When reliability is defined as the spread between valuation outcomes in such way that reliability increases when the spread decreases, it appears form the results that the Yield model qualifies as a more reliable model than the DCF model.

2) The spread is comparable with the findings of earlier research [Geltner, 1998], [Fisher,Miles,Webb,1999] where transaction prices from the NCREIF were compared to the values of the foregoing valuations.

### Analysis of differences in model

Since the yield model uses less input variables than the DCF model the yield model will be more robust in practice, where no input variables are provided. Because of the small number of input variables, a change in input variables will have a greater effect on the valuation value within the yield model than within the DCF model. Although this effect has also surfaced in our cases, it is of greater importance to examine the plausibility of the input variables on the basis of market evidence.

In the yield model specifically the net yield and the market rent have a large effect on the ultimate estimate of the valuation result, while for the DCF both the market rent, the discount rate and the exit yield have effect. Since it is common knowledge that the net yield can be determined more accurately on the basis of market evidence than the discount rate and the exit yield, the yield model should lead to more accurate and evidence based valuation results, which is also the case in this research.
Graph 1. Assessed values Office building

Graph 2. Assessed values Apartment building
Evidence for the aforementioned conclusion can be found in the idea that the market in general does not "think" in discount rates, macro economic entities, the risk of vacancy in year eight, etc. However, this does not mean that the DCF model can be discarded completely as an instrument of valuation. Specifically in the context of determination of individual investment worth for investors, the DCF model offers additional value compared to the yield model. The yield model, being a general market-explaining model, is based on recent market evidence. Because of its premises the DCF model is more forward looking (future oriented) and offers its user the possibility to arrive at one or more individual value estimates on the basis of the development of the several (macro) economic variables.

**Analysis of differences in arithmetic**

With respect to the arithmetical level, on which differences in valuation results have originated, the following can be concluded.

Given the unambiguous calculation technique and the limited number of input variables of the Yield method, only two components lead to substantial differences between valuers, namely:
- Ground lease
- Operating costs

For the DCF models more input variables generated differences between valuers, namely:
- Ground lease (office building only)
- Operating expenses
- First year rent
- Adjustment to market rent
- End value outgoing value
- Time period
- Number of dwellings in exploitation (residential only)

It must be noted that the aforementioned differences in input variables at the same time have an effect on the value of the other components, which determine the final property value. For instance if the first year rent is assessed by two valuers in two different ways, this difference will be of influence on the determination of the outgoing value. This also goes for, for instance, the operating expenses, adjustment to market rent, etc.
A subsidiary effect will be that the calculations in these models, as a basis for analysis, become less transparent. Differences in amounts can be established, but it cannot be established what mix of input variables and calculation aspects in the model causes these differences.

An other example concerns the influence of the time period on the valuation result. A theoretical difference in value could arise only on the basis of the chosen time period. Compared to the assessed value for a time period of 10 years the difference amounts to 5% and 10% respectively for a time period of 15 and 20 years. Taking only into account those valuers who did use a 10-year holding period in their assessment, the spread was still large, namely 13%.

In general it can be established that there is more consensus between valuers on the theoretical as well as the practical arithmetical approach of the Yield model compared to the DCF model.

**General findings**

On the basis of the case under investigation it can be concluded that there are arithmetical differences within the models used by the valuers. Therefore the question of this research "Will identical data input lead to identical output of valuation results?" needs to be answered negatively.

The obtained results do not appear to deviate significantly from the results of earlier studies on the reliability of valuation results. Fisher, Miles and Webb [1999] show that selling prices of objects from NCREIF show variations of on average 8,2% for apartments and 11,6% for offices. A similar study of Webb [1994] demonstrates comparable deviations. Both studies are based on the comparison of valuation results of objects, which are part of the NCREIF and the selling price of these objects. These studies cover a long time period of respectively 1985-1998 and 1978-1992. In a case study of Hutchison, MacGregor and Nanthakumaran [1995] differences in valuation results of on average 10,7% for office buildings on prime locations in the United Kingdom, were found, using a different research technique.

However, an important difference with the above mentioned studies is that in our case all necessary input information - market variables, macro-economical variables and object
variables - was given to the valuers and therefore the differences found could only have arisen on a arithmetical level.

It was to be expected that valuers would come to more or less the same valuation results on the basis of identical input variables. This meant that arithmetical differences would play a minor role in the origin of differences of valuation results. In that case, valuation differences would only be caused by non-identical appraisals of the market and the property by the valuers.

Since this case shows that the arithmetical differences are larger than was to be expected and since this case shows comparable variations in valuations as the above mentioned researches, this could support the existence of a so called 'confirmation bias'.

The existence of confirmation bias means in fact that valuers already arrive at an initial notion of what the outcome might be before a valuation task is completed [Gallimore, 1996]. This initial estimate is subsequently confirmed by searching especially for those data, which will support the primary notion (search limitation).

If, for the current investigation, valuers had been asked to determine the data input for the cases – of market variables and macro-economical variables - themselves it is plausible to assume that all valuers would not have estimated these input variables in the same way. This means that then the spread of valuation results could be expected to be even larger. But since there is no substantial difference between the test results with fixed data and the practice found in literature, this could mean that using an initial notion of the value which exists in the mind of the valuers, must be responsible for the large spread in results in both instances.

An other consequence of the existence of differences in arithmetic's - especially with the DCF model - could be an effect which is in line with confirmation bias. If valuers already arrive at a general notion of the value before the valuation is completed - on the basis of experience, market knowledge, rules of thumb, ratios, etc.- and then enter their market evidence input in their model, this could lead to a different outcome than was determined beforehand on the basis of experience and market knowledge. This effect will be more notable for complicated valuation models such as used in the DCF model. In this model the input will have to be adjusted to end up with an outcome which is in concordance with the initial notion of the
value. This effect was called 'anchoring' in earlier research [Havard, 2000] and is well known in behavioural science.

**Findings in relation to the ROZ/IPD benchmark index**

Assuming that the eventual assessed market value is a correct one, the effects of anchoring will not be of influence on the quality of the ROZ/IPD benchmark as such. However, anchoring does have an effect when the underlying adjusted data, which are used as input for the calculation model, are also employed on behalf of different analyses and researches - both on individual object level as well as on a portfolio and benchmark level. There is a definite danger of wrongful conclusions. Statistically and analytically these conclusions could be correct as such on the basis of the data used, but if these data are not 100% reliable the conclusions can never be 100% correct either.

**Summary**

The demonstrated presence of arithmetical differences will have the following consequences in real estate valuation practice.

i. Valuers calculate different valuation results - starting from identical data regarding object, market and macro economy;

ii. Valuers assess more or less identical values by applying adjusted input variables (anchoring);

iii. Both effects appear simultaneously and subsequently;

iv. The demonstrated effects will be of more frequent occurrence for the DCF calculations compared to the calculations for the Yield model.

These effects - spread and anchoring - are undesirable in the context of constructing a reliable real estate (benchmark) index. One can assume that the above mentioned effects will more or less cancel out each other for the appraisal results on an index level [Fisher, Miles, Webb, 1999], especially when the average return is examined on the long term (5 to 7 years). This does not influence the reliability of the index more than average [Geltner, 1998]. However, on an individual portfolio level or individual property level a distortion of reality can occur. This can be especially relevant for smaller portfolios. Earlier research demonstrates that for portfolios which encompass more than 50 -100 individual properties no extra reduction of valuation flaws occurs. [Geltner,1998]. When smaller portfolios or
individual objects are compared with the benchmark results, the risk exists that the comparison is not fully trustworthy.

**Recommendations**

Although variations in valuations will always occur it is important to prevent the development of differences where possible, or at least be able to discover the origin of these differences. Theoretically differences in valuation results should only arise on the basis of the valuer’s assessment of the market and the object. To attain this goal the following recommendations are given:

i. In case the DCF model is used, one must strive for less arithmetical ambiguity than exists at this moment by improving the arithmetical valuation guidelines for this model. Unambiguousness in its most optimal form consists of one clearly defined DCF model for the ROZ/IPD valuations. An extension of the valuation guidelines will have to take place in order to rule out differences in arithmetical methods as found in this research.

ii. As long as the valuation guidelines for the DCF model are not yet adjusted, we plead for the Yield model in its most elaborate form to be used for the ROZ-IPD valuations. Compared to the current DCF model this leads to the following advantages.

- The Yield model is unambiguous (less spread with identical input data)
- Simple calculation technique
- High accessibility of market data for the determination of the most important input variables
- Absence of future macro economic input variables
- High transparency of the model
- Lower risk of data adjustment within the model
NOTES
[1) See for ROZ-IPD guidelines: http://www.rozindex.nl/ or http://www.ipdindex.co.uk/

REFERENCES


Geltner D., (1998), How accurate is the NCREIF Index as a benchmark, and who cares?, Real Estate Finance, 14(4)


## OFFICE BUILDING

**June 2002**

### Characteristics Office building

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Office</th>
<th>Parking units</th>
<th>Reference picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net m²</td>
<td>15,000</td>
<td>150 units</td>
<td></td>
</tr>
<tr>
<td>Gross m²</td>
<td>17,645</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floors</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Construction year</td>
<td>1980</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operating expenses

| Maintenance             | 6.00 € / m² gross | 15 € / unit |
| Management              | 1.5%              |             |
| Tax (ZWB)               | 3.20 € / per unit of tax value |         |
| Insurance               | 0.45 € / 1000 m²  |             |

### Sale value

| Resale value            | 1.250 € / m² gross at valuation date |             |

### Market rent

| Ground lease rent       | 205,000 € / year (indexed for inflation) |             |
| End ground lease        | 30/31 May 31                              |             |
| Land price              | 500 € / m² gross at valuation date       |             |

### Tenants

<table>
<thead>
<tr>
<th>Tenants</th>
<th>net m²</th>
<th>rental income</th>
<th>parking units</th>
<th>rental income</th>
<th>total income</th>
<th>VAT</th>
<th>payment</th>
<th>expiring details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6,775</td>
<td>1,524,976</td>
<td>68</td>
<td>17,100</td>
<td>1,809,066</td>
<td>YES</td>
<td>MONTH</td>
<td>31-10-04 Adjustment to market rent</td>
</tr>
<tr>
<td>B</td>
<td>3,325</td>
<td>628,975</td>
<td>32</td>
<td>36,320</td>
<td>665,615</td>
<td>NO</td>
<td>QUARTER</td>
<td>31-8-04 Adjustment to market rent</td>
</tr>
<tr>
<td>C</td>
<td>2,690</td>
<td>561,400</td>
<td>27</td>
<td>30,645</td>
<td>592,045</td>
<td>YES</td>
<td>QUARTER</td>
<td>30-3-09 No adjustment to market rent</td>
</tr>
<tr>
<td>D</td>
<td>2,310</td>
<td>498,569</td>
<td>23</td>
<td>26,105</td>
<td>522,765</td>
<td>NO</td>
<td>QUARTER</td>
<td>30-8-07 No adjustment to market rent</td>
</tr>
<tr>
<td>E</td>
<td>15,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### General Information

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005 etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase market rent</td>
<td>2.6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPI</td>
<td>2.25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>5.00%</td>
<td>2.00%</td>
<td>2.50%</td>
<td>2.00%</td>
</tr>
<tr>
<td>Net yield</td>
<td>7.25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount rate</td>
<td>7.66%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exit Net Yield</td>
<td>8.00%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Other Information

It may be assumed that all tenants will continue to rent after expiring of the rental contract.

### Valuation task

We request to complete a valuation by using the Gross/Net Yield model as well as the Discounted cash flow model (DCF) on the basis of the above mentioned information.

In conducting the valuation we require you to make use of the ROD-PD valuation guidelines.

The date of valuation is 2002 June 30.
## APPENDIX 2

### RESIDENTIAL APARTMENT BUILDING

**Characteristics apartment complex**

<table>
<thead>
<tr>
<th>Types</th>
<th>A 2-rooms</th>
<th>B 3-rooms</th>
<th>C 3-rooms</th>
<th>D 4-rooms</th>
<th>Parking units</th>
</tr>
</thead>
<tbody>
<tr>
<td>net m²</td>
<td>85</td>
<td>75</td>
<td>95</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>gross m²</td>
<td>76</td>
<td>66</td>
<td>98</td>
<td>103</td>
<td>18</td>
</tr>
<tr>
<td>Volume m³</td>
<td>206</td>
<td>237</td>
<td>259</td>
<td>300</td>
<td>50</td>
</tr>
<tr>
<td>Units</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td>Construction year</td>
<td>1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>550.00</td>
<td>550.00</td>
<td>550.00</td>
<td>550.00</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>305.00</td>
<td>305.00</td>
<td>305.00</td>
<td>305.00</td>
<td></td>
</tr>
<tr>
<td>Tax 0.33%</td>
<td>3.40</td>
<td>3.40</td>
<td>3.40</td>
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<tr>
<td>Insurance</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>A type</th>
<th>B type</th>
<th>C type</th>
<th>D type</th>
<th>Parking units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rents</td>
<td>395</td>
<td>448</td>
<td>395</td>
<td>530</td>
</tr>
<tr>
<td>Resale value</td>
<td>180,000</td>
<td>192,500</td>
<td>305,000</td>
<td>210,000</td>
</tr>
<tr>
<td>Replacement value</td>
<td>54,641</td>
<td>57,894</td>
<td>110,946</td>
<td>125,989</td>
</tr>
<tr>
<td>All rents are paid monthly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General information

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005 etc</th>
<th>Mutation vacancy</th>
<th>Mutation percentage</th>
<th>Mutation costs</th>
<th>Number of sold dwellings</th>
<th>Splitting costs</th>
<th>Mouse price rise</th>
<th>3 months</th>
<th>15%</th>
<th>500 euro per dwelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>2.50%</td>
<td>3.00%</td>
<td>5.00%</td>
<td>2.00%</td>
<td>2.50%</td>
<td>2.00%</td>
<td>3 months</td>
<td>15%</td>
<td>500 euro per dwelling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rent index</td>
<td>3.00%</td>
<td>3.5%</td>
<td>3.00%</td>
<td>2.00%</td>
<td>2.50%</td>
<td>2.00%</td>
<td>3 months</td>
<td>15%</td>
<td>500 euro per dwelling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>7.00%</td>
<td>7.00%</td>
<td>7.00%</td>
<td>7.00%</td>
<td>7.00%</td>
<td>7.00%</td>
<td>3 months</td>
<td>15%</td>
<td>500 euro per dwelling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Valuation task

We request to complete a valuation by using the Gross/Net Yield model as well as the Discounted cash flow model (DCF) on the basis of the above mentioned information.

In conducting the valuation we require you to make use of the ROCZ-PO valuation guidelines.

The date of valuation is 30th June 2002.