Outline

I. Idea and goals

II. Literature review

III. Methodology

IV. Data

V. Hypotheses and results

VI. Summary and future research
Research project

Decision-making in real estate

Decision theory

1. Decisions, decision-making, and decision support systems in real estate investment management (ERES Conference, June 2015)

Decision support systems

2. Reducing the property appraisal bias with decision support systems (ERES Conference, June 2015)

3. Real estate risk scorings – Approaches to solve theoretical and practical problems of an underestimated decision aid (Working Pap., Oct. 14)

Decision processes

4. Decision support systems for real estate appraisals (forthcoming)

5. Improving the purchase decision in real estate asset management by debiasing decision-makers (ERES Conference, June 2015)

6. The purchasing process in real estate asset management (forthcoming)
Idea and goals

Any appraiser is subject to many potentially biasing influences which compromise the accuracy of the appraisal. One of these possible biases is the so-called anchoring heuristic: Appraisers are involuntarily influenced by (anchor to) reference points such as their previous value opinion, the value opinion of the seller, or property transaction prices.

While many studies have proven the existence and importance of the anchoring effect in real estate appraisals, very few studies have suggested practical means to counter it.

GOALS:

- Literature review
- Applying knowledge from psychology, computer science, and real estate research to valuation practice
- Development of a valuation software which supports the valuer in making decision and thus reduces the anchoring effect (= decision support system, DSS)
- Testing the software in various settings, e.g., with different properties
Outline

I. Idea and goals

II. Literature review

III. Methodology

IV. Data

V. Hypotheses and results

VI. Summary and future research
Three distinct streams within the real estate valuation literature:

(1) In the 1980s a discussion on **valuation accuracy and variation** started in the UK which led to the concept of the “margin of error”. It is generally accepted that different appraisers come to different results, but that the variance should be kept to a minimum. [Exemplary studies: Hager/Lord (1985), Crosby (2000)]

(2) Later many studies were undertaken to identify the reasons for valuation variation. Many of them looked into **behavioral issues of valuation** and confirmed the prominent role of the anchoring effect. [Exemplary studies: Northcraft/Neale (1987), Diaz/Hansz (2001)]

(3) In recent years more and more authors addressed the question how **technology** can help in debiasing. Drawing on findings from computer science, psychology and other fields, some of these studies suggest the use of decision support systems (DSS). [Exemplary studies: George/Duffy/Ahuja (2000), Bhandari/Hassanein/Deaves (2008), Tidwell (2013)]

No need to prove or measure the anchoring effect or the benefit of a DSS. Instead: Demonstrating that small alterations can transform a standard MS Excel spreadsheet into a tool which effectively supports the appraiser and improve appraisal accuracy.
Forms of appraisal bias (according to Yiu et al. 2006, p. 323)

- Appraisal Bias
  - Random Bias
    - Appraisal Smoothing (Lower Variance)
    - Overreaction (Higher Variance)
    - Purely Random
  - Systematic Bias
    - Behavioral
      - Anchoring
        - Anchoring to other references
    - Options Value Hypothesis
    - Different Base-of-Valuation Hypothesis
Current valuation software does not support the decisions of the valuer in the valuation process

Example: Argus®, one of the most widely used valuation systems worldwide

😊 Very flexible
😊 Technically and methodologically sound
😊 Many features that enhance ease of use and efficiency

BUT…
😊 „Advanced pocket calculator“, i.e. no decision support functionalities for…
- choosing between different sources of market data,
- weighing divergent information,
- deciding on the correct cap rate,
- protecting against human biases and errors, etc.
😊 Not suitable for beginners
There are several decisions to make in a valuation process, especially in the German form of the income approach.

### South African Income Approach

<table>
<thead>
<tr>
<th>Potential Gross Income</th>
<th>= Effective Gross Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Gross Income</td>
<td></td>
</tr>
<tr>
<td>Vacancy and Collection Losses</td>
<td></td>
</tr>
<tr>
<td>= Effective Gross Income</td>
<td></td>
</tr>
</tbody>
</table>

### German Income Approach (Ertragswertverfahren)

<table>
<thead>
<tr>
<th>Potential Gross Income (Jahresrohertrag)</th>
<th>= Net Operating Income (Grundstücksnennwert)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Expenses (Bewirtschaftungskosten)</td>
<td></td>
</tr>
<tr>
<td>Maintenance costs (Instandhaltungskosten)</td>
<td></td>
</tr>
<tr>
<td>Administrative costs (Verwaltungskosten)</td>
<td></td>
</tr>
<tr>
<td>Utilities (Betriebskosten)</td>
<td></td>
</tr>
<tr>
<td>Allowance for rental loss (Mietausfallwagnis)</td>
<td></td>
</tr>
<tr>
<td>= Net Operating Income (Grundstücksnennwert)</td>
<td></td>
</tr>
<tr>
<td>Return on land value (Bodenwertverzinsung)</td>
<td></td>
</tr>
<tr>
<td>Land value (Bodenwert)</td>
<td></td>
</tr>
<tr>
<td>Property yield (Liegenschaftszinssatz)</td>
<td></td>
</tr>
<tr>
<td>= Net Operating Income from building (Reinertrag d. baulichen Anlagen)</td>
<td></td>
</tr>
<tr>
<td>Multiplier (Vervielfältiger)</td>
<td></td>
</tr>
<tr>
<td>Property yield (Liegenschaftszinssatz)</td>
<td></td>
</tr>
<tr>
<td>Remaining useful life (Restnutzungsdauer)</td>
<td></td>
</tr>
<tr>
<td>= Income value of the building (Ertragswert der baulichen Anlagen)</td>
<td></td>
</tr>
<tr>
<td>Land Value (Bodenwert)</td>
<td></td>
</tr>
<tr>
<td>= Provisional Market Value (vortäufiger Ertragswert)</td>
<td></td>
</tr>
<tr>
<td>+/- Adjustments (Zu- und Abschläge)</td>
<td></td>
</tr>
<tr>
<td>Deviation of actual rent from market rent</td>
<td></td>
</tr>
<tr>
<td>Maintenance backlog</td>
<td></td>
</tr>
<tr>
<td>Market conditions</td>
<td></td>
</tr>
<tr>
<td>= Income Value (Ertragswert)</td>
<td></td>
</tr>
</tbody>
</table>

### Decisions

- Vacancy and Collection Losses
- Operating Expenses
- Net Operating Income
- Return on land value
- Multiplier
- Income value of the building
- Land Value
- Provisional Market Value
- Adjustments
- Income Value
Outline

I. Idea and goals
II. Literature review
III. Methodology
IV. Data
V. Hypotheses and results
VI. Summary and future research
Methodology: Valuation experiment with multiple properties and test groups

Three experiments with experts (= experienced valuers) and novices (= real estate students), in Germany and South Africa with real and fictitious properties.

Participants were asked to do a mock valuation of an office building, based on a set of documents (rent roll, floor plan, pictures, real estate market report, etc.) and with the help of a self-made valuation software.

Three versions of the software with no/little/many features for debiasing:

1. **Standard** (= no support for identifying anchors): Standard income approach in MS Excel. The appraiser transfers the figures from the documents to the software, either directly or after some mental arithmetics. No hints are given to the nature of anchoring or the possible anchor, the book value of the property.

2. **Modified** (= little support for identifying anchors): Same calculation core, but with a written warning which informs the appraiser about the anchoring effect.

3. **Decision support system** (= all-round support for performing the appraisal task): This version has several features that were found to reduce the anchoring effect in previous experiments, such as warnings, better information display, and help texts.
Similar information memoranda for the properties in Cape Town (South Africa), Hamburg (Germany), and Nuremberg (Germany)
The calculation core was identical in all three software versions; the basis for our software was a simple MS Excel® spreadsheet.

<table>
<thead>
<tr>
<th>Potential Gross Income</th>
<th>R 1,749,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental income (offices):</td>
<td>R 100 * 1,368 m² * 12 months = 1,641,600</td>
</tr>
<tr>
<td>Other income (parking lots):</td>
<td>R 900 * 10 bays * 12 months = 108,000</td>
</tr>
<tr>
<td>Total</td>
<td>1,749,600</td>
</tr>
</tbody>
</table>

- Vacancy and Collection Losses: 5% * 1,641,600 = -R 87,480

= Effective Gross Income: R 1,662,120

- Operating Expenses: -R 524,880

  - Rates and taxes: 211,849
  - Insurance: 12,648
  - Cleaning & security: 50,591
  - Leasing commissions: 73,778
  - Maintenance allowance: 68,508
  - Property management: 107,506

= Net Operating Income: R 1,137,240

÷ Capitalization Rate: 9.50%

= Provisional Market Value: R 11,970,947

+/- Adjustments: R 0

= Market Value: R 11,970,948
Decision support systems are computerized aids designed to enhance the outcomes of an individual’s decision-making activities. They range from simple calculators to complex systems of artificial intelligence. For our purposes it seemed sufficient to incorporate some of the **features** which had proven useful before into our spreadsheet:

- Process orientation
- Data analysis
- Plausibility checks
- Explanations
- Information display
- Emoticons
- Warning messages

For the “modified” and “DSS” versions we added various features of decision support systems to the basic spreadsheet.

Caution: Previous valuations, price expectations of the owner, market rumors, etc., should not affect a valuation. They cannot be verified, may be outdated or based on other assumptions. However, psychologists have found out that valuers are unconsciously influenced by them. This is called the "anchoring effect" because such a value acts as an anchor and prevents an objective valuation.

Therefore please check your valuation again. If you think that the anchor value has unduly influenced you, you now have the opportunity to correct your valuation. With the help of the slider, move your value to the RIGHT, AWAY from the anchor.

**Adjusted market value:** R 12,569,495
Outline

I. Idea and goals
II. Literature review
III. Methodology
IV. Data
V. Hypotheses and results
VI. Summary and future research
Data collection: The first experiment in Germany is finished, the others are not

We are aiming at a minimum of 60 probands per country/method, equally divided over the three software versions and two groups. This was achieved in the first German experiment, which was carried out in June/July 2014.

### Number of probands per software version and group

<table>
<thead>
<tr>
<th>Software Version</th>
<th>Germany (&quot;Ertragswert&quot; Approach)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard version</td>
<td>28</td>
</tr>
<tr>
<td>Modified version</td>
<td>28</td>
</tr>
<tr>
<td>DSS version</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total probands</strong></td>
<td><strong>89</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>Total probands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>46 of 54 (= 85.2%)</td>
</tr>
<tr>
<td>Experts</td>
<td>43 of 289 (= 14.9%)</td>
</tr>
<tr>
<td><strong>Total probands</strong></td>
<td><strong>89</strong></td>
</tr>
</tbody>
</table>

The experts were recruited via random sampling from the membership rosters of the most important professional bodies RICS, BIIS (Association of Investment Property Valuers). To enhance the response rate we also used personal contacts. The student sample was collected in property valuation courses at Nürtingen-Geislingen University.
Outline

I. Idea and goals
II. Literature review
III. Methodology
IV. Data
V. Hypotheses and results
VI. Summary and future research
Hypotheses

Main hypotheses

(1) The valuation variation is lower if the valuer is debiased and supported in his decisions

(2) The anchoring effect is reduced if the valuer is debiased and supported in his decisions

Sub-hypotheses

(3) Lower variation of land values with DSS

(4) Lower variation of market rents with DSS

(5) Lower variation of operating costs with DSS

(6) Lower variation of cap rates with DSS

(7) More adjustments of market value with DSS

(8) Longer processing time with DSS
Preliminary results from Germany show less variation in the market values = higher accuracy of valuations with DSS version

**Standard version:**
- Mean: € 2.68
- Range: Min. € 1.6, Max. € 4.2 (160.6%)
- Standard deviation: € 0.50
- Variation coefficient: 19%

**Modified version:**
- Mean: € 2.54
- Range: Min. € 1.6, Max. € 3.6 (122.5%)
- Standard deviation: € 0.50
- Variation coefficient: 20%

**DSS version:**
- Mean: € 2.68
- Range: Min. € 2.2, Max. € 3.5 (59.1%)
- Standard deviation: € 0.32
- Variation coefficient: 12%
The reduction of the variation was obvious in both student and expert groups; surprisingly it was greater in the expert groups.

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>€2.58</td>
<td>€2.59</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Min. €2.1, Max. €4.2 (99.7%)</td>
<td>Min. €1.6, Max. €3.3 (101.9%)</td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td>€0.55</td>
<td>€0.45</td>
</tr>
<tr>
<td><strong>Variation coefficient</strong></td>
<td>21%</td>
<td>17%</td>
</tr>
</tbody>
</table>

**Standard version**

**Experts using DSS version showed lowest variation of all subgroups; mean was closest to overall mean**

**DSS version**

**Variation reduced by all measures**
The relative impact of the individual features cannot be determined. The results suggest that the reduction was caused by a mix of decision support and more intensive thinking.

**Hypothesis 4:** The variation of the market rents was significantly lower in the DSS version. Possible interpretation: In the DSS the valuers focused on the data sources that were more objective, current, and relevant. The software required a judgment regarding these criteria, and the consensus was fairly high.

<table>
<thead>
<tr>
<th>Degree of consensus regarding data sources</th>
<th>Objectivity</th>
<th>Currentness</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source 1</td>
<td>74%</td>
<td>68%</td>
<td>52%</td>
</tr>
<tr>
<td>Source 2</td>
<td>77%</td>
<td>58%</td>
<td>87%</td>
</tr>
<tr>
<td>Source 3</td>
<td>65%</td>
<td>94%</td>
<td>81%</td>
</tr>
<tr>
<td>Source 4</td>
<td>71%</td>
<td>84%</td>
<td>58%</td>
</tr>
</tbody>
</table>

**Hypothesis 2:** A warning message was enough to significantly reduce the anchoring effect … but only in the modified version, not in the DSS version. Possible interpretation: The DSS forces the valuer to think more about every decision so that the danger of anchoring towards an unreasonable anchor is diminished.

<table>
<thead>
<tr>
<th>Effect of warning message on variation</th>
<th>Version M</th>
<th>Version DSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before warning</td>
<td>After</td>
<td>Before</td>
</tr>
<tr>
<td>Range</td>
<td>139%</td>
<td>123%</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.56€</td>
<td>0.50€</td>
</tr>
<tr>
<td>Var. Coeff.</td>
<td>22%</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Hypothesis 8:** The average processing time increased. Possible interpretation: The DSS required more reading and more data inputs, thus forcing the valuer to spend more time on decision-making.

<table>
<thead>
<tr>
<th>Average processing time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version Modified</td>
</tr>
<tr>
<td>Version DSS</td>
</tr>
</tbody>
</table>
Outline

I. Idea and goals
II. Literature review
III. Methodology
IV. Data
V. Hypotheses and results
VI. Summary and future research
Summary and future research

Preliminary findings (one country / one method):

- Most hypotheses could be falsified, i.e., it could be shown that a decision support system can effectively reduce valuation variation.
- Our goal was not to measure the anchoring effect. Therefore it is not clear to which extent the anchoring effect and the appraisal bias could be reduced.

Caveats:

- Fairly large sample of randomly selected experts, but by no means representative.
- Real world case and software, but laboratory conditions which have limited validity for the practice of property valuation.
- Focus on the anchoring effect, other effects and their interrelation were ignored.

Suggestions for further research:

- Replication of the experiment with other properties / locations / valuation methods, and improved software.
- Incorporation of other biases.
Contact information

Kathleen Evans, Jesse Sui Sang How, François Viruly

University of Cape Town
Department of Construction Economics & Management
Fifth Level, New Snape Building, Upper Campus Rondebosch 7701
South Africa
Website: http://cons.uct.ac.za/
Email: Kathleen.evans@uct.ac.za, Francois.viruly@uct.ac.za
Phone: +27 (0)21 650 4856

Anja Dust, Carsten Lausberg, Marcel Schmid

Nürtingen-Geislingen University
Campus of Real Estate
Parkstr. 4
73312 Geislingen
Germany
Website: www.hfwu.de/lausberg
Email: carsten.lausberg@hfwu.de
Phone +49 (0) 7331 / 22 -574