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Property Valuations and Valuation Accuracy in Germany and Europe

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1 Introduction

Property valuations play a key role in the real estate market and are used for a variety of reasons, such as purchase and sale decisions, mortgage lending, pricing of shares, insurance premiums or taxes. Their most common purpose in the real estate investment universe, and focus of this thesis, is as proxies for market prices. Due to the special attributes of real estate as an asset class, property values are not readily observable on the market and therefore the industry depends on valuations to estimate the value of a property at a specific moment in time. The ability of valuations to accurately mirror market values is therefore of vital importance.

The data for all analyses was provided by the real estate division of MSCI (formerly IPD), a global provider of decision tools and support services for a wide range of investment classes. Among other real estate services, MSCI publishes annual valuation-based indices, measuring the performance of unlevered, directly held, commercial real estate investments. Figure 1.1 displays the annual total returns of eight European MSCI all-property indices.

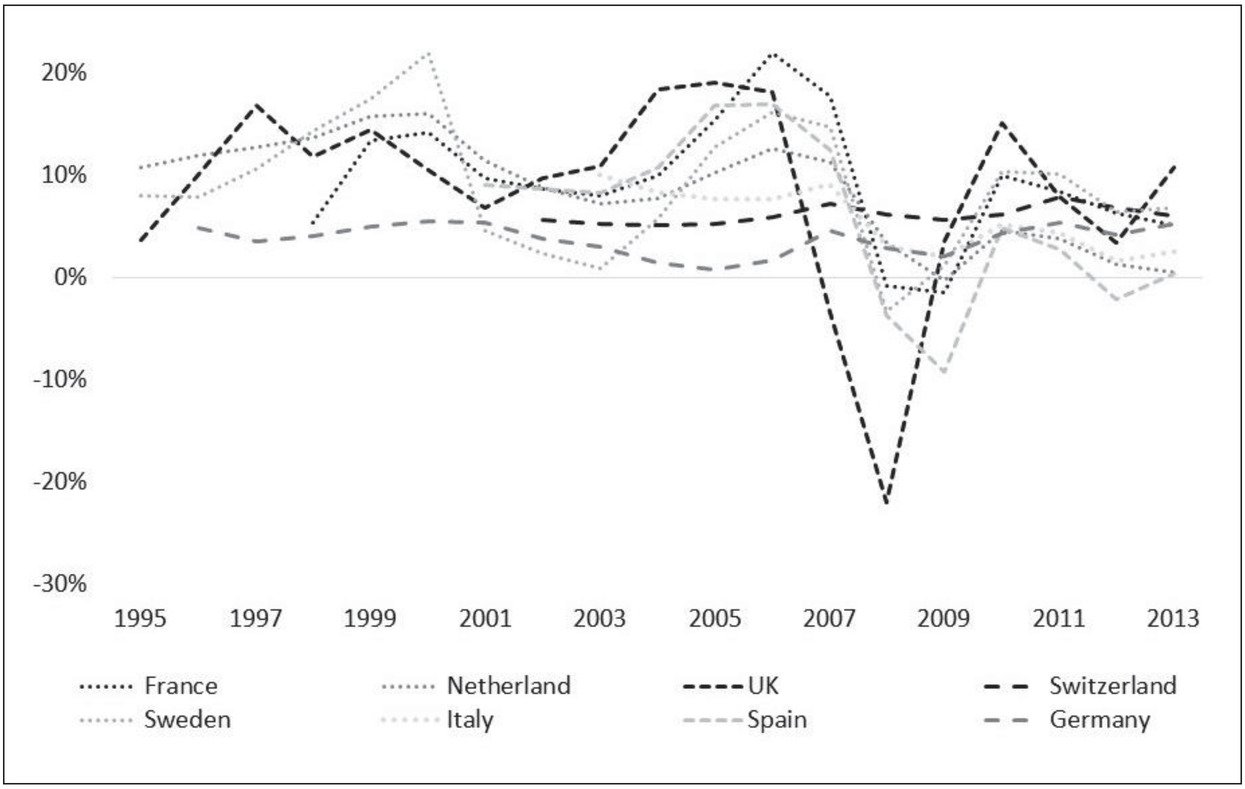


Figure 1.1 **MSCI Selected Country All-Property Indices, 1995-2013**

Figure 1.1 shows that total return patterns differed drastically between countries over the years 1995 to 2013. This time period was chosen because it corresponded to the longest time series used in the analyses. Over the eleven years from 2003 to 2013, for which data was available for all eight countries, the highest total return volatilities could be found in the UK and Spain. The average annual total return was 7.4% in the UK and 5.3% in Spain. The standard deviations were 11.6 and 8.2 percentage points respectively. Switzerland and Germany on the other hand experienced the lowest total return volatilities. Average annual total returns were 6.1% in Switzerland and 3.2% in Germany. The standard deviation of the total returns were only 0.8 and 1.5 percentage points respectively.

Splitting the total return into its components of income return and capital value growth revealed that the observed differences in total returns were driven by the volatility of capital value growth. The standard deviations of capital value growth ranged from 0.9 percentage points in Switzerland to 10.9 percentage points in the UK. The standard deviations of income returns on the other hand were more similar and only ranged from 0.2 percentage points in Switzerland to 0.7 percentage points in the UK.

In the above comparison, Switzerland and Germany were the markets with the highest total return per unit of standard deviation while the UK and Spain were the markets with the lowest total return per unit of standard deviation. These vastly divergent risk-return profiles should have significant implications for risk diversification and portfolio allocation. However, since the indices in Figure 1.1 are valuation based and the different return patterns are the result of fluctuations in capital value growth, an alternative explanation could be cross-country differences in the underlying valuations. Valuation accuracy, the difference between appraised values and market prices, has long been the subject of debate among academics, practitioners and the Courts. If valuations failed to accurately mirror underlying market prices, actual return patterns may not be as divergent as Figure 1.1 suggests. This claim is often used to explain the comparative smoothness of German property valuations in comparison to other markets.

This thesis summarizes the analyses of two different aspects of property valuations in Germany, which may contribute to the observed stability of German property values in comparison to other countries. Chapter 2 analysed and compared valuations according to the traditional German income approach with valuations according to discounted cash flow and assessed their valuation accuracy (Papers 1 and 2). Chapter 3 analysed the valuation accuracy of external property valuations in comparison to internal property valuations, which are quite common in the German real estate industry (Paper 3). The results of Chapters 2 and 3 raised general questions over the overall level of valuation accuracy in Germany. However, due to a lack of suitable comparables or benchmarks from other markets, no general conclusions could be drawn. Therefore, a comparison of valuation accuracy across several European real estate markets was carried out (Paper 4). This made it possible to put the levels of valuation accuracy identified in Germany into a broader perspective. The final chapter gives a conclusive summary, outlining the main results of this thesis.

2 Comparison and Valuation Accuracy of the DCF and German Income Approach

There is an ongoing debate surrounding the traditional German Income Approach of property valuation (GIA) and internationally applied methods such as the DCF. In Germany, the majority of institutional investors uses the traditional valuation method known as *Ertragswertverfahren* (literally translated as *earnings-value-technique*) while investors abroad prefer other methods, such as discounted cash flow (DCF) approaches. Even though there is a wide range of property valuation models to choose from, the GIA remains the most common technique of property valuation among profit seeking investors in Germany. In the cleaned dataset of this analysis, 91% of valuations were based on GIA. This indicates the dominance of the GIA in the German real estate market.

A large body of research with regards to smoothing and delayed market movements of property valuations exists (Weistroffer & Sebastian, 2015; Geltner et al., 2003; McAllister et al., 2003; Clayton et al., 2001; Brown & Matysiak, 2000), but it is often claimed that the German valuation technique is even more prone to these inefficiencies (Schnaidt & Sebastian, 2012; Crosby, 2007). These claims could be an alternative explanation for the observed smoothness of the German index in comparison to the other markets in Figure 1.1.

So far, research into the GIA has remained largely theoretical and the few existing empirical analyses lack suitable comparisons. Due to an increasing number of German investors employing DCF appraisals, it was possible to compare the two methods directly under the same market conditions.

In the next section, the GIA is explained, followed by a summary of the on-going debate. Thereafter, the data is introduced. The analysis was twofold. First, the two valuation techniques were compared in order to establish if and how GIA and DCF valuations differed from each other. Thereafter, the valuation accuracy of both approaches was analysed. The chapter closes with a conclusive summary.

2.1 Income Based Valuation Techniques

Most property valuation techniques fit broadly into three categories: cost approach, comparison approach and income approach. Even though all three methods are used internationally, they can differ considerably in their application (Downie et al., 1996). Both, the GIA and the DCF, are income-based approaches, deriving a property's value from the income streams it generates.

Even though DCF-style valuations are widely applied, there is no standardised and universal framework (gif e.V, 2006; Hordijk & Van de Ridder, 2005). It is therefore inaccurate to talk about the DCF because methods can vary between and even within countries. The International Valuation Standards Council (IVSC) broadly defines Discounted Cash Flow Method as *"A method within the income approach in which a discount rate is applied to future expected income streams to estimate the present value"* (IVSC, 2019a).

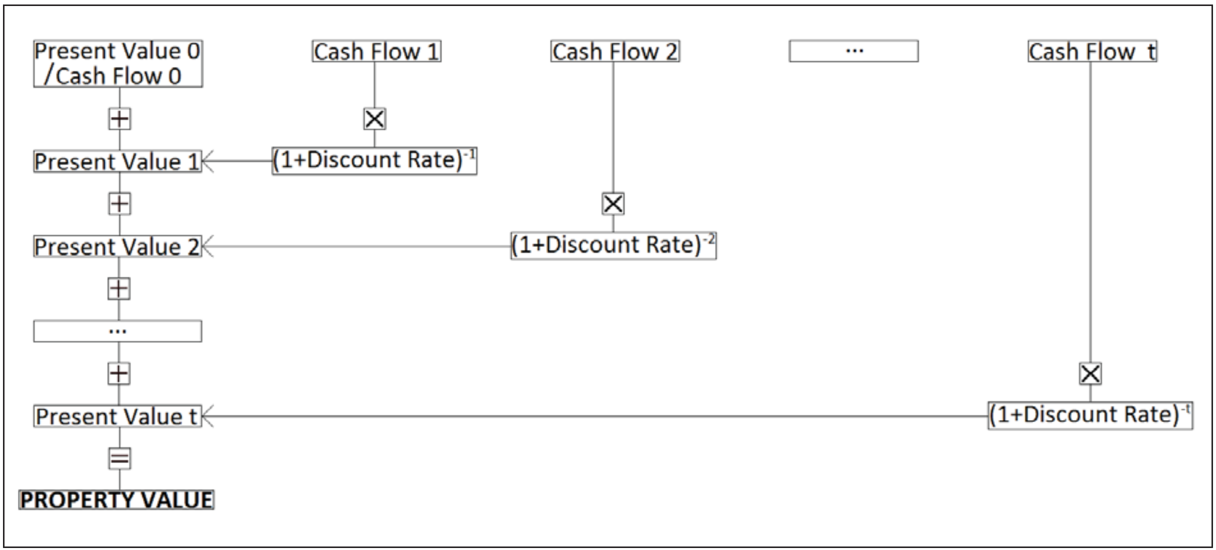


Figure 2.1 Diagram of Standard DCF Valuation

The DCF discounts and sums up all future cash flows associated with a property, see Figure 2.1. These cash flows include at least the income (gross or net) for a number of years and a terminal value. Usually DCF analyses cover a time span of ten years (Greiner & Dildei, 2007) but the time horizon can be adjusted according to the valuation objective or anticipated holding period. The terminal value is the discounted value of all future cash flows at the end of the analysis period. Most commonly, it is derived by capitalising the final cash flow in perpetuity at an appropriate risk-adjusted yield. Depending on the approach, additional lease events such as vacancies, new leases, breaks, rent-free periods and so on can be included as well. The resulting net cash flows are discounted to the date of valuation using the appropriate risk-adjusted discount rate. The sum, or present value, of all discounted cash flows is used as the value of the property.

The DCF approach is forward looking, trying to predict future cash flows and their timing as realistically as possible (Isaac & O'Leary, 2013). This is a major difference to the GIA, which is backward looking, relying on historical market information. Unlike the DCF, GIA valuations follow strict, codified procedures. At the centre of the GIA is the official Property Valuation Committee (*Gutachterausschuss*) which collects market information. When a property in Germany is sold, its information is transmitted to the Property Valuation Committee, which aggregates and standardizes the information in order to derive the input variables required for a traditional GIA valuation. These variables include benchmark land values (*Bodenrichtwert*), market rental income (*Marktüblicher Rohertrag*), GIA yields (*Liegenschaftszins*) and the remaining lifespan of the building (*Restnutzungsdauer*).

By using verified historical market information, the German valuation method tries to limit subjectivity of valuations to a minimum (Schnaidt & Sebastian, 2012). The backward-looking approach of the GIA is seen as potentially problematic by international observers but proponents claim that the technique of the GIA is more transparent and objective (McParland et al., 2002) and that predicting future rents would require *prophetic gifts* (Kleiber, 2007).

The downside of using actual market data is that markets may move and historical data might not be representative of the market conditions at the time of valuation (Geppert & Werling, 2009). Input variables are usually based on transactions in the previous year and may be more than a year old by the time they have been published. Therefore, valuers will need to use discretion and make suitable adjustments to the input variables, if necessary. Another issue is that relying on input variables from the Property Valuation Committee makes it impractical to apply the GIA abroad because the required input information is not readily available (Geppert & Werling, 2009).

Figure 2.2 depicts the steps of a traditional GIA valuation. The GIA calculates land value (left side) and building value (right side) separately. In the end, both components are combined to derive the value of the whole property. Land, being more homogenous than buildings, is valued by comparison, using lists of benchmark land values published by the Property Valuation Committee. The benchmark land values are based on plots with standard characteristics and the valuer needs to make adjustments depending on size, shape, micro-location and other characteristics that make the land to be valued different from the average lot. Land values are assumed to be infinite while the value of a building depreciates over time (Geppert & Werling, 2009). If a building is never renovated and upgraded, its cash flows will eventually cease. In the GIA, a building's so called economic age (*Wirtschaftliches Baualter*) is estimated depending on the current state of repairs, fit out and type of use (Junius & Piazolo, 2008). Together with the total expected lifespan, available from comparative lists supplied by the Property Valuation Committee, a building's remaining economic lifespan can be derived. For example, if a building, constructed in 1900, is completely renovated and modernized in 2000, it may have an economic age of 20 years in 2020. If the total expected lifespan of the building is 60 years, the remaining income producing lifespan of the building would be 40 years and hence 40 years would be used as the capitalisation period of its income. Total expected lifespans vary by type, building standard and required upkeep. Industrial properties, which usually rely on modern fittings and technology, generally have a comparatively low expected lifespan. 40 years is often given as a guiding value (Geppert & Werling, 2009). The expected lifespan of residential buildings is among the highest, 60 to 80 years, while office properties have an expected life of approximately 60 years (Geppert & Werling, 2009).

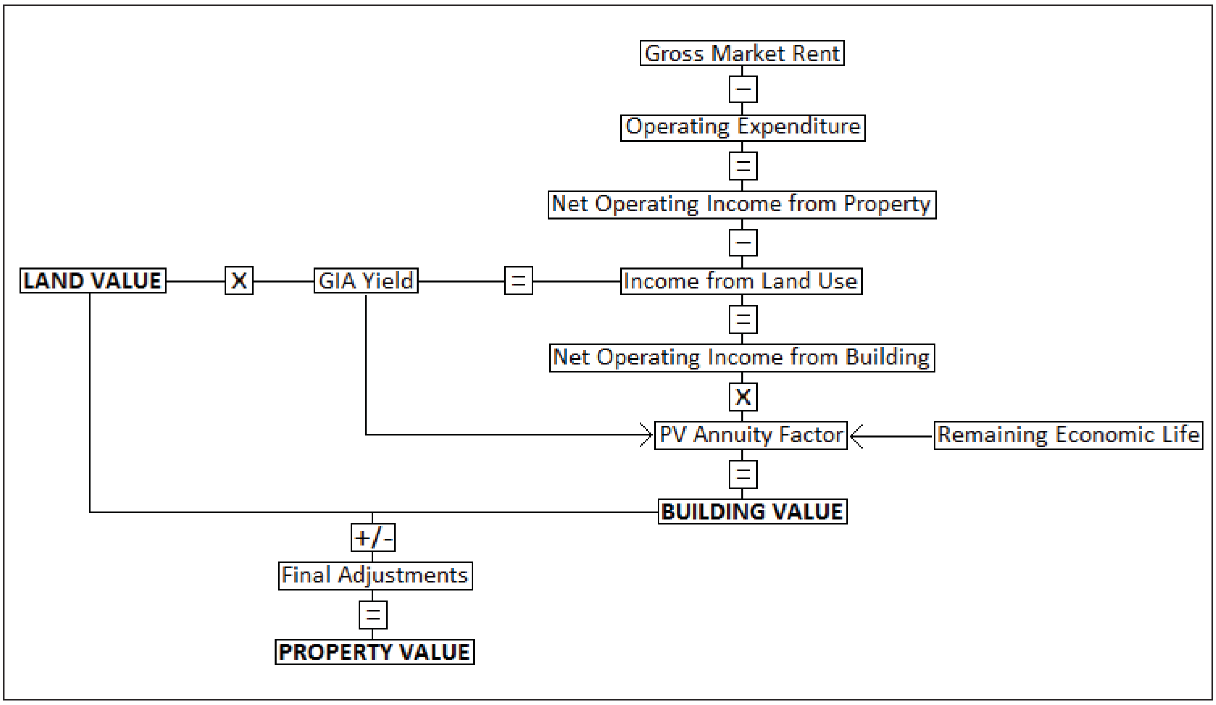


Figure 2.2 Diagram of Standard GIA Valuation

The calculation of the building value starts with the gross market rent of the property. Next, the operating expenditure is deducted. The resulting net operating income reflects the net income of the entire property, including the building as well as the land. Since the future rental payments from the land are already included in the land value, the operating income needs to be adjusted. This is done by selecting the appropriate GIA yield, from lists supplied by the Property Valuation Committee, and multiplying it with the value of the land. The result represents the proportion of income that stems from the use of the land. This amount is then deducted from the net operating income of the property to calculate the net operating income of the building. This income is used to derive the value of the building as the present value of an annuity using the remaining economic lifespan and the appropriate risk adjusted GIA yield. Finally, the land value and the building value are combined and, after final adjustments to incorporate any recent market movements or other factors, the value of the total property is derived.

Over the years some variations of the classical GIA have been developed. The so called simplified GIA (*Vereinfachtes Ertragswertverfahren*) has a less clear separation of land value and building value but reaches the same result as the classical GIA (Geppert & Werling, 2009). In the simplified GIA, the value of the whole property, including land and building, is calculated over the remaining economic lifespan of the building. Then the perpetual land value, discounted from the end of the building's economic lifespan, is added.

2.2 Literature Review

While there are different objectives for property valuations, their most common purpose, and focus of this research, is as surrogates for market prices. As such, they should emulate a property's market value at a specific moment in time. Numerous definitions of value and price exist. For the purpose of this thesis, it is sufficient to follow simple and straightforward definitions: value is an <u>estimation</u> of the price of exchange while price is the <u>actual</u> amount for which an asset is exchanged in the open market (French, 2006).

It is often said that valuation is an art, not a science. This statement applies to the method, not the concept of value itself (French & Gabrielli, 2004). It has been well established that individual valuations are prone to some degree of uncertainty (Baum, 2009; French & Gabrielli, 2004; Mallinson & French, 2000), arising from uncertainties in the method and input variables (French & Gabrielli, 2004). The GIA differs significantly from internationally applied Anglo-Saxon valuation methods in terms of calculation method and input variables. Unsurprising many German researchers and professionals are in favour of the GIA while international sources express a preference for Anglo-Saxon methods such as the DCF.

Schnaidt and Sebastian (2012) compared the definitions, legislation and general processes of German and Anglo-Saxon valuation methods. They concluded that the existing differences between valuation approaches should not be large enough to cause significant differences in outcome. For instance, comparing the official German definition of value with that of the Royal Institution of Chartered Surveyors (RICS)[1] shows that there are more similarities than differences (Schnaidt & Sebastian, 2012). The definition of *Verkehrswert*, the conventional German term for value, according to the Building Code (*Baugesetzbuch*) can be translated as *"Verkehrswert is determined by the price which may be achieved on the day of valuation under regular trading conditions depending on legal circumstances and actual characteristics, depending on the nature and the location of the property or other asset without regard to any exceptional or personal circumstances"[2].* In an attempt to eliminate any remaining confusion, the current legal frameworks make it clear that *Verkehrswert* is the same as *Marktwert* or market value (BauGB *§ 194*; ImmoWertV *§ 1.1).* It follows that, at least in theory, definitions of value in Germany and abroad should be comparable, aiming to identify the price of exchange.

While a large body of research regarding smoothing and delayed market movements of property valuations exists (Weistroffer & Sebastian, 2015; Baum, 2009; Geltner et al., 2003; McAllister et al., 2003; Clayton et al., 2001; Brown & Matysiak, 2000), it is often said that the German valuation method is even more prone to these inefficiencies (Schnaidt & Sebastian, 2012; Crosby, 2007). German valuers are said to smooth peaks and troughs and to adjust their valuations only if market movements persist (Schnaidt & Sebastian, 2012; Kilbinger, 2006). As a consequence, GIA valuations would understate true risk in the short run. Some opponents

[1] *The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where theparties had each acted knowledgeably, prudently and without compulsion. (RICS, 2017)*

[2] *Der Verkehrswert (Marktwert) wird durch den Preis bestimmt, der in dem Zeitpunkt, auf den sich die Ermittlung bezieht, im gewöhnlichen Geschäftsverkehr nach den rechtlichen Gegebenheiten und tatsächlichen Eigenschaften, der sonstigen Beschaffenheit und der Lage des Grundstücks oder des sonstigen Gegenstands der Wertermittlung ohne Rücksicht auf ungewöhnliche oder persönliche Verhältnisse zu erzielen wäre.*

of the GIA claim that German valuers understand value as a sustainable long-term average, similar to mortgage lending (Weistroffer & Sebastian, 2015; Schnaidt & Sebastian, 2012; Crosby, 2007; Kilbinger, 2006; Mansfield & Lorenz, 2004). However, according to the official definition presented above, the aim of a valuation should be to assess a property's value at a particular moment in time.

Much of the above criticism relies on market sentiment, interpretation and circumstantial evidence. Direct empirical evidence is scarce. A large part of empirical research on the German valuation method focusses on open-end property funds and their crisis in 2005/2006. During the crisis, more than €12 billion, or approximately 13% of total assets under management, were withdrawn over a short period of time and for the first time in their long and successful history, many public open-end real estate funds were forced to suspend the redemption of shares due to shortage of liquidity (Weistroffer & Sebastian, 2015). In his discussion paper, Crosby (2007) formulated the hypothesis that the German fund crisis was aggravated by a valuation problem caused by the German valuation technique. He argued that there is evidence that overvaluation during recessions is more likely to occur with the GIA than with other methods and that investors are tempted to make withdrawals if they suspect shares are overvalued. Crosby also suggested that valuations in Germany are less transparent and conceptually correct than elsewhere. This, so Crosby, is caused by different definitions of value, valuation methods, professional as well as educational environments and higher vulnerability to coercion by clients. Crosby's hypothesis, that a valuation problem contributed to the fund crisis of German open-end funds, was shared by Weistroffer and Sebastian (2015) who concluded in their empirical analysis that assets held by German open-end funds were indeed overvalued prior to the crisis which made the mass redemption of shares a rational move by investors.

Research on German property valuations is largely theoretical and results are mixed. This analysis is the first large scale empirical comparison of the traditional GIA and the international DCF under the same market conditions. In order to eliminate distorting factors, the analysis was limited to German properties held by German investors. This way, market conditions, definitions of value, legal frameworks, professional environments and educational backgrounds of valuers should be largely identical across all valuations in the dataset, offering a levelled playing field for comparison.

2.3 GIA and DCF Dataset

The data was provided by the real estate division of MSCI. MSCI provides its clients with a wide range of portfolio analyses and performance benchmarking services. Performance is measured on the individual property level and excludes the impact of debt, cash and other active management initiatives at the fund level (IPD, 2012). All data providers are for-profit commercial real estate investors, operating in the German market.

In the first step of the data cleaning process, foreign properties and domestic properties held by foreign investors were removed. German properties held by foreign investors were excluded to avoid noise by including foreign investors, operating outside their home market. In order to reduce heterogeneity, residential properties and properties in the use category *other* were dropped. *Other* property types can include anything from health care properties to parking lots. Only office, retail and industrial properties were used in the analysis. Next, properties under development and assets that experienced significant partial transactions were excluded.

In Germany, the data is usually supplied to MSCI directly by the investors themselves. Data providers have the option to report the valuation technique that was used to derive a property's value. They can select from the following categories: *Ertragswertverfahren according to ImmoWertV*, *Discounted Cash Flow Method* and *Simplified Ertragswertverfahren* (IPD, 2011). As the classical and the simplified GIA result in the same outcome, both were combined into the GIA sub-sample. Unfortunately, no information on other valuation methods or on the specifics of the employed DCF technique were recorded or could be deduced from the available data. Since the valuation technique was not required for benchmarking or performance analyses, some data suppliers did not supply this information at all. Therefore, observations with missing information on the valuation method were excluded. Prior to 2006, there were not enough DCF valuations in the dataset to enable statistically robust analyses and comply with MSCI's confidentiality rules. Hence, observations prior to 2006 were eliminated.

The final dataset included 12,280 observations of 2,630 properties across 90 portfolios. The majority of observations in the cleaned dataset were offices (62%) followed by retail (33%) and industrial properties (5%). Investor variables followed MSCI definitions (IPD, 2011). These were open-end specialized funds, open-end public funds, closed-end funds, unlisted property companies, listed property companies, REITs, insurance and pension funds.

	2006	2007	2008	2009	2010	2011	2012	2013	All Years
Valuations	1,586	1,381	1,488	1,396	1,390	1,368	1,354	1,185	11,148
GIA Valuations	*1,531*	*1,281*	*1,365*	*1,231*	*1,238*	*1,235*	*1,220*	*1,062*	*10,163*
DCF Valuations	*55*	*100*	*123*	*165*	*152*	*133*	*134*	*123*	*985*
Sales	387	269	82	60	60	77	92	105	1,132
All Observations	1,973	1,650	1,570	1,456	1,450	1,445	1,446	1,290	12,280

Table 2.1 Number of Observations per Year

Table 2.1 displays the number of observations per year. The largest group of observations in any given year were GIA valuations, which made up 83% of the cleaned dataset (or 91% of all valuations). DCF valuations accounted for 8% of observations. Even though these numbers were based on a cleaned dataset, they gave an indication of how dominant the GIA is in Germany. The proportion of DCF valuations grew from 2006 to 2009 and remained around 10% since then. Sales made up 9% of the cleaned dataset.

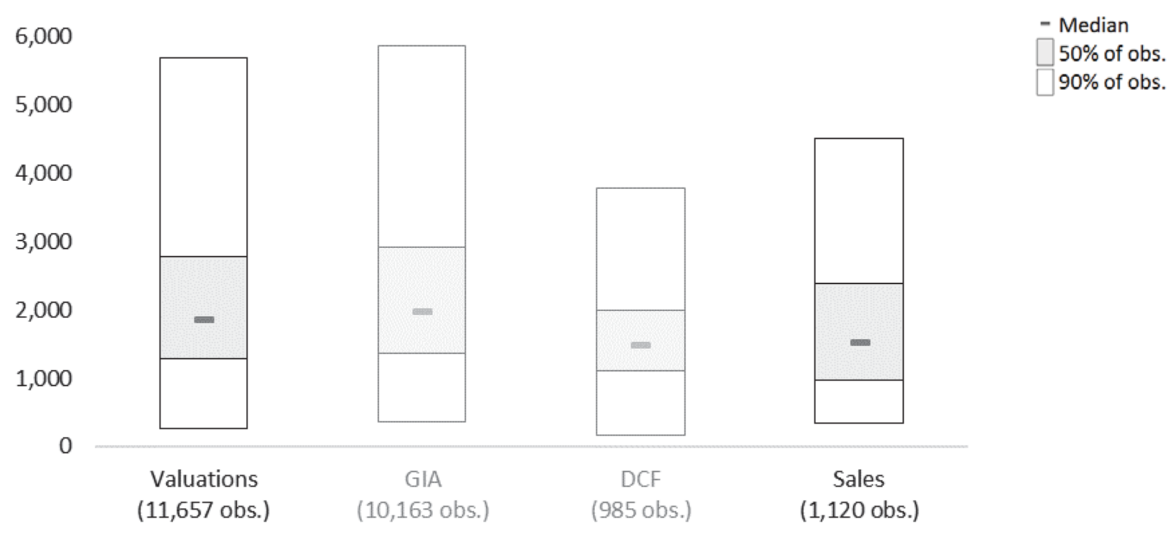


Figure 2.3 Comparison of Value and Price of GIA and DCF Valuations

Figure 2.3 displays the spread of value and price per square meter for the cleaned dataset. The numbers in brackets depict the number of observations in each sub-sample. Properties that had been valued by GIA had a larger median value (€1,976) than those that had been valued by DCF models (€1,492). A two-sample t-test showed that the population means of the two groups were statistically unlikely to be identical. Median estimated rental values were €11.54 per m² p.a. for GIA and €9.00 per m² p.a. for DCF valuations. However, the yield was quite similar across both sub-samples: 6.4% and 6.8% respectively. Further, there was some variation between the two sub-groups in terms of location and investor type. For example, 52% of GIA valuations came from properties in Germany's *Big 7*[3] cities but only 32% of DCF valuations were located in those cities. Further, 29% of GIA valuations stemmed from properties held by insurance funds. In contrast, the largest investor group among DCF valuations were unlisted property companies (58%).

2.4 Comparison of DCF and GIA Valuations

The following section presents the results of a comparison of the GIA and DCF valuations in the dataset. First, a key performance indicator comparison was carried out. Second, a regression analysis was done in order to eliminate any distortions caused by varying underlying property characteristics in the valuation sub-samples.

2.4.1 Key Performance Indicator Analysis

MSCI, the supplier of the dataset, carries out performance and benchmarking services. Therefore, the dataset contained information on the annual total return, income return and capital value growth of the unlevered properties. The cleaned sample was split according to appraisal method into DCF and GIA valuations. Returns were weighted by the properties' year-end capital values. Figure 2.4 depicts the annual performance for DCF (top) and GIA valuations (bottom) from 2006 to 2013. Similarly to the German MSCI property index (Figure 1.1), only appraised properties were included. The graphs visualize the smoothness of GIA valuations in contrast to DCF valuations. Over the entire eight years, the average annual total return for DCF valuations was 3.7% with a standard deviation of 5.1 percentage points and the average

[3] *Berlin, Munich, Hamburg, Cologne, Frankfurt, Dusseldorf and Stuttgart*

annual total return for GIA valuations was 4.0% with a standard deviation of merely 1.0 percentage point. Income return for both methods was approximately 4.8%-4.9% and remained relatively stable across all years. The performance difference between the two methods was almost exclusively the result of fluctuating capital value growth. Excluding 2013, the direction of capital value growth was identical across both methods. However, the magnitude and volatility was considerably larger among DCF valuations. Average annual capital value growth for DCF valuations was -1.1% with a comparatively high standard deviation of 5.2 percentage points. For GIA valuations it was -0.8% with a deviation of only 0.8 percentage points. This difference in volatility has been one of the main critiques by opponents of the GIA who claim that the method results in smoothed values and understates the true risk of the underlying real estate. Figure 2.4 seems to give some credence to that claim.

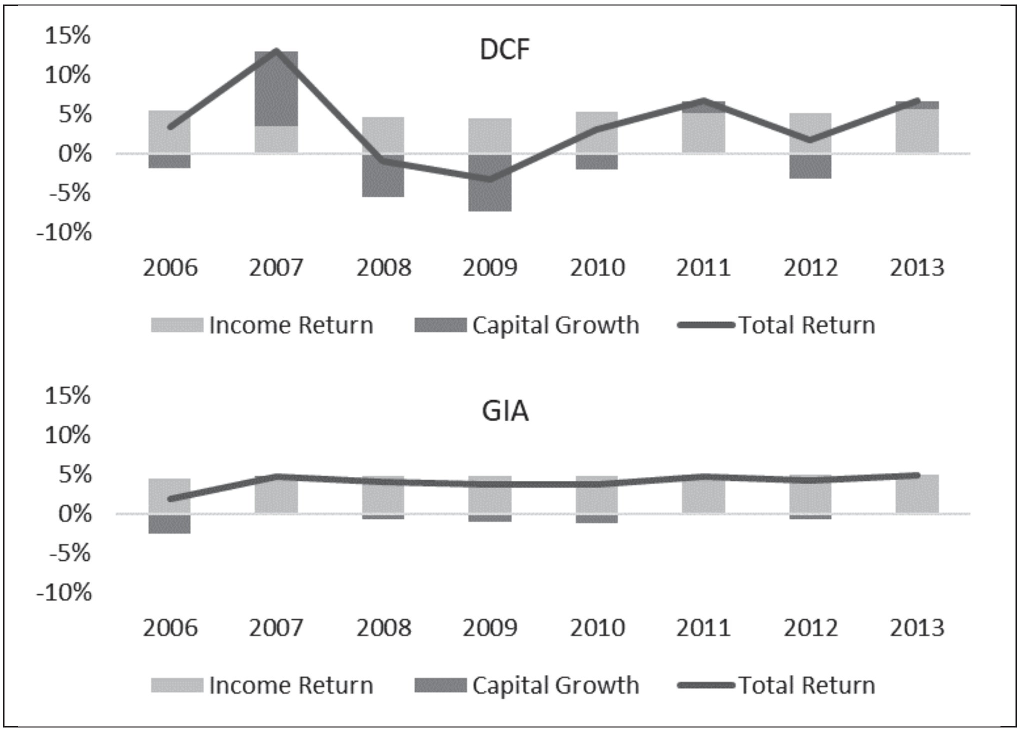


Figure 2.4 Weighted Average Performance of GIA and DCF Valuations, 2006-2013

The dataset contained either a DCF or a GIA valuation for every property. Therefore, the sub-samples in Figure 2.4 contained different underlying properties. Additionally, the pool of properties changed slightly from year to year whenever an asset was sold, bought or developed. Therefore, it could not be ruled out that the observed difference in performance between the two methods was the result of differences in the underlying property data. In order to eliminate any distortions caused by varying property characteristics, hedonic regressions were used to obtain fitted GIA and DCF valuations for each property in the dataset.

2.4.2 Hedonic GIA and DCF Valuation Analysis

Table 2.2 displays the results of the regression analyses. The explained variable was the natural log of value in Euro per square meter. The explanatory variables of the regressions were based on theory and availability of data. Estimates were obtained via Ordinary Least Squares (OLS) with heteroscedasticity robust standard errors. The total number of observations differed from those presented in Table 2.1 because only properties with a full set of variables were included in the regressions.

The explanatory variables included year dummies, with the base year 2006, followed by open market rental value (OMRV) and an occupancy indicator (Occ). The occupancy indicator captured the economic vacancy, the difference between market rent and passing rent per square meter. An additional quantitative variable was the leasable area in square meters (Area). All remaining variables were dummy variables, referring to usage, location and investor type.

	Combined Sample	**GIA Sample**	**DCF Sample**
	Model 1	**Model 2**	**Model 3**
	ln(Value)	**ln(Value)** *if GIA = 1*	**ln(Value)** *if DCF = 1*
Y2007	0.005	0.006	0.064
Y2008	0.014**	0.009	0.104*
Y2009	-0.002	-0.001	-0.015
Y2010	-0.001	-0.003	-0.007
Y2011	-0.014*	-0.012*	-0.057
Y2012	-0.011	-0.005	-0.096
Y2013	-0.018**	-0.002	-0.135**
ln(OMRV)	1.196***	1.224***	1.032***
ln(Occ)	0.114***	0.108***	0.246***
ln(Area)	0.014***	0.013***	0.025**
Retail	-0.020***	-0.029***	-0.154***
Indus.	-0.019	-0.008	-0.076
South	0.022***	0.016***	0.032*
East	0.028***	0.032***	0.004
Frankf.	0.059***	0.040***	0.117**
Munich	0.099***	0.077***	0.489*
Berlin	0.108***	0.095***	0.144***
Hamburg	0.083***	0.072***	0.102**
Dusseld.	0.058***	0.042***	0.206***
Cologne	0.049***	0.038***	0.134***
Stuttg.	0.067***	0.053***	0.148**
OpEnPuFu	0.048***	0.046***	-0.111**
UnLiPrCo	-0.067***	-0.068***	0.044
LiPrCo	-0.056***	0.003	-0.079*
DCF	0.027***		
Cons	1.528***	1.406***	2.310***
Obs.	10,245	9,476	769
adj. R^2	0.934	0.939	0.898
Confidence Level	**10%*	***5%*	****1%*

Table 2.2 Hedonic GIA and DCF Valuation Models

The sectors used in the analysis were office, retail (Retail), and industrial properties (Indus.). Office properties, the largest group (62%), were used as reference. Regression analyses with different combinations of location dummies showed that many locations outside the Big 7 cities were insignificantly different from each other. Therefore, some locations were combined into broader categories. Preliminary regressions showed that no significant explanatory power, in terms of adjusted R^2, was lost by merging locations into the categories of *East* for former eastern Germany (excluding Berlin), *South* (the two southern states excluding Munich and Stuttgart) and *West* (the remaining states, excluding Frankfurt, Cologne and Dusseldorf). West, the largest location category (31%), formed the base for the location dummies. There was not enough variation among DCF valuations to distinguish all available investor categories. Only open-end public funds (OpEnPuFu), unlisted property companies (UnLiPrCo) and listed property companies (LiPrCo) could be classified. The reference group were other investor types that did not fall into the aforementioned categories (59%).

All subsequent regressions followed a similar set up with similar explanatory variables in order to assure comparability. The regressions were restricted by the availability of the variables collected by MSCI and therefore interpretation was not straightforward due to omitted variable bias. Among others, the omitted variables included the state of repairs and fit out of the building, the unexpired lease term and the micro location. However, some aspects of these variables were likely imbedded in the available rental variables.

The goodness of fit of all models was very high. This was expected because the value calculation of income-based valuation techniques, such as the GIA or DCF, is a direct function of income itself. A preliminary analysis showed that market rent per square meter (OMRV) was the most important explanatory variable. In a univariate regression, it could explain 86.8% of the variation in value per square meter. Since the explanatory variables in the full regression are interacting with each other, another approach to assess each variable's individual contribution to adjusted R^2 was carried out. In turn, each variable or variable group was excluded from the model. The difference between the adjusted R^2 of the full model and the adjusted R^2 of the reduced models illustrated a variable's individual contribution to the overall regression. This approach was applied to Model 1 in Table 2.2. The last line in Table 2.3 confirmed that the variable with the highest individual impact on the adjusted R^2 was the market rent. Without this variable, the adjusted R^2 was approximately 46 percentage points lower than before. No other variable or variable group came close to this level of relevance. The next highest contribution to adjusted R² came from *Occupancy*, another variable measuring the level of rental income. These conclusions were the same across all models in this thesis.[4]

	Full Model	***Excl. Year Dummies***	***Excl. ln(OMRV)***	***Excl. ln(Occ)***	***Excl. ln(Area)***	***Excl. Use Dummies***	***Excl. Location Dummies***	***Excl. Investor Dummies***	***Excl. DCF Dummy***
	ln(Price)								
Y2007	0.005		*0.060****	*0.011*	*0.006*	*0.005*	*0.006*	*0.001*	*0.005*
Y2008	0.014*		*0.095****	*0.026****	*0.015***	*0.014***	*0.014**	*0.007*	*0.014***
Y2009	-0.002		*0.076****	*0.011*	*0.000*	*-0.002*	*-0.001*	*-0.012**	*0.000*
Y2010	-0.001		*0.088****	*0.011*	*0.002*	*-0.001*	*-0.001*	*-0.012*	*0.001*
Y2011	-0.014*		*0.084****	*0.006*	*-0.011*	*-0.014**	*-0.014**	*-0.026****	*-0.012**
Y2012	-0.011		*0.101****	*0.003*	*-0.008*	*-0.012**	*-0.013**	*-0.022****	*-0.010*
Y2013	-0.018**		*0.145****	*0.007*	*-0.016***	*-0.019****	*-0.020****	*-0.032****	*-0.017***
ln(OMRV)	1.196***	*1.195****		*1.076****	*1.196****	*1.193****	*1.228****	*1.216****	*1.196****
ln(Occ)	0.114***	*0.114****	*0.167****		*0.114****	*0.113****	*0.112****	*0.107****	*0.114****
ln(Area)	0.014***	*0.014****	*0.011*	*0.012****		*0.015****	*0.018****	*0.022****	*0.013****
Retail	-0.020***	*-0.021****	*0.377****	*0.027*	*-0.025****		*-0.042****	*-0.041****	*-0.019****
Indus.	-0.019	*-0.022*	*-0.970****	*-0.123**	*-0.007*		*-0.019*	*-0.021*	*-0.018*
South	0.022***	*0.022****	*0.032***	*0.022****	*0.022****	*0.021****		*0.020****	*0.022****
East	0.028***	*0.029****	*-0.138****	*0.018*	*0.028****	*0.028****		*0.032****	*0.031****
Frankf.	0.059***	*0.059****	*0.768****	*0.118***	*0.061****	*0.066****		*0.057****	*0.060****
Munich	0.099***	*0.100****	*0.773****	*0.167****	*0.103****	*0.104****		*0.090****	*0.099****
Berlin	0.108***	*0.108****	*0.614****	*0.156****	*0.112****	*0.112****		*0.107****	*0.108****
Hamburg	0.083***	*0.084****	*0.432****	*0.136****	*0.086****	*0.088****		*0.080****	*0.083****
Dusseld.	0.058***	*0.059****	*0.509****	*0.098****	*0.057****	*0.064****		*0.055****	*0.058****
Cologne	0.049***	*0.050****	*0.334****	*0.080****	*0.049****	*0.055****		*0.044****	*0.050****
Stuttg.	0.067***	*0.068****	*0.296****	*0.095****	*0.070****	*0.074****		*0.063****	*0.069****
OpEnPuFu	0.048***	*0.052****	*0.223****	*0.050****	*0.060****	*0.047****	*0.039****		*0.049****
UnLiPrCo	-0.067***	*-0.066****	*-0.390****	*-0.106****	*-0.066****	*-0.078****	*-0.073****		*-0.060****
LiPrCo	-0.056***	*-0.058****	*-0.101***	*-0.092****	*-0.055****	*-0.054***	*-0.057****		*-0.034**
DCF	0.027***	*0.024***	*0.014*	*0.032****	*0.019**	*0.026***	*0.030****	*-0.009*	
Cons	1.528***	*1.536****	*7.104****	*2.090****	*1.648****	*1.531****	*1.391****	*1.383****	*1.535****
adj. R^2	0.934	*0.934*	*0.477*	*0.882*	*0.934*	*0.934*	*0.932*	*0.932*	*0.934*
obs.	10,245	*10,245*	*10,245*	*10,507*	*10,245*	*10,245*	*10,245*	*10,245*	*10,245*
Impact on adj. R²		***-0.02%***	***-48.91%***	***-5.65%***	***-0.04%***	***-0.01%***	***-0.25%***	***-0.19%***	***-0.01%***

Table 2.3 Individual Variable Contribution to Adjusted R² in Model 1

[4] *Since all regression models in this thesis followed a similar set up, the following analyses are representative of subsequent models whose regression analyses were kept short in order to keep the thesis concise.*

A correlation matrix across all variables of Model 1 in Table 2.2 showed that the only high correlation (0.96) existed between rental income and value, which was expected based on the previous analysis and the fact that income is the main contributor to value in income-based valuation approaches. All other correlations were low (0.46 or lower). Additionally, all variance inflation factors (VIF), measuring how much the variance of an explanatory variable is influenced by its interactions with the other explanatory variables, were below the critical value (2.5) for all variables in Model 1 (see 4). Therefore, it could be concluded that there should be no multicollinearity issues in the model. This conclusion was the same for all regressions in this thesis.

Variable	VIF
Y2007	1.62
Y2008	1.69
Y2009	1.68
Y2010	1.69
Y2011	1.69
Y2012	1.67
Y2013	1.58
ln(OMRV)	1.88
ln(Occ)	1.05
ln(Area)	1.33
Retail	1.64
Indus.	1.41
South	1.26
East	1.11
Frankf.	1.41
Munich	1.38
Berlin	1.25
Hamburg	1.37
Dusseld.	1.24
Cologne	1.2
Stuttg.	1.13
OpEnPuFu	1.33
UnLiPrCo	1.7
LiPrCo	1.34
DCF	1.55
Mean	1.45

Table 2.4 VIFs

Another potential issue of the close relationship and dependency between value and income could be endogeneity. From a theoretical point of view, endogeneity should not be present. The value of an investment property should be dependent on its rental income but the same should not be the case the other way around. For example, a reduction in the value of an apartment should not reduce the amount of rent that can be charged in the open market but if the market rent of the apartment changes, so should its value for a for-profit-investor. A common detection method for endogeneity is to check for a correlation between the explained variable and the error term. No or only modest correlations between rental income and the error term were detected in the models of this thesis. In the worst case, endogeneity may bias estimators and result in incorrect significance testing. Even if endogeneity were present, it was judged to be unproblematic for the overall analyses. The aim of the regressions was not to separate value into individual factors and to assess individual significances. Instead, the regressions' objective was to derive fitted values that could be used in the subsequent analyses. Therefore, the focus should not be on individual factors and significances but rather on overall fit and the ability to produce fitted values. The subsequent empirical analyses showed that fitted values and actual values of all regressions were statistically very similar and had identical means. On average, the resulting fitted values were very good estimators for actual valuations, which was the main aim of the regressions. Therefore, even if mild endogeneity were present in some regressions, it was unlikely to pose a serious problem for the analyses.

The variable of interest in Model 1 in Table 2.2. was DCF, a dummy variable for observations based on DCF methodology. The highly significant and positive coefficient indicated a premium for DCF valuations in comparison to GIA valuations when controlling for the other variables in the model. This was surprising considering that the statistical comparison in Figure 2.3 showed that the DCF valuations in the cleaned dataset were on average smaller than the GIA valuations. A Chow test justified to split the data into DCF and GIA sub-samples and run separate regressions, Models 2 and 3. The fitted values were obtained for further analysis. As expected, market rent (OMRV) remained highly significant in both models. Further analyses showed that the coefficients of OMRV were statistically unlikely to be identical across the two regressions, implying a different impact of market rent on value among the GIA and DCF sub-samples. Nevertheless, market rent remained the main explanatory variable in both regressions.

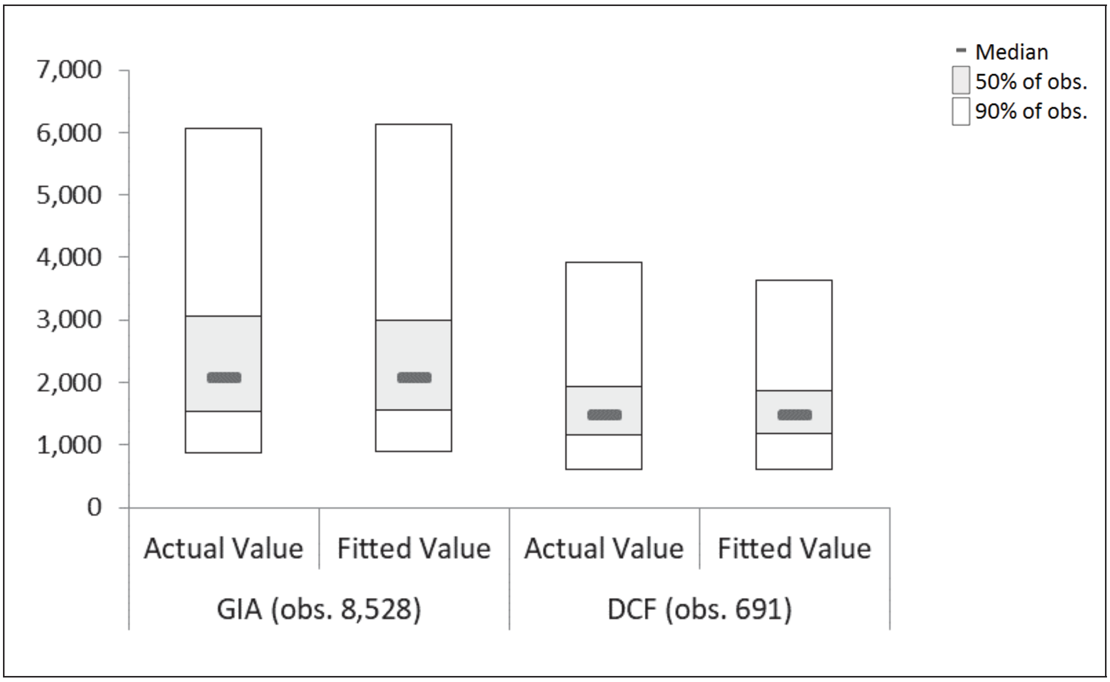


Figure 2.5 Comparison of Actual and Fitted GIA and DCF Values

Figure 2.5 compares the spread of fitted valuations obtained from regression Models 2 and 3 to their actual[5] valuations. The fitted values were obtained from regressions that fit the data on average best and hence some extreme and sometimes even nonsensical outliers existed. In order to limit the distorting impact of these outliers, the top and bottom 5% of observations were excluded. The numbers in brackets display the number of observations. Comparing the actual and fitted values with each other shows how well the hedonic valuations fit the actual data. The median actual GIA value was €2,084 per square meter compared to a fitted value of €2,077. The median actual DCF value was €1,492 per square meter and the fitted DCF value was €1,471. 89.2% of fitted GIA values and 85.7% of fitted DCF values fell within 10% of their actual valuation. A t-test showed statistically identical means between fitted GIA and actual GIA, as well as between fitted DCF and actual DCF valuations. Overall, the fitted values were very comparable to their actual valuations. However, it was still not possible to compare the GIA and DCF values in Figure 2.5 directly as the bars still contained different underlying properties, as shown by the varying numbers of observations.

Figure 2.6 Comparison of Fitted GIA and DCF Values

[5] *In subsequent parts, actual was used to refer to the original valuation or sale price from the dataset and hedonic or fitted was used to refer to values derived from regressions.*

Figure 2.6 depicts a comparison of the fitted GIA and fitted DCF values for all observations. The underlying pool of properties was now identical as can be seen by the number of observations. The spread and median have converged significantly in comparison to Figure 2.5. Especially the mid-50% of fitted values were very similar across both valuation methods. A t-test showed that the population means were still statistically unlikely to be identical.
Based on the equation below, the difference between fitted GIA and fitted DCF values was derived according to the following formula:

$$\frac{\text{Fitted GIA Valuation}}{\text{Fitted DCF Valuation}} - 1 \qquad \textbf{Formula 2.1}$$

Figure 2.7 displays the simple difference (left side) and the absolute difference (right side) between fitted GIA and fitted DCF valuations. The simple median deviation between fitted GIA and fitted DCF appraisals was -2.7%. The mid-50% of observations had a deviation between -11.4% and +7.8%. Overall, 57.6% of fitted GIA values were below, and 42.4% above their respective fitted DCF counterpart.
As negative and positive deviations could cancel each other out, the absolute deviation was also derived. The median absolute deviation between fitted GIA and fitted DCF values was |9.9%|. Given that in the past, the Courts in the UK have accepted deviations between valuations and transactions of 10-15% (Crosby et al., 1998), it was concluded that on average fitted GIA and fitted DCF valuations were very comparable. Overall, there was a large overlap between the two methods. More than half of fitted GIA values (50.6%) were within 5%, 70.1% within 10% and 83.5% within 15% of their fitted DCF counterpart.

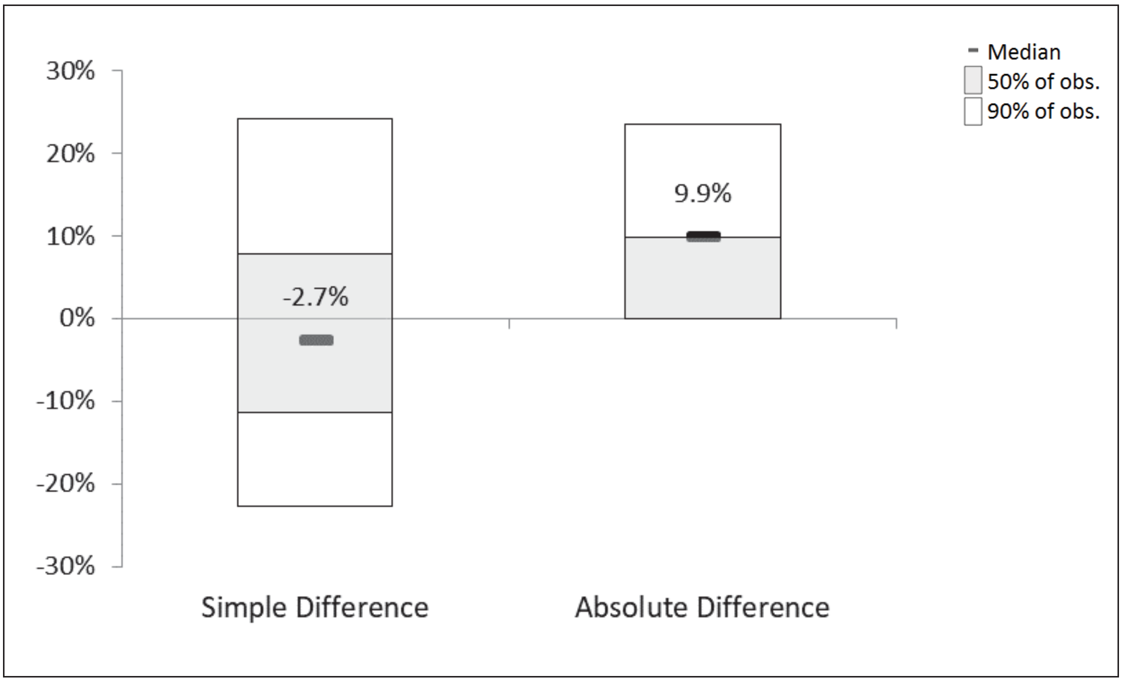


Figure 2.7 Simple and Absolute Difference between Fitted DCF and GIA Values

Figure 2.8 displays the simple difference between fitted GIA and fitted DCF values over time. The lowest median simple deviation was found in 2008 (-9.0%) and the highest in 2013 (6.7%). As demonstrated by Figure 2.8, the difference between fitted DCF and GIA values was not constant throughout time. Over the years under investigation, the ratio between the two methods changed from comparatively lower GIA values in the years 2006 to 2010 to identical fitted values in 2011 and comparatively lower DCF values in 2012 and 2013. This changing relationship could possibly be explained by changing market movements. If the real estate market was rising, forward looking DCF valuations would likely be higher than GIA valuations which are based largely on historical data. In a downward market on the other hand, backward-looking GIA values would likely be higher than DCF valuations.

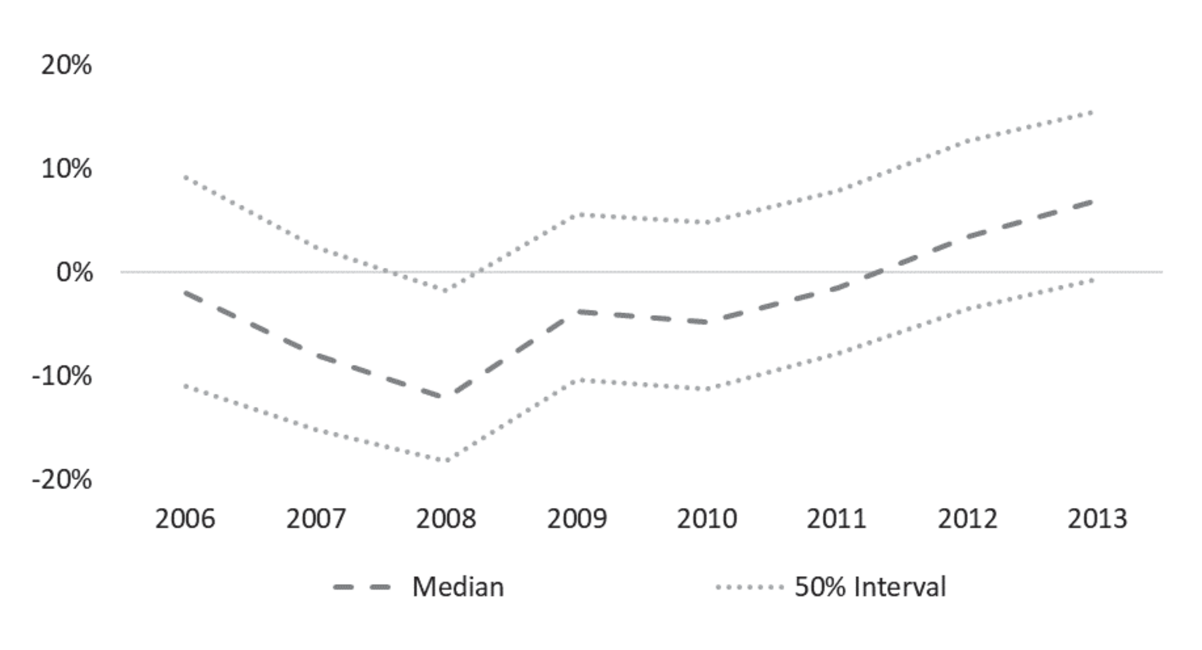


Figure 2.8 Difference between Fitted GIA and DCF Values, 2006-2013

2.5 Accuracy of the GIA in Comparison to German DCF Valuations

The previous section showed that valuations according to GIA and DCF resulted in significantly different estimations of value. Thus far, the analysis solely focussed on a comparison between the two valuation methods and made no claims about the accuracy of either technique in terms of approximating market prices. The subsequent analysis of valuation accuracy was twofold. The first part focussed on a comparison between actual sale prices and their last uninfluenced, market-adjusted valuations. In the second part, a comparison between fitted sale prices and actual as well as fitted valuations was carried out.

2.5.1 Comparison of GIA and DCF Valuations with Actual Sale Prices

The term valuation accuracy has occasionally been used to refer to issues of valuation variation among different valuers (Boyd & Irons, 2002; Crosby et al., 1998; Lizieri & Venmore-Rowland, 1993; Brown, 1992). However, valuation accuracy in this thesis is defined as the difference between appraised values and market prices (Boyd & Irons, 2002). The easiest way to assess valuation accuracy would be to compare the price achieved in the market to a valuation at the same moment in time. While there are some small case studies with such a set-up (Parker, 1999), this approach is usually difficult to implement. In most cases, a valuation is carried out in lieu of a transaction and the sale that the valuation emulates remains hypothetical (Gallimore & Wolverton, 2000). Even if both were available at the same time, it is unlikely that the valuation has been derived independently and has not been influenced by information from the transaction proceedings.

The annual Valuation and Sale Price Comparison Report by RICS and MSCI tries to approximate valuation accuracy by comparing actual sale prices against their last uninfluenced, market-adjusted valuations across different countries (RICS, 2019). The report does not explicitly distinguish between different valuation techniques, but it takes them into account indirectly because, unlike the other markets, the overwhelming majority of German valuations in the MSCI databank adhere to GIA. The Valuation and Sale Price Comparison Report also includes a long-term comparison. Any significant and consistent difference between valuation accuracy in Germany and the other countries could be used as indication for inefficiencies of the GIA. Even though a more recent Valuation and Sale Price Comparison Report exists (Walvekar & Kakka, 2020), Figure 2.9 displays the results of the Valuation and Sale Price Comparison Report 2014 for the business year 2013 (IPD, 2014), the report closest to the analysis period of this research.

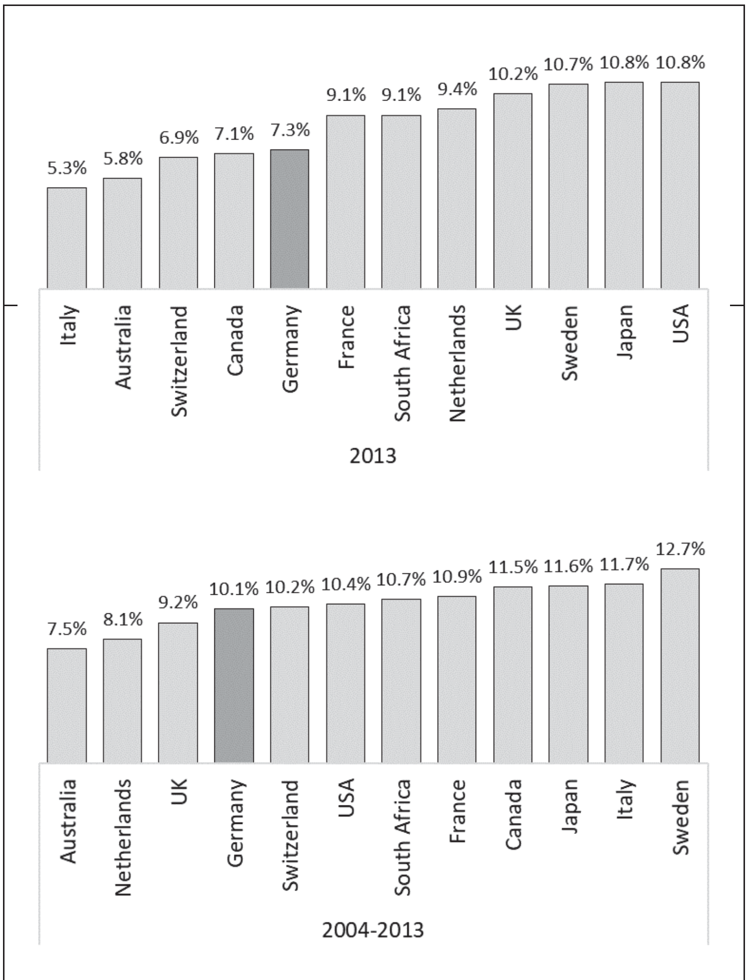


Figure 2.9 Average Absolute Deviations between Valuations and Sale Prices

Among the European markets in the study, Italy had the lowest (5.3%) and Sweden (10.7%) the highest weighted average absolute deviation between adjusted valuations and subsequent market prices. The difference between sale prices and valuations in Germany was 7.3%, which placed Germany in the lower half of the country comparison for 2013. Further, the report showed that in most countries, with the exception of Italy and The Netherlands, prices achieved in the market were on average higher than their last valuation. Over a 10-year period, the lowest average deviations in Europe were found in the Netherlands (8.1%) while the largest were observed in Sweden (12.7%). The German 10-year weighted average absolute deviation (10.1%) was again in the lower half of the country comparison. A clear and consistent difference between valuation accuracy in Germany and other European real estate markets could not be detected in the results of the Valuation and Sale Price Comparison Report.

Some studies report acceptable margins of error as low as 5-10% to judge valuation accuracy (Eziukwu, 2019; Skitmore et al., 2007; Crosby at al., 1998). Historically, the Courts in the UK have applied margins of error of up to 15% to judge normal negligence cases. However, this threshold seems to be based on theory and sentiment rather than empirical evidence (Levy & Schuck, 2005; Boyd & Irons, 2002; Bretten & Wyatt, 2001; Crosby et al., 1998). In fact, empirical studies routinely identified significant proportions of valuations well outside the 10-15% thresholds (Skitmore et al., 2007; Crosby at al., 1998). Nevertheless, applying this threshold to the results of the Valuation and Sale Price Comparison Report indicated that all countries, including Germany, fell on average within an acceptable range of 15%.

A similar approach to that of the Valuation and Sale Price Comparison Report was used to calculate the difference between sale prices and valuations in the cleaned dataset. In line with the Report's methodology, properties under development, assets with values below €15k or above €900m and assets that were bought and sold within the same year were excluded (Walvekar & Kakka, 2020). In order to avoid the window of influence that arises when valuers become aware of sale proceedings, valuations within three months of a sale were deleted. Three months was chosen in accordance with MSCI's Valuation and Sale Price Comparison Report even though the actual period of influence may vary by country and even sub-market (McNamara, 1998). In the final step, the valuation was adjusted for market movements between the date of valuation and the date of sale by applying capital value growth, as captured by the official MSCI market segment indicators. This adjustment was done up to three months before the sale date, which was assumed to be the date the sale price was agreed on (Walvekar & Kakka, 2020). The market-adjusted valuation was then compared to the actual sale price in order to approximate valuation accuracy. The difference between actual sale price and market-adjusted valuation was calculated by the following formula (RICS, 2019):

$$\frac{\text{Actual Sale Price-Market Adjusted Valuation}}{\text{Actual Sale Price}} \quad \textbf{Formula 2.2}$$

Figure 2.10 depicts the difference between actual sales and their last market-adjusted valuation. The number in brackets displays the number of observations. Unfortunately, the last valuation technique was unknown for many sales and there were only 51 observations in the DCF sub-sample. This comparatively small number did not allow for a year-by-year breakdown. In order to make the numbers more comparable, the year distribution of the DCF sub-sample was applied to the GIA sub-sample. The lighter bar in Figure 2.10 displays the weighted simple difference between adjusted valuations and actual sale prices. Since positive and negative deviations could cancel each other out, the absolute difference was also calculated (darker bar). The weighted average difference for GIA valuations was 0.3%. For DCF valuations, the weighted average difference was 1.4%. The weighted average absolute difference for GIA and DCF valuations were 13.0% and 13.8% respectively. All of these numbers fell within the aforementioned acceptable threshold of 15%. The analysis further showed that on average, prices achieved in the market were higher than their valuation. This was expected, firstly because of the results of the Valuation and Sale Price Comparison Report 2014 and secondly because it seemed intuitive that mostly properties that experienced value appreciation were selected to be sold.

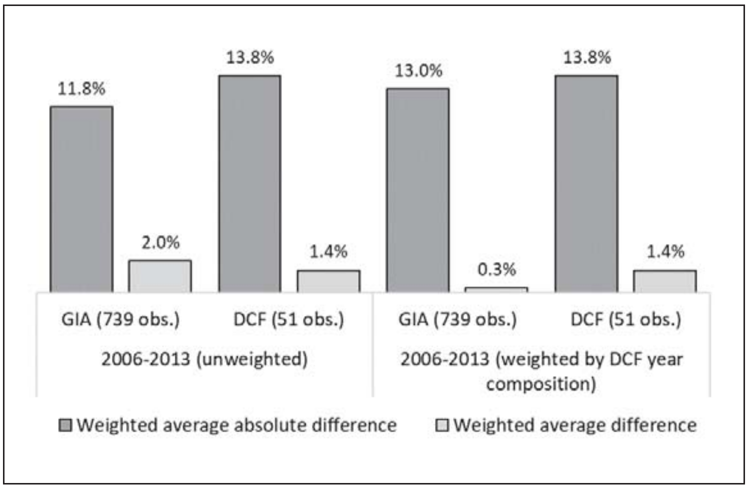


Figure 2.10 Average Absolute Deviations between Sale Prices and GIA and DCF Valuations

2.5.2 Comparison of GIA and DCF Valuations with Fitted Sale Prices

It is difficult to apply conclusions from the Valuation and Sale Price Comparison Report and the above comparison of market-adjusted valuations and actual sale prices to the whole market. Firstly, because the sample size for German DCF valuations was small and secondly, because the information gained from sold properties might not be representative of properties that were held. Sample selection bias is a widespread problem with analyses of transacted properties and several studies found evidence that sold properties were valued more closely to market prices than held properties (Weistroffer & Sebastian, 2015; Baum & Crosby, 1988). The selling process is usually a conscious decision and the selection of assets for sale is non-random. Investors are likely to avoid capitalising losses and therefore, assets whose market prices have moved above their last valuation should be more likely to be sold than properties whose prices fell in comparison to their last appraisal. Some investors, like German open-end property funds, are even legally restricted from selling assets below their last valuation and can only to do so in exceptional circumstances. Conclusions based on transacted properties can therefore not readily be applied to held properties. In order to correct this, the analysis was extended to a comparison of valuations with fitted sale prices.

Naïve Pricing Model

Table 2.5 displays the results of a regression using the natural log of price per square meter as explained variable (Model 1). Explanatory variables were the same as in the previous regressions (Table 2.2). Coefficients were obtained via OLS with heteroscedasticity robust standard errors. As before, the regression had a comparatively high adjusted R^2. This was mostly due to the variable OMRV, the market rental income. Fitted prices from Model 1 were obtained for further analysis. Model 1 was referred to as *Naïve Pricing Model* because it ignored sample selection bias. A transaction only takes place if the buyer's offer exceeds or meets the seller's reservation price (Gatzlaff & Haurin, 1998). Hence, selection is non-random and sample selection bias is likely to be present.

Heckman Pricing Model

A common procedure to correct for sample selection bias in regressions of transaction data is the Heckman Correction (Weistroffer & Sebastian, 2015; Devaney & Martinez Diaz, 2011;

Fisher et al., 2003; Gatzlaff & Haurin, 1998). The Heckman Correction (Heckman, 1979) consists of two steps. The first step is the selection equation. The selection equation is essentially a probit model based on the criteria that *selected* observations into the sample. In this analysis, the selection equation was the probability that a property has been sold. The second step, the outcome equation, is a regression using information from the selection equation, namely the inverse Mills ratio, as an additional explanatory variable. The inverse Mill's ratio is the probability density function over the cumulative distribution function. Using this variable as an additional regressor removes the part of the error term that is correlated with the explanatory variables.

	Naive Pricing Model	Heckman Pricing Model	
	Model 1	Model 2	Model 3
	ln(Price)	Step 1 Sale=1	Step 2 ln(Price)
Y2007	0.094***	-0.121**	0.235***
Y2008	0.166***	-0.805***	1.381***
Y2009	0.091**	-0.873***	1.472***
Y2010	0.116**	-0.863***	1.535***
Y2011	0.073	-0.807***	1.410***
Y2012	-0.085	-0.564***	0.862***
Y2013	0.048	-0.431***	0.744***
ln(OMRV)	1.013***	-0.002***	1.512***
ln(Occ)	0.260***	-0.285***	0.438***
ln(Area)	-0.004	0.000***	0.120***
Retail	0.051	0.048	-0.006
Indus.	-0.307	-0.098	0.314*
South	0.077**	-0.007	0.070***
East	0.057	0.167**	-0.146**
Frankf.	0.248	-0.035	0.377**
Munich	0.315**	-0.111	0.464***
Berlin	0.297***	-0.273***	0.679***
Hamburg	0.277**	-0.069	0.327***
Dusseld.	0.226**	-0.034	0.231**
Cologne	0.045	-0.022	0.049
Stuttg.	0.123*	-0.290***	0.613***
OpEnSpFu	0.042	0.003	0.001
UnLiPrCo	0.094	-0.308***	0.505***
InsPen	0.033	-0.025	0.071***
OpEnPuFu	0.136***	0.290***	-0.345***
LiPrCo	0.189***	0.092	-0.123**
ValRes		0.248***	
InvMill			-1.987***
Cons	2.314***	-0.248***	1.743**
adj. R2	0.707	0.103	0.779
obs.	1,099	12,283	1,099

Confidence Level **10%* ***5%* ****1%*

Table 2.5 Hedonic Valuation and Pricing Models

In order to yield optimal results, the selection equation should include an additional explanatory variable that impacts the selection equation, but not the outcome equation. One suitable variable would be the difference between the buyer's offer and the seller's reservation price, also known as the valuation reserve (Weistroffer & Sebastian, 2015). The more a buyer is willing to pay above the seller's reservation price, the more likely it is that a sale will take place and vice versa. Unfortunately, offer and reservation prices are usually not readily observable. Weistroffer and Sebastian (2015) approximated the valuation reserve by using fitted prices as proxies for the buyer's offer price and actual valuations as proxies for the seller's reservation price. The higher a property's market price in comparison to the valuation, the more likely it should be that a sale takes place and vice versa. This analysis followed a similar approach, approximating the valuation reserve for actual valuations by comparing them to the fitted Naïve Prices (Model 1 in Table 2.5) and for actual transactions by comparing them to their fitted valuations (Table 2.2). In reference to its proxy as the valuation reserve, the newly created variable was called *ValRes*.

Models 2 and 3 in Table 2.5 display the results of the two steps of the Heckman Correction. Model 2 displays the results of the selection equation, the probit model, using the dummy variable for sales (Sale) as dependent variable. The impact of the valuation reserve (ValRes) was positive and highly significant. This meant that, ceteris paribus, the bigger the difference between the valuation and the price, the higher the probability of a sale. Model 3 displays the results of the outcome equation, including the inverse Mill's ratio as an additional regressor (InvMill). Fitted prices, called *Heckman Prices*, were obtained for further analysis.

Before analysing the difference between fitted prices and valuations, the obtained sale prices were compared to actual prices in order to assess their goodness of fit. Figure 2.11 displays a comparison of actual sale prices, Naïve Prices and Heckman Prices. In order to limit the impact of extreme outliers, the top and bottom 5% of observations were excluded. The graphs on the left depict the median and spread of actual and fitted sale prices. Only observations for which all three sale price observations were available were included in the comparison, as can be seen by the number of observations. At first glance, the Naïve and Heckman Prices both looked very similar to actual prices in terms of median and spread of observations.

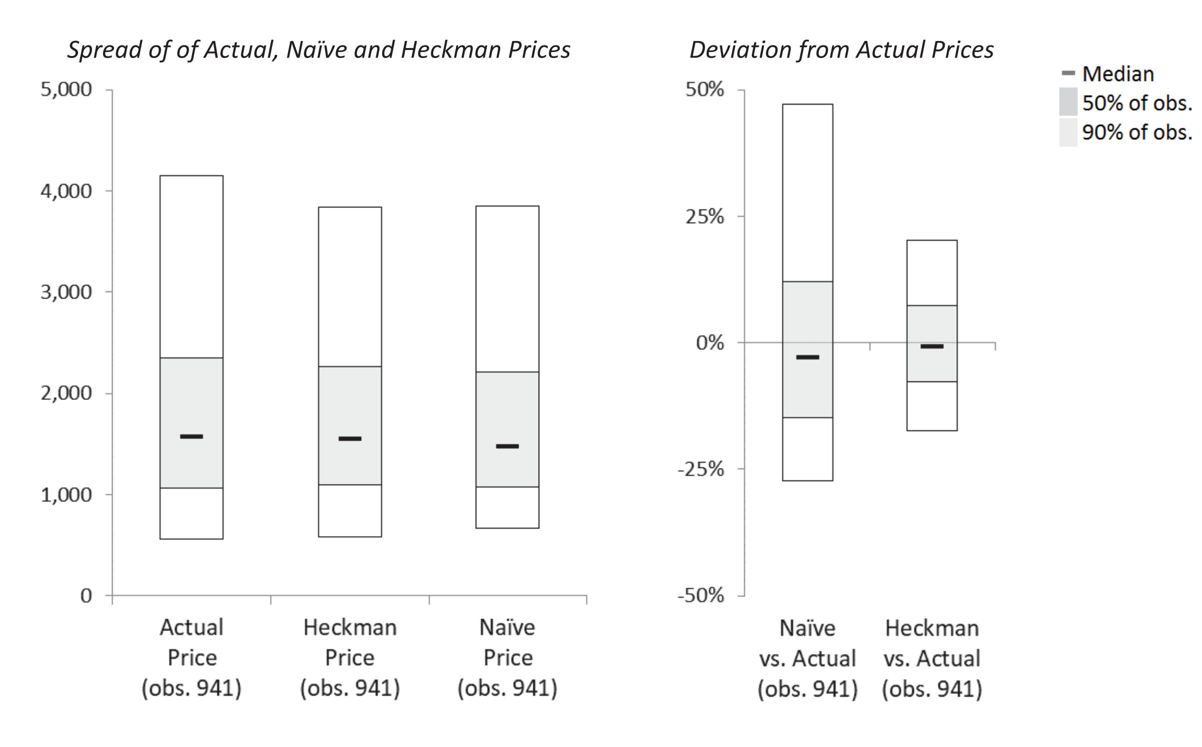


Figure 2.11 Comparison of Actual, Naïve and Heckman Prices, Chapter 2

The right side of Figure 2.11 also displays the simple difference between actual and fitted prices according to the following formula:

$$\frac{\text{Fitted Sale Price-Actual Sale Price}}{\text{Fitted Sale Price}} \qquad \textbf{Formula 2.3}$$

The median simple deviation of -3.0% between actual and Naïve Prices indicates that the majority of Naïve Prices, 55%, were below actual prices. The standard deviation was 22 percentage points, which was considerably larger than that of the Heckman Prices (11 percentage points). The median simple deviation between Heckman Prices and actual sale prices was only -0.8%. Overall, 81% of Heckman Prices fell within 15% of actual prices while only 56% of Naïve Prices did so. Overall, the Heckman Prices fit the actual transaction data much better than the Naïve Prices and therefore the subsequent analysis focussed on Heckman Prices.

Valuation Accuracy

The deviation between Heckman Prices and appraised values was used as an indicator for valuation accuracy, calculated according to the following formula:

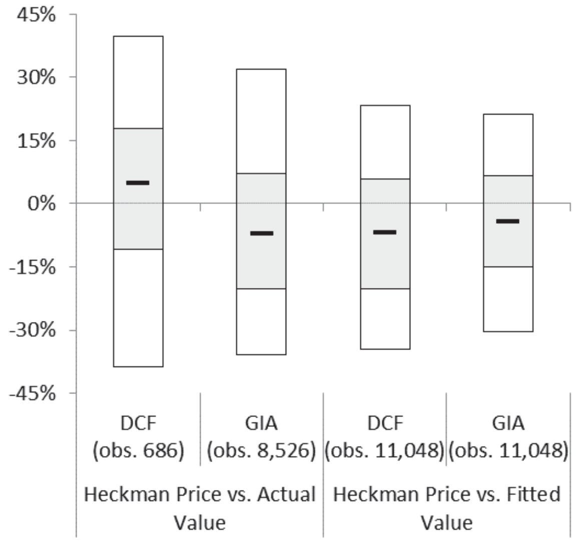
$$\frac{\text{Heckman Sale Price - Valuation}}{\text{Heckman Sale Price}} \qquad \textbf{Formula 2.4}$$

Figure 2.12 depicts the simple (top) and absolute (bottom) deviation between Heckman Prices and valuations for both valuation techniques. The simple difference is helpful in assessing direction. It can tell whether valuations were on average above or below prices. However, the simple difference is likely to understate true valuation accuracy because positive and negative deviations may cancel each other out. Valuation accuracy is an absolute measure and for the assessment of general accuracy, it does not matter if a valuation was above or below the market price it was supposed to approximate. Therefore, the absolute difference was also derived.

The top and bottom 5% of outliers were excluded. The figures on the left are the graphical representation of the tables on the right. The analysis includes a comparison of Heckman Prices with actual valuations, as well as a comparison of Heckman Prices with fitted valuations (Models 2 and 3 in Table 2.2). The comparison with fitted valuations was carried out in order to enlarge the sample size, especially for DCF valuations, and to ensure comparability by holding the underlying pool of properties constant. The numbers in brackets show the number of observations.

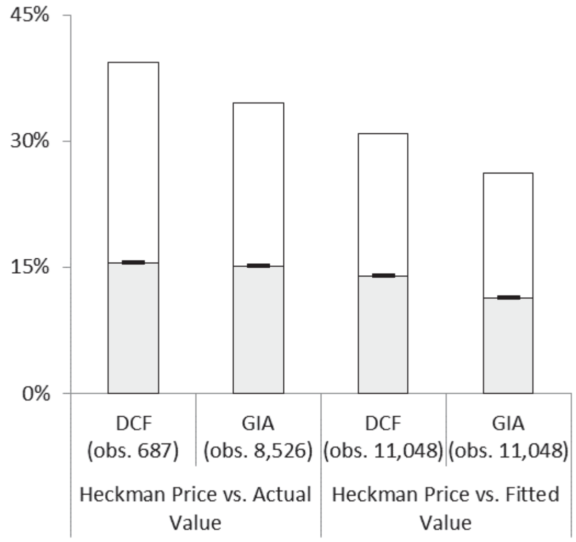
The comparison of the simple deviation between Heckman Prices and actual DCF valuations showed that a majority (58%) of actual DCF valuations fell below Heckman Prices. The opposite was the case for actual GIA valuations, of which a majority (63%) were above Heckman Prices. The comparison of Heckman Prices with fitted valuations gave a more unanimous picture: 64% of fitted DCF and 61% of fitted GIA valuations were above Heckman prices. This finding was in line with Weistroffer and Sebastian (2015) who concluded that, on average, properties in Germany, held by open-end property funds, had been overvalued.

Simple Deviation



	Heckman Price vs. Actual Value DCF	Heckman Price vs. Actual Value GIA	Heckman Price vs. Fitted Value DCF	Heckman Price vs. Fitted Value GIA
5.%-ile	*-38.9%*	*-35.8%*	*-34.6%*	*-30.5%*
25.%-ile	*-10.9%*	*-20.1%*	*-20.2%*	*-15.1%*
Median	*4.7%*	*-7.2%*	*-6.9%*	*-4.4%*
75.%-ile	*17.8%*	*7.2%*	*5.9%*	*6.7%*
95.%-ile	*39.7%*	*31.8%*	*23.3%*	*21.3%*
Obs.	*686*	*8,526*	*11,048*	*11,048*

Absolute Deviation



	Heckman Price vs. Actual Value DCF	Heckman Price vs. Actual Value GIA	Heckman Price vs. Fitted Value DCF	Heckman Price vs. Fitted Value GIA
Median	*15.6%*	*15.1%*	*13.9%*	*11.3%*
90.%-ile	*39.4%*	*34.6%*	*30.8%*	*26.2%*
Obs.	*687*	*8,526*	*11,048*	*11,048*

Figure 2.12 Deviations between Heckman Prices and GIA and DCF Valuations

In addition to the simple difference, the absolute difference was also calculated (bottom of Figure 2.12). According to the comparison of Heckman Prices with actual valuations, the median absolute deviation among DCF valuations was |16%| and the median absolute deviation among GIA valuations was |15%|. The median deviations between Heckman Prices and fitted valuations were |14%| and |11%| respectively. Overall, both techniques produced a similar majority of valuations within or on the edge of the acceptable margin of error of 15%.

The median as well as the spread of deviations was only marginally smaller among GIA valuations.

2.6 Conclusion Chapter 2

The first part of the analysis consisted of a comparison of the GIA and DCF valuations in the dataset, in order to establish if and how the two methods differ from each other. A performance analysis, in which total return, income return and capital value growth were compared, showed that German properties, appraised by DCF, displayed more return volatility than properties appraised by GIA. Income return was very similar between the two methods and the observed volatility was caused solely by capital value growth. One drawback of the performance analysis was that the underlying pool of data varied between the two valuation methods as well as year by year. In order to eliminate distortions caused by individual property factors, hedonic regressions were used. The regression models displayed high adjusted R^2 due to the inclusion of the market rent as explanatory variable. A regression of the combined sample showed that the DCF dummy was positive and highly significant, indicating a premium for DCF valuations when controlling for other variables. It was statistically justifiable to split the dataset into GIA and DCF sub-samples and run separate regressions. The fitted GIA and DCF valuations were significantly different from each other and fitted GIA valuations were on average lower than their DCF counterparts. However, the two approaches shared a large overlap with 83.5% of observations within 15% of one another. A time analysis showed that the difference between the two methods was not constant over time. Between 2006 and 2010 fitted GIA values were below fitted DCF values. After 2011, the ratio was reversed.

The second part of the analysis compared the valuation accuracy of the two methods. The Sale Price Comparison Report 2014 by MSCI and RICS, which investigated the difference between sale prices and their last uninfluenced market-adjusted valuation across different countries, showed no noticeable difference between valuation accuracy in Germany, which uses mainly GIA, and the other countries. Applying a similar methodology to the dataset at hand showed that the absolute deviation between last uninfluenced valuation and sale price was 13.0% for German GIA valuations and 13.8% for German DCFs. Based on existing literature, the threshold of acceptable valuation error was set at 15% and hence both valuation techniques fell on average within this range. However, due to a very low number of DCF valuations, heterogeneous sub-samples and sample selection bias, the results could not be generalized. Therefore, a hedonic comparison of valuation accuracy was carried out.

Real market transactions were used to derive fitted sales prices. The first set of fitted prices, called Naïve Prices, ignored sample selection bias. Therefore, the Heckman Correction was applied and new fitted prices, called Heckman Prices, were obtained. The Heckman Prices fit the actual transaction prices of the dataset much better than the Naïve Prices. At first, the simple deviation between Heckman Prices and actual valuations was compared. This analysis showed that DCF valuations were on average below fitted prices and GIA valuations were on average above. In the next step, the hedonic Heckman Prices were compared against fitted valuations. This way, the sample size could be increased and the underlying pool of properties was homogenous across both sub-groups, improving comparability. This time, the hedonic DCF valuations were also above Heckman Prices. As positive and negative deviations could cancel each other out, the absolute deviation was also derived. All median deviations between Heckman Prices and valuations were below or on the edge of the chosen threshold of 15%. The median as well as the spread of deviations was only marginally smaller among GIA valuations.

Overall, German GIA valuations and German DCF valuations produced on average similarly accurate predictors of market prices. Throughout the analyses, both techniques produced at least 50% or more of observations within the selected margin of error of 15%.

One possible explanation for the similar valuation accuracy of the two methods could be the underlying definition of value. If a valuer's aim were to derive a long-term average, as many opponents of German valuations claim, the underlying valuation method might not matter to reach that value. Another possible explanation for the similar level of accuracy among GIA and DCF valuations could be that the DCF is less standardized and a variety of acceptable methodologies exists. Unfortunately, the dataset did not include additional information on the type of DCF valuation. Therefore, it cannot be ruled out that, depending on the selection of the input variables and the calculation approach, some DCF valuations could mirror GIA valuations or be in fact GIA valuations in disguise. Future studies should aim to find out if German DCF valuations are comparable to DCF valuations in other countries.

The results of the analysis seem to indicate an overall adequate level of valuation accuracy in Germany. This conclusion would be in line with the Sale Price Comparison Report, which did not detect any significant difference in valuation accuracy in Germany when compared to other countries. This might seem surprising, given the significantly different risk-return-profile of the German MSCI property index in comparison to the other European markets (Figure 1.1). However, it is too early to draw general conclusions on German valuation accuracy from the presented results. The results of the analysis suggested that the median deviation in most analyses was at or below 15%. Whether or not this is a high or low could not be established, due to a lack of suitable comparables from other countries. In order to be able to comment on general valuation accuracy in Germany, a reference value or benchmark would be required.

3 Valuation Accuracy of External and Internal Property Valuations in Germany

In order to ensure credibility of results, all valuers must act impartially and transparently in order to reduce subjective bias within the valuation process. While this applies to all valuations, the closer relationship between valuers and clients in internal valuations may raise additional concerns regarding the independence of the valuer and hence the objectivity of the subsequent valuation. Internal valuations are quite common in the German real estate industry. Nevertheless, scientific research on internal property valuations and their ability to reflect true market prices is scarce.

The analysis of this chapter was twofold. First, actual sale prices were compared against their last available valuation in order to approximate valuation accuracy of sold properties. The previous chapter showed that analyses of transacted properties can be subject to sample selection bias because properties that were sold may differ from properties that were held. Therefore, the second part of the analysis used actual transaction data to derive hedonic prices that could be compared against valuations in order to approximate valuation accuracy of held properties.

3.1 Internal Valuations and Client Influence

The relationship between the valuer and the client who commissioned the valuation determines whether a valuation is classified as external or internal. An external valuer performs the valuation for a third party while an internal valuer carries out the valuation for their own employer (IVSC, 2019b). Internal valuations are widely used in the German real estate industry. A market survey by Deloitte showed that 72% of respondents carried out internal valuations in addition to external valuations and 6% of respondents even relied solely on internal property valuations (Schrader & Aholt, 2013). Nevertheless, scientific research on the topic of internal vs. external valuations is lacking.

In Germany, the preferred valuation technique among profit seeking investors is the German income approach (*Ertragswertverfahren*). The German income approach and its suitability to predict market prices has been at the centre of a long, ongoing debate (Schnaidt & Sebastian, 2012). While a large body of research regarding general smoothing and delayed market movements of property valuations exists (Weistroffer & Sebastian, 2015; Geltner et al., 2003; McAllister et al., 2003; Clayton et al., 2001), it is often claimed that the German valuation technique is even more prone to these inefficiencies (Schnaidt & Sebastian, 2012; Crosby, 2007). The German income approach follows strict codified procedures and relies on standardized input variables that are derived centrally by the Property Valuation Committee (*Gutachterausschuss*). The only difference between external and internal German income valuations should therefore be the relationship between the valuer and the client.

In order to achieve credible estimators of market prices, all valuers are required to act impartially and without subjective bias (IVSC, 2019b). Even though this applies to internal as well as external valuations, the closer relationship between the client and the valuer in internal valuations may raise further questions concerning the independence of the valuer and hence the objectivity of the valuation result (IVSC, 2019b). Attempts by property owners to influence the valuation process have been well documented around the globe (Chen & Yu, 2009; Smolen & Hambleton, 1997). Client influence arises when the client is trying to use his influence over the valuer in order to change the valuation result (Levy & Schuck, 2005; Smolen & Hambleton, 1997). The more influence the client is able to assert over the valuer, the more likely it is that his attempts may be successful. Client influence is accomplished through different means and may accordingly be referred to as “pressure” (Levy & Schuck, 1999; Worzala et al., 1998; Smolen & Hambleton, 1997), “feedback” (Crosby et al., 2010; Gallimore & Wolverton, 2000; Wolverton & Gallimore, 1999) or even “threat” (Smolen & Hambleton, 1997).

Clients may use their influence to change valuations in different ways, depending on their underlying objective. The common expectation is that clients have a general incentive to overvalue their own assets. However, under certain market conditions, the opposite may be the case. For example, a study of unlisted open-end property funds in the UK during the real estate crisis revealed that their capital values dropped faster than for other types of funds. The authors of the study hypothesized that this was due to client influence on valuations (Crosby et al., 2010). Another possible consequence of client influence is valuation smoothing (Levy & Schuck, 1999) in order to avoid sudden movements in value. For example, a study on German open-end funds showed that fund managers have a high incentive to influence valuations (Glasner, 2010) in order to avoid sharp movements in share prices.

The majority of research on client influence is qualitative in nature and usually consists of survey data collected from valuers (Gallimore & Wolverton, 2000; Smolen & Hambleton, 1997). Even though some claim that coercion from clients is even more likely to occur in Germany, empirical evidence for the German market is still scarce (Crosby, 2007). The aim of this chapter is to analyse empirically if and how internal and external valuations in Germany differ in terms of their ability to mirror market prices. If a significant difference can be identified, the results can be used for further research into client influence in Germany.

Valuation accuracy can be defined as the difference between appraised values and market prices (Boyd & Irons, 2002). Most existing studies of valuation accuracy compare prices of sold properties against their last available valuation. One such study is the Valuation and Sale Price Comparison Report by MSCI (Walvekar & Kakka, 2020). The report uses the difference between sale prices achieved in the market and their last valuation to compare valuation accuracy across countries. A similar approach was used in the first part of the analysis. The *Market-Adjusted Valuation and Actual Sale Price Comparison* compared sale prices against their last available, uninfluenced valuation.

While this approach is intuitive, it is likely to suffer from sample selection bias because it only takes into account properties that were eventually sold. Therefore, the second part of the analysis, the *Actual Valuation and Fitted Sale Price Comparison*, compared hedonic market prices, based on the transaction observations of the dataset, with valuations of held properties. The Heckman Correction was applied to mitigate the impact of sample selection bias.

3.2 Internal and External Valuation Dataset

Figure 3.1 displays the steps of the data cleaning process for this chapter. The numbers vary in comparison to the previous chapter because the emphasis on a different variable of interest allowed for a longer time period, a larger sample size and more explanatory variables. At the end of December 2013, the German MSCI databank contained 13,217 data entries. Every entry contains annual information on an individual property from the date of purchase to the date of sale.

As before, the analysis was restricted to office, retail and industrial properties, in order to reduce heterogeneity. In contrast to the previous chapter, some properties could be classified as mixed-use according to the MSCI definition[6]. The remaining 5,168 property data entries could be split into 34,625 annual observations. Some of these annual observations were properties under development or assets that experienced significant partial transactions. In order to avoid distortions, these observations were excluded.

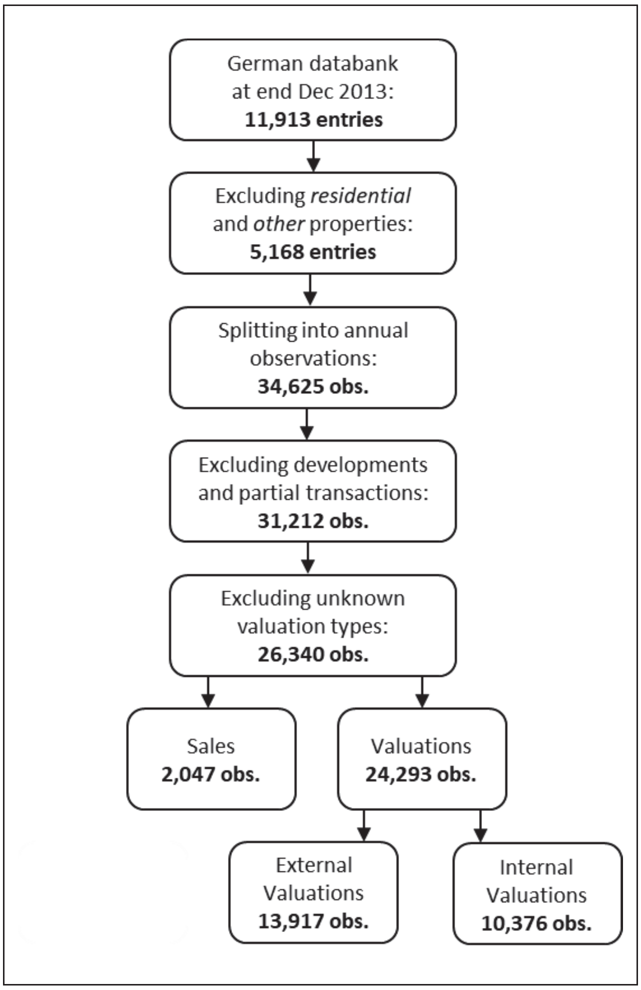


Figure 3.1 Data Cleaning Process

In addition to the variables required for the performance measurement, several optional variables are collected by MSCI in order to allow for more in-depth analyses. One of these variables is the information if the valuation was derived externally or internally. Since this information was optional, not all data providers supplied it. Therefore, observations that did not contain this information were dropped. While MSCI prefers the data to be derived from external valuations, internal valuations are also accepted, if they are based on a suitable definition of market value (IPD, 2012). Previous chapters and other studies have shown, that the official German definition of market value is overall comparable to the definitions used in other markets (Schnaidt & Sebastian, 2012).

In the end, the final dataset contained 26,340 observations of 4,805 properties across 138 portfolios from 1995 to 2013. The actual number of observations may differ in the subsequent analyses due to missing variables. 13,917 (52.8%) observations stemmed from external

[6] *If at least 75% of the market rent derives from one of the following sectors, the property should be allocated to that sector. If at least 25% of the market rent derives from a secondary use, there is a "mixed use"…* (IPD, 2011)

valuations, 10,376 (39.4%) observations were internal valuations and 2,047 (7.8%) were sales. Total observations per year ranged from 280 in 2005 to 2,209 in 2006. For some reason the valuation type was not recorded for the majority of observations in 2005. However, even though the number of observations in 2005 was substantially lower than in other years, it was judged to be sufficiently large to derive meaningful conclusions.

Due to a more even split between the sub-samples of internal and external valuations, the data providers could be grouped into more investor categories than in the previous chapter. The following data providers could be distinguished: insurance and pensions funds, listed and unlisted property companies, REITs, open-end public funds, open-end special funds and closed-end funds. The legal requirements regarding property valuations in Germany are quite mixed. While some investor classes, like open-end public funds, have to obtain external or independent valuations at least once a year (§216 & §272 KAGB), other investors, like insurance companies, only need to value their assets every five years (§55 RechVersV). As a consequence, the share of internal valuations was highest among insurance companies and lowest among open end public funds. Overall, 90.8% of internally valued properties were held by insurance and pension funds. Due to this dominance, special attention was given to insurance and pension funds in the analyses.

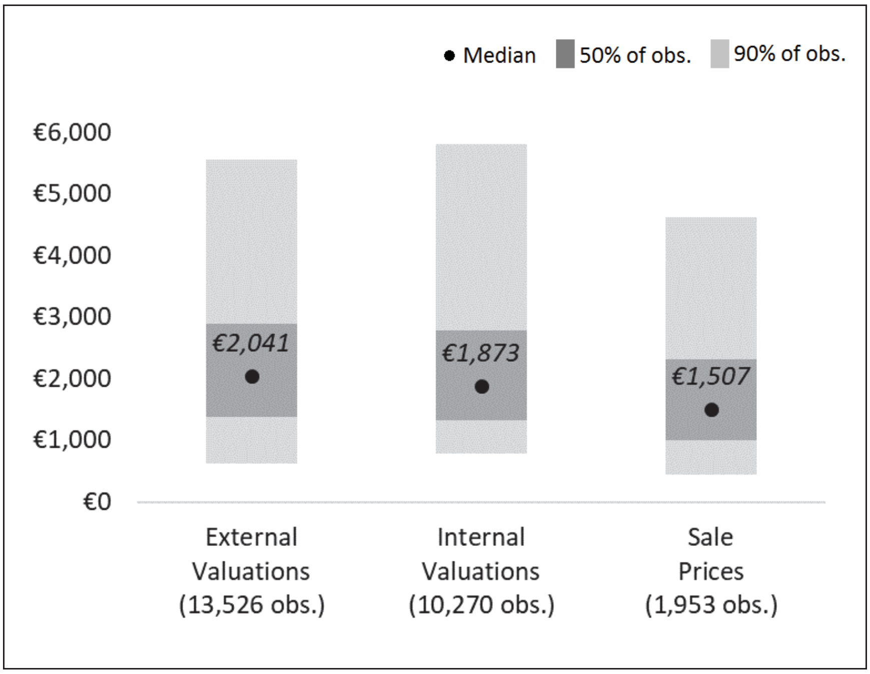


Figure 3.2 Spread of External and Internal Valuations and Sale Prices

Figure 3.2 displays the median and spread of valuations and sale prices per square meter. The median value per square meter for external valuations was €2,041, 8.9% higher than the median internal valuation of €1,873. The spread of observations was marginally larger among internal valuations. The median price was €1,507 per square meter, substantially lower than either type of valuation. A t-test confirmed different means between external and internal valuations, as well as between valuations and sale prices. The same comparisons were carried out using only properties held by insurance and pension funds in order to check if the dominance of these investor types among internal valuations distorts the results. The resulting valuations and sale prices for insurance and pension funds were almost identical to those across all investor types.

The numbers in brackets in Figure 3.2 show the number of observations in each category. The fluctuating numbers of observations across groups show that the dataset contained either an internal valuation, external valuation or sale price for each observation, never all three at the same time. Hence, the underlying pool of properties changed across the three categories, which may explain the observed differences.

3.3 Comparison of Internal and External Valuations with Actual Sale Prices

The annually published Valuation and Sale Price Comparison Report by MSCI (until 2012 in cooperation with the RICS) tries to assess valuation accuracy across different countries by comparing actual sale prices to their last valuation (Walvekar & Kakka, 2020). This analysis followed a similar approach in order to approximate the valuation accuracy of external and internal valuations among transacted properties. In line with the report's methodology and the steps outlined in Chapter 2.5.1, the last uninfluenced, market-adjusted valuation for each sale observation was derived. The difference between sale prices and market-adjusted valuations was calculated by the following formula:

$$\frac{\text{Actual Sale Price}}{\text{Market Adjusted Value}} - 1 \qquad \textbf{Formula 3.1}$$

Figure 3.3 depicts the median and spread of the difference between adjusted valuations and actual sale prices according to valuation type. Due to the dominance of insurance and pension funds among internal valuations, the right hand side of Figure 3.3 displays the same results only for properties held by insurance and pension funds. This eliminated distortions due to a different distribution of investor types among the sub-samples of external and internal valuations.

Figure 3.3 Market-Adjusted Valuation and Actual Sale Price Comparison

The median simple difference between actual sale prices and market-adjusted valuations was 1.6% for external and -0.4% for internal valuations among all investor types. This meant that on average external valuations were below and internal valuations above sale prices, which may imply a tendency of internal valuations to overstate market prices. At first glance, the smaller median difference among internal valuations may seem to indicate higher valuation accuracy of internal valuations. However, the absolute valuation difference showed that the simple difference understated true valuation accuracy. The absolute median valuation difference among external valuations was |4.5%|. The absolute median difference among internal valuations was |9.5%|, more than twice as high. The spread of observations was also significantly larger among internal valuations. Unfortunately, the number of observations differed quite significantly across years, especially among internal valuations, and it was therefore not possible to carry out a year-by-year breakdown.

The right hand side of Figure 3.3 displays the same results only for properties that were held by insurance and pension funds. The median simple difference of external valuations for insurance and pension funds was 0.0%, implying that external valuations were on average in line with sale prices. The other measures, and hence the overall conclusions of Figure 3.3, remained the same as in the comparison across all investor types.

Similarly to previous chapters, an acceptable valuation margin of error of 15% was applied. 78.6% of external and 64.4% of internal valuations fell within a valuation difference of 15%. Both valuation types had a majority of observations within the set margin of error but external valuations were on average closer to actual market prices.

It is difficult to apply conclusions derived from sold properties to the entire property market, which consists mostly of held properties, due to sample selection bias. Therefore, the analysis was extended to a regression analysis.

3.4 Comparison of Internal and External Valuations with Fitted Sale Prices

The second part of the analysis used the transaction observations in the dataset to derive hedonic sale prices for comparison with actual valuations of held properties. The Heckman Correction was used to correct sample selection issues among the sale observations in the dataset.

Table 3.1 contains the results of the regression models. Coefficients were obtained via OLS with heteroscedasticity robust standard errors. The first model depicts the regression of the natural log of value per square meter. Fitted values were obtained for the Heckman Correction. The set-up and explanatory variables across all models were very similar to the regression models in previous chapters. However, the more even split between the sub-samples of internal and external property valuations allowed for more detailed explanatory variables than the previous analyses. Additional explanatory variables included the economic age (Age), mixed-use properties (as the base case) and more diverse investor variables. Additionally, the time period could be extended to 1996 (the new base year).

The base case for the investor dummies were insurance companies, which made up the largest group. From a theoretical point of view, a property's value or price should not depend on who owns it. Nevertheless, most investor dummies were significant. This could be the result of client influence on valuations. An alternative explanation might be that the investor dummies are substitutes for other variables that were not included in the model.

The adjusted R^2 of the valuation model (Model 1) was 90.7%. This was mostly due to the inclusion of the market rent (OMRV) which alone could explain 89.2% of the variation in value in a univariate regression. This was expected, due to the regression results of previous chapters.

The dummy variable *Internal* signified if a valuation was derived internally. Interestingly, the coefficient was insignificantly different from zero meaning that the model failed to detect a significant difference between internal and external valuations when controlling for other variables. Given the results of the *Market-Adjusted Valuation and Sale Price Comparison*, this finding was unexpected. One possible explanation could be that the difference between

	Value Regression 1	Sale Regression 2	Heckman Correction 3	4
	ln(Value)	*ln(Price)*	*Step 1 Sale = 1*	*Step 2 ln(Price)*
Y1997	0.014	0.178**	-0.133	-0.068
Y1998	0.035*	0.182	-0.518	0.441***
Y1999	0.060***	0.096	-0.262	-0.390***
Y2000	0.057***	0.302***	-0.674**	-0.659***
Y2001	0.053***	0.259***	-0.004	-0.373***
Y2002	0.029	0.197**	0.248	-0.630***
Y2003	0.025	0.239***	0.014	-2.076***
Y2004	0.019	0.228***	0.183	-1.619***
Y2005	0.027	0.209**	1.557***	-1.486***
Y2006	0.023	0.102	1.072***	-0.950***
Y2007	0.036*	0.258***	0.956***	-0.818***
Y2008	0.050**	0.284***	0.488	-0.592***
Y2009	0.032	0.225***	0.373	-0.669***
Y2010	0.039**	0.321***	0.165	-0.872***
Y2011	0.031	0.227***	0.232	-1.115***
Y2012	0.034*	0.220***	0.420	1.459***
Y2013	0.026	0.181**	0.632**	0.233***
ln(OMRV)	1.147***	1.173***	-0.262***	0.078***
ln(Occ)	0.094***	0.129***	-0.111***	-0.330***
ln(Area)	0.001	-0.008	-0.066***	0.007
ln(Age)	-0.044***	-0.053***	0.242***	-0.004
Office	-0.016***	-0.033	-0.026	0.082***
Retail	-0.067***	-0.084***	-0.072	0.294***
Indus.	-0.050***	-0.002	-0.132	0.211***
Berlin	0.106***	0.206***	-0.174**	0.137***
Hamburg	0.094***	0.194***	-0.124**	-0.032
Munich	0.120***	0.194***	-0.032	0.071***
Cologne	0.051***	0.028	0.039	0.118***
Frankf.	0.087***	0.114***	-0.015	0.130***
Dusseld.	0.068***	0.147***	-0.059	0.053***
Stuttg.	0.080***	0.095**	-0.060	-0.245***
South	0.024***	0.078***	-0.020	1.505***
East	0.049***	0.028	0.259***	-0.398***
Pension	0.031***	0.110**	-1.148***	0.341***
LiPrCo	-0.051***	0.080	0.323***	0.090***
UnLiPrCo	-0.050***	0.110	-0.383***	-0.135***
REIT	-0.039***	-0.121	-0.183*	0.184***
OpEnPuFu	0.046***	0.092***	0.171***	-0.063***
OpEnSpFu	0.028***	0.025	-0.139***	
ClEnFu	-0.053***	-0.102*	0.034	
Internal	0.005			
ValRes			0.010***	
InvMills				-1.394***
Cons	1.539***	1.076***	-1.156**	3.009***
Adj. R^2	0.907	0.813		0.978
Pseudo R^2			0.157	
Obs.	17,934	1,411	19,345	1,411

Confidence Level **10% **5% ***1%*

Table 3.1 Hedonic External/Internal Valuation and Sale Regression Models internal and external valuations is imbedded in another explanatory variable. For example, if OMRV were consistently inflated among internal valuations, the dummy variable *Internal* might fail to detect an additional impact because the effect would already be captured by OMRV. However, the dummy variable *Internal* remained insignificant even when passing rent was used instead of OMRV in an alternative regression.

Model 2 in Table 3.1 depicts the regression of the natural log of price per square meter. The aim was to derive simple hedonic sale prices that could be used to approximate the valuation reserve for the Heckman Correction. Using the same set up as the previous regression model made it possible to assess if the explanatory variables were interpreted the same way by valuers and buyers. The adjusted R^2 was slightly lower (81.3%) than in the valuation regression, implying that the model had a better goodness of fit when predicting the variation in valuations than in prices. Just as before, the comparatively high adjusted R^2 was mostly due to the market rent, which could explain 78.2% of the variation in price in a univariate regression. Fitted prices were obtained for further analyses. The fitted prices from Model 2 were referred to as Naïve Prices because they ignored the issue of sample selection bias.

In order to derive a proxy for the valuation reserve that could be used in the Heckman Correction, the Naïve Prices (Model 2), or where available actual prices, were compared to fitted valuations (Model 1). The higher a property's price in comparison to the valuation, the more likely it should be that a sale took place and vice versa. In reference to its proxy as the valuation reserve, the newly created variable was called *ValRes*.

Models 3 and 4 in Table 3.1 display the results of the two steps of the Heckman Correction. The first step, the probit model, used the dummy variable for sales (Sale=1) as dependent variable. The impact of the valuation reserve (ValRes) was positive and highly significant, meaning that, ceteris paribus, the larger the price was compared to the valuation, the higher the probability of a sale. Model 4 displays the results of the outcome equation, including the inverse Mill's ratio (InvMills) as an additional regressor. Fitted prices, called Heckman Prices, were obtained from Model 4 for further analysis.

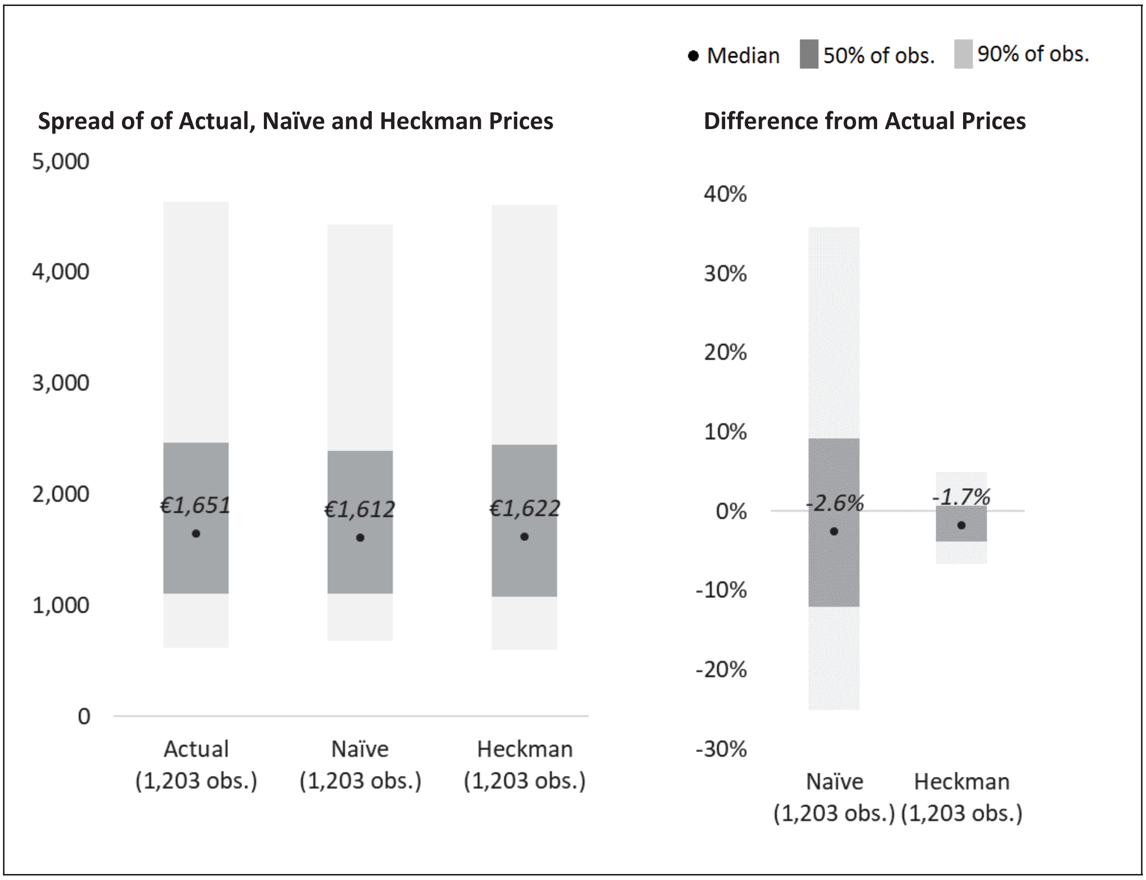


Figure 3.4 Comparison of Actual, Naïve and Heckman Prices, Chapter 3

Before comparing hedonic prices with actual valuations, the fitted sale prices were compared to actual prices in order to assess their goodness of fit. Figure 3.4 displays the comparison of actual sale prices, Naïve Prices and Heckman Prices. The left hand side displays the median and spread of prices per square meter. At first glance, actual prices, Naïve Prices and Heckman Prices all looked very similar to each other. Therefore, Figure 3.4 also displays the simple difference between fitted and actual prices on the right hand side. The simple difference was calculated according to the following formula:

$$\frac{\text{Fitted Sale Price}}{\text{Actual Sale Price}} - 1 \qquad \textbf{Formula 3.2}$$

Since the hedonic prices were based on models that fit the data best on average, there were bound to be some outliers. The top and bottom 5% of observations were excluded from the comparison in order to reduce the impact of these extreme and sometimes nonsensical outliers. Additionally, in order to ensure comparability, only observations with all three variables were included in the comparison.

The simple median difference between actual prices and Naïve Prices was -2.6%, indicating that Naïve Prices were on average below actual sale prices. The same was concluded about the Heckman Prices because the median difference was also negative at -1.7%. The most important difference between the Naïve Prices and Heckman Prices was the spread of their difference to actual sale prices. The standard deviation of the difference between actual prices and Naïve Prices was 18.4 percentage points while the standard deviation with Heckman Prices was only 3.6 percentage points. Only 61.8% of Naïve Prices fell within 15% or less of actual sale prices while 100.0% of Heckman Prices did so. Further, a t-test found a high probability of equal means between actual and Heckman Prices but not between actual and Naïve Prices. Overall, the Heckman Prices fit the actual transaction data much better than the Naïve Prices and therefore the analysis was continued with the Heckman Prices. This conclusion was in line with previous chapters.

Figure 3.5 depicts the median and spread of the difference between actual valuations and fitted prices, derived by the following formula:

$$\frac{\text{Heckman Sale Price}}{\text{Actual Valuation}} - 1 \qquad \textbf{Formula 3.3}$$

The comparison included the simple difference as well as the absolute difference. The top and bottom 5% of outliers were excluded. The numbers in brackets depict the number of observations. The sample size was significantly larger than in the comparison of market-adjusted valuations and actual sale prices. As before, the results only for properties held by insurance and pension funds were displayed on the right hand side.

The simple median difference for external valuations was -6.4% and for internal valuations -9.7% across all investor types. The negative numbers implied that on average, actual valuations were higher than Heckman Prices. This finding was in line with previous chapters and other studies that detected or suspected a tendency to overvalue held properties in Germany (Weistroffer & Sebastian, 2015; Crosby, 2007). An alternative explanation for the possible overvaluation could be that valuations tend to lag market movements and that the time period included the real estate crisis with falling prices.

Figure 3.5 Actual Valuation and Fitted Sale Price Comparison

The comparison of the absolute difference showed that absolute valuation accuracy was lower than suggested by the simple difference analysis. The absolute difference between actual valuations and Heckman Prices among external valuations was |10.1%|. The absolute difference for internal valuations was |12.1%|. Applying a threshold of 15% showed that both valuation types had a majority of observations within the acceptable range of valuation accuracy. 69.9% of external valuations and 61.7% of internal valuations fell within the 15% threshold. When the analysis was restricted to properties held by insurance and pension funds, the absolute valuation difference of the two valuation types became more similar. The difference between Heckman Prices and actual valuations of externally valued properties held by insurance and pension funds was |11.4%| and for internally valued properties |11.9%|. Overall, both valuation types had a majority of observations within the acceptable margin of error but external valuations were closer to market prices than internal valuations.

3.5 Conclusion Chapter 3

This chapter was an empirical comparison of internal and external property valuations with market prices in Germany. A market survey by Deloitte revealed how common internal property valuations are in the German market. Overall, 78% of respondents regularly derived internal valuations. The ability of these valuations to accurately mirror market prices is therefore of vital importance. Nevertheless, empirical research is still scarce.

The first part of the analysis, called the *Market-Adjusted Valuation and Actual Sale Price Comparison*, focussed on the sold assets in the available dataset. In order to account for value changes between the time of the last uninfluenced valuation and the actual sale date, the last valuations were adjusted by applying capital value growth as captured by the relevant MSCI market segment indicators. The comparison showed that external valuations had a median absolute difference between market-adjusted valuations and actual sale prices of |4.5%|. The absolute median difference among internal valuations was |9.5%|, more than twice as high. Overall, 78.6% of external and 64.4% of internal valuations fell within the acceptable margin of valuation error of 15%. While both valuation types produced a majority of observations within the acceptable threshold, external valuations were significantly closer to real market prices than internal valuations. This conclusion remained unchanged even when the analysis was restricted to properties held by insurance and pension funds, which were the largest investor group among internal valuations.

Since previous studies found out that sold properties are often valued closer to sale prices than held properties, a second comparison, based on held properties was carried out. This *Actual Valuation and Fitted Sale Price Comparison* significantly increased the sample size. The transaction observations of the dataset were used to derive fitted prices that could be compared against actual valuations. In order to reduce the impact of sample selection bias, the Heckman Correction was applied. The resulting hedonic Heckman Prices were very similar to actual sale prices and all fell within a range of 15% or less. The median absolute difference between actual valuations and Heckman Prices among all investor types was |10.1%| for external valuations and |12.1%| for internal valuations. 69.9% of external valuations and 61.7% of internal valuations fell within the acceptable 15% threshold. The absolute valuation error of external and internal valuations became more similar when the analysis was restricted to insurance and pension funds. However, the general conclusion remained unchanged.

Overall, the *Market-Adjusted Valuation and Actual Sale Price Comparison,* based on sold properties, as well as the *Actual Valuation and Fitted Sale Price Comparison*, based on held properties, reached the same general conclusion. Both valuation types had a majority of observations within the acceptable margin of error but external valuations were on average closer to market prices than internal valuations.

The aim of this empirical study was to analyse how external and internal valuations differ in terms of valuation accuracy. The next step would be to investigate the possible reasons. The traditional German valuation approach, which is the most common method for property valuations in Germany, follows strict codified procedures and relies on standardized input variables. Further, the legal framework, the educational background and the professional environment for external and internal valuers are the same. Therefore, the most likely reason for the observed differences would be client influence. In theory, internal valuers should be even more subject to pressure from clients than external valuers. The regression models showed that the investor dummies had a significant impact on valuations which could be due to client influence. This would be an interesting starting point for future research as the research of client influence in Germany is scarce.

One limitation of both analyses was that significant adjustments to the data were required in order to compare valuations and prices directly. The survey by Deloitte (Schrader & Aholt, 2013) showed that many investors in Germany simultaneously derive internal and external valuations for their properties. If both could be obtained, a more direct empirical comparison would be possible. However, it would be unlikely that both sets of valuations were derived completely independent from one another. This would need to be considered in the analysis.

The results of the analysis gave some indication of overall valuation accuracy in Germany. However, due to a lack of suitable comparables or references from other countries, no conclusions on general valuation accuracy in Germany were made.

4 Valuation Accuracy across Europe: a Mass Appraisal Approach

This chapter is a comparison of the valuation accuracy across eight European countries between 2002 and 2013, making it possible to infer conclusions on general valuation accuracy in Germany.

Even though a large body of research on valuation accuracy exists from around the globe, the results are very diverse and depend heavily on the time period, data source and methodology employed. Already in 1995, McAllister summarized this problem in a statement that still applies to the existing body of literature today: "*We are left with a number of studies which analyse different data in different ways to produce different results and draw different conclusions*." This makes comparing valuation accuracy across studies impossible. This research is using the same time period, data source and methodology to calculate the difference between appraised values and market prices, as an indicator of valuation accuracy, for eight different European countries. This makes it possible to directly compare results. All data was supplied by MSCI. Among other services, MSCI Real Estate publishes a long-term study called the Valuation and Sale Price Comparison Report which compares actual sales against their last valuation. This chapter is complementing MSCI's existing research by extending valuation accuracy to held properties as empirical studies have shown that sold properties are often priced closer to the market than held properties. The analysis used mass appraisals to derive hedonic sale prices that were compared against actual valuations of held properties.

4.1 European Valuation and Sale Price Comparison Report Summary

One of the few studies that compares valuation accuracy across countries is the Valuation and Sale Price Comparison Report by MSCI. The Report tries to approximate valuation accuracy by comparing actual sale prices to their last uninfluenced, market-adjusted valuations (Walvekar & Kakka, 2020). Figure 4.1 displays the results of the European markets in the Valuation and Sale Price Comparison Report for the years 2013 (IPD, 2014) and 2019 (Walvekar & Kakka, 2020). The year 2013 was chosen because it was the report closest to the end of the analysis period of this research. In the year 2013, Italy displayed the lowest (5.3%) and Sweden (10.7%) the highest average absolute deviation between valuation and subsequent sale price in

Europe. Over a 10-year period (2004-2013), the lowest average absolute deviations were found in the Netherlands (8.1%) and the largest were observed in Sweden (12.7%) and Italy (11.7%).

A comparison with the numbers for 2019 showed, that valuation accuracy can vary substantially throughout time. This illustrates how important it is to use the same time period when comparing valuation accuracy across countries. The countries with the lowest average absolute deviations in 2013, Italy, Switzerland and Germany, had the largest differences to their 2019 numbers. Especially noticeable was Germany where the average absolute difference was a staggering 12.1 percentage points higher in 2019 than in 2013. Surprisingly, the Report did not offer an explanation for this development. The 10-year averages from the 2013 and 2019 Reports were more similar to each other but still displayed some sizable differences. Sweden for example went from the country with the largest average absolute difference in the years 2004-2013 to the middle of the country comparison for the years 2010-2019.

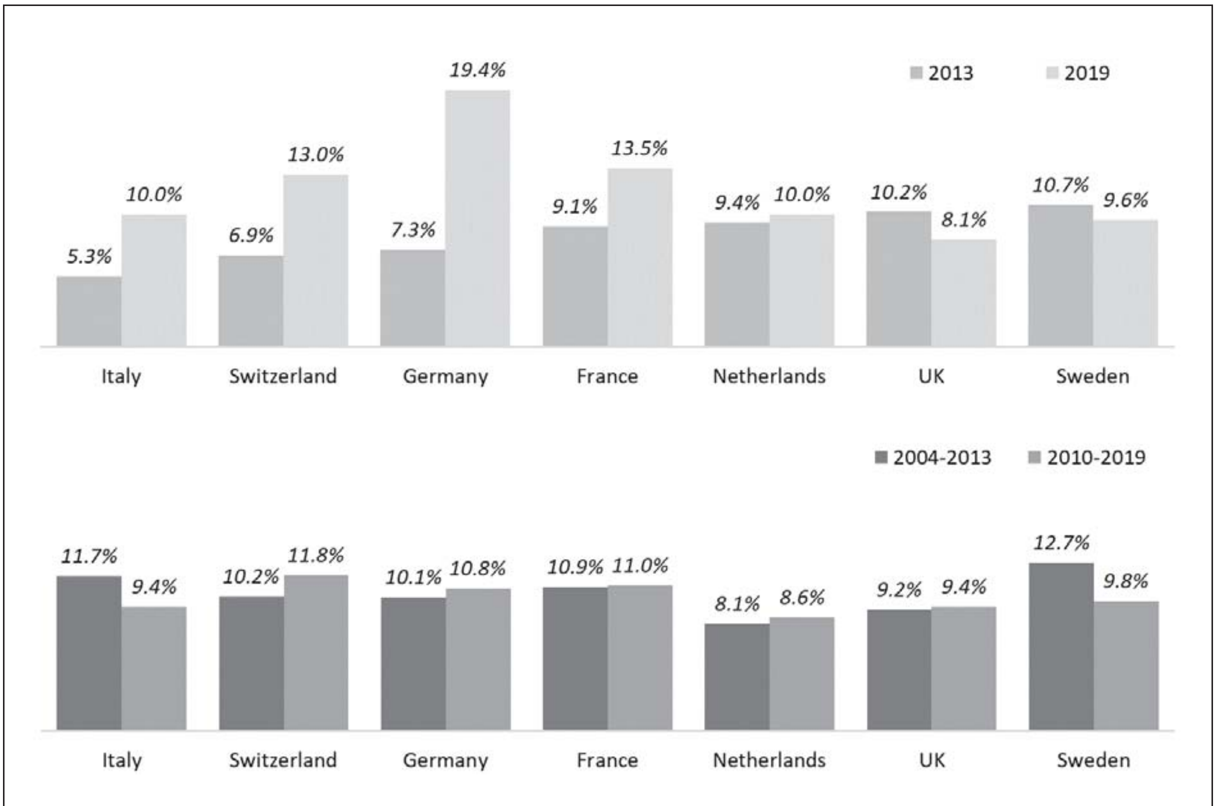


Figure 4.1 Absolute Deviations between Valuations and Sale Prices in Europe

If the previously mentioned acceptable margin of valuation error of 15% were applied to the numbers of the Valuation and Sale Price Comparison Reports, all countries, except Germany in 2019, would fall on average within a 15% margin of error. Most countries would even fall below or marginally above an error margin of 10%. Since the margins of error relate to individual cases, a more useful comparison than the average would be the share of valuations within a certain threshold. This will be done in the analysis of this research but unfortunately, this information was not available for the results of the Valuation and Sale Price Comparison Reports.

The Valuation and Sale Price Comparison Report is one of the few studies of valuation accuracy that allows for a country comparison because it uses the same data source and research methodology. The varying estimates for valuation accuracy across years show the importance of ensuring comparability when comparing valuation accuracy across studies. The design of assessing valuation accuracy by comparing sales observations to their last valuation is intuitive but means that accuracy is only approximated for properties that were sold. This makes it difficult to apply its conclusions to the wider real estate market, which consists mostly of held properties.

4.2 European Datasets

The analysis was based on data from Europe’s largest economies for which sufficient MSCI data was available: UK, France, Netherlands, Germany, Sweden, Switzerland, Italy and Spain. Unfortunately, the available dataset ended in 2013 and no additional data could be obtained. At the end of 2013, the final year of the dataset, the regional MSCI databanks contained a total of 168,394 entries of domestic properties. By far the largest share, 63.3%, came from the UK, which was due to historical reasons, as the UK was the first country in which data collection started in the 1980s. Since then, services have been expanded to numerous countries around the globe. The next largest share of observations came from France, 10.6%, followed by the Netherlands, 7.7%. The other five countries made up the remaining 18.4% all together.

Table 4.1 depicts the steps of the data cleaning process, which largely followed that of previous chapters. The analysis was limited to office, retail and industrial properties, excluding residential and “other” property types. This eliminated 38.9% of entries. The remaining

102,919 entries were split into 817,063 annual observations of sales and valuations. The earliest year of available data varied between 1980 for the UK and 2002 for Italy. In order to ensure comparability, observations prior to 2002 were dropped. This eliminated 56.8% of observations, mostly due to the omission of historical observations from the UK dataset. Finally, assets under development and assets with partial sales or purchases were dropped. At this point, the preliminary dataset consisted of 319,736 observations across all eight countries.

	UK	France	Netherlands	Germany	Sweden	Switzerland	Italy	Spain	Total
Domestic entries at end of Dec 2013	106,614	17,802	12,919	11,913	7,526	6,498	3,402	1,720	168,394
Excluding residential and "other" assets	67,047	13,762	6,571	5,168	4,189	1,923	3,050	1,209	102,919
Splitting into annual valuation and sale obs.	569,381	91,741	57,213	34,625	28,087	13,413	16,352	6,251	817,063
Excluding years prior to 2002	164,569	80,050	33,279	26,619	12,988	13,121	16,352	5,813	352,791
Excluding developments and partial transactions	148,162	72,634	31,518	24,259	11,491	12,023	14,494	5,155	319,736
Excluding obs. with missing key variables	101,043	48,321	26,826	17,603	9,597	9,704	9,188	2,751	225,033
Valuations	**91,754**	**45,305**	**25,336**	**16,252**	**8,627**	**9,352**	**8,770**	**2,614**	**208,010**
Sales	**9,289**	**3,016**	**1,490**	**1,351**	**970**	**352**	**418**	**137**	**17,023**

Table 4.1 Number of Valuation and Sale Observations per Country

Some observations only included the minimally required variables for the performance analyses. Non-essential information, such as age or market rents, were not always recorded. Excluding observations which do not contain a full set of variables required for the subsequent regressions, reduced the final dataset to 225,033 observations. Just as in the uncleaned dataset, the majority of observations came from the UK. However, the UK's share of observations dropped from 63.3% to 44.9% during the cleaning process. 21.5% of observations in the cleaned dataset came from France and 11.9% from the Netherlands. The other five countries made up the remaining 21.7%. The country with the smallest number of observations was Spain (1.2% = 2,751 observations). Overall, 92.4% of observations stemmed from valuations and 7.6% came from sales. The ratio of sales to valuations was largest in Sweden (10.1%) and smallest in Switzerland (3.6%). Interestingly the number of sale observations remained quite constant over time, even during the years of the real estate crisis. In fact, the year with the largest number of sales observations was 2008.

Figure 4.2 displays the median and spread of valuations and sale prices per square meter for each country in the cleaned dataset. The values in the UK, Sweden and Switzerland were converted into EUR by using the Dec 2013 exchange rates.[7] The largest median properties could be found in Switzerland, the UK and Spain. The UK and Switzerland were also the countries with the widest spreads of observations. The smallest median assets were those in France, Italy and Sweden. Germany displayed the narrowest spread of observations. Figure 4.2 combines valuations and sale observations. In all countries but the UK, median prices per square meter were lower than median values per square meter. However, a direct comparison of valuations and sale observations is unfeasible because the two sub-samples include different properties and the sale sub-sample was significantly smaller than the valuation sub-sample.

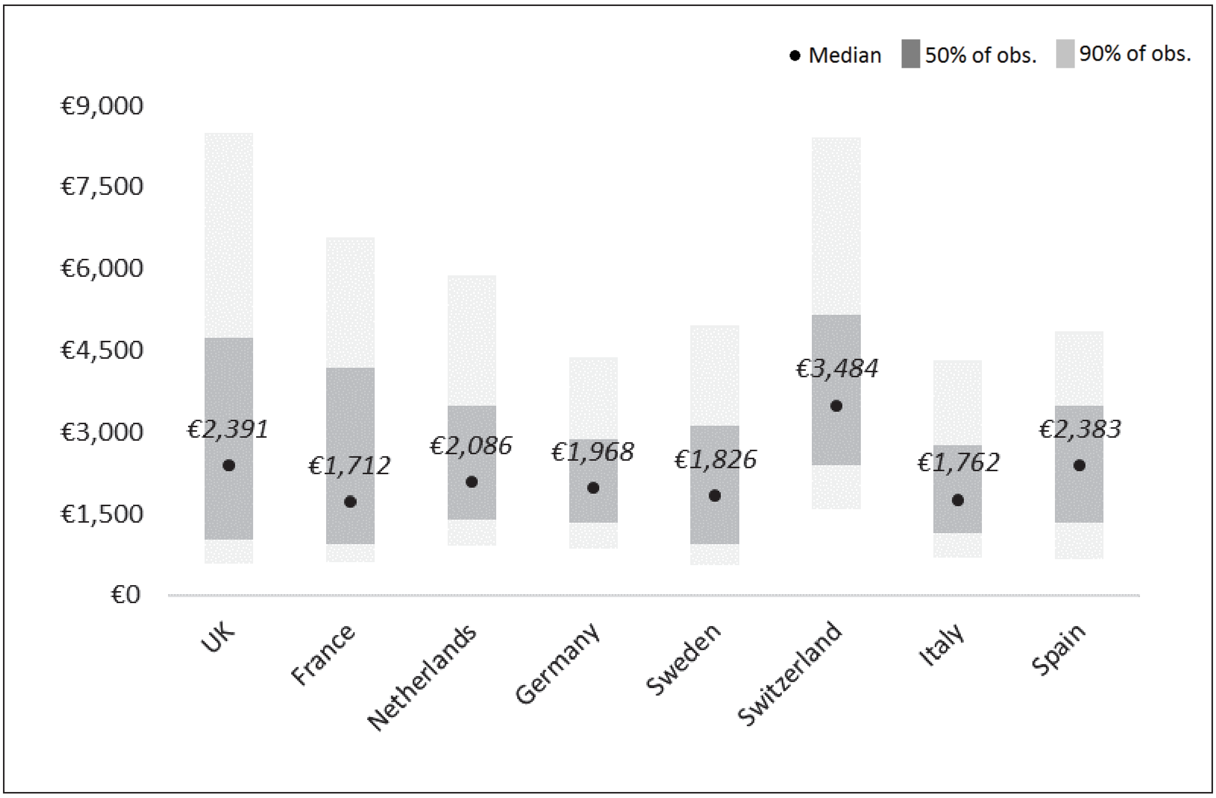


Figure 4.2 Spread of Valuations and Sale Prices across Europe

[7] *1 GBP = 1.203 EUR, 1 SEK = 0.113 EUR, 1 CHF = 0.815 EUR*

4.3 European Hedonic Valuation Regressions

Table 4.2 displays the results of the valuation regressions, which were needed for the Heckman Correction to derive fitted sale prices that could be compared against actual valuations. The explained variable was the natural log of value per square meter, ln(Value). All subsequent models followed a similar set up. Explanatory variables were based on theory and availability of data from MSCI. Coefficients were obtained via OLS with heteroscedasticity robust standard errors.

ln(Value)	UK	France	Netherlands	Germany	Switzerland	Italy	Sweden	Spain
Y2003	0.060***	0.028***	0.005	-0.005	0.053***	-0.071	-0.011	0.089***
Y2004	0.158***	0.077***	0.023***	-0.032***	0.070***	-0.079*	0.008	0.170***
Y2005	0.292***	0.143***	0.062***	-0.037***	0.069***	-0.021	0.087***	0.187***
Y2006	0.359***	0.241***	0.110***	-0.007	0.074***	0.016	0.160***	0.268***
Y2007	0.265***	0.316***	0.155***	0.009	0.091***	0.041	0.247***	0.292***
Y2008	-0.023***	0.240***	0.117***	0.018***	0.089***	0.001	0.121***	0.135***
Y2009	0.020***	0.199***	0.066***	0.007	0.093***	-0.037	0.096***	0.103***
Y2010	0.100***	0.218***	0.063***	0.001	0.107***	-0.037	0.147***	0.115***
Y2011	0.119***	0.255***	0.050***	-0.008	0.138***	0.007	0.164***	0.111***
Y2012	0.081***	0.269***	0.019***	-0.004	0.168***	-0.056	0.166***	0.047**
Y2013	0.132***	0.282***	-0.002	-0.015*	0.186***	-0.051	0.176***	0.055***
ln(OMRV)	0.996***	1.066***	1.075***	1.135***	1.172***	0.918***	1.267***	1.049***
ln(Occ)	0.159***	0.068***	0.065***	0.038***	0.065***	0.070***	0.105***	0.042***
ln(Area)	-0.013***	0.016***	0.001	0.002	0.010***	-0.035***	-0.004	-0.016***
ln(Age)	-0.041***	-0.044***	-0.001	-0.045***	-0.014***	-0.011***	-0.020***	-0.001
Retail	0.188***	0.032***	0.160***	-0.017***	-0.027***	0.044***	0.071***	-0.162***
Indus.	-0.001	-0.063***	0.003	-0.047***	-0.110***	-0.199***	-0.057***	-0.169***
Loc2	0.066***	0.269***	-0.011**	0.120***	0.046***	0.149***	0.256***	0.074***
Loc3	0.023*	0.200***	-0.002	0.092***	0.001	0.070***	0.272***	-0.046*
Loc4	-0.075***	0.134***	-0.003	0.138***	-0.011	0.050***	0.094***	0.024*
Loc5	-0.133***	0.058***	0.022***	0.059***	-0.136***	0.096***	0.238***	-0.012
Loc6	-0.154***	0.033***	-0.010**	0.112***	-0.050***	0.118***	0.111***	-0.035
Loc7	-0.148***	0.033***	0.029***	0.085***	0.014*	0.107***	0.281***	-0.011
Loc8	-0.180***	0.000	0.004	0.093***	0.000	0.062***	0.144***	-0.022
Loc9	-0.179***	0.000	0.003	0.026***	-0.084***	0.127***	0.180***	-0.128***
Loc10	-0.178***	0.000	0.007*	0.041***	-0.003	0.002	0.102***	-0.054**
Public	-0.084***	0.015					-0.015**	
UnLiPrCo	0.077***	0.028***	0.009***	-0.072***	-0.149***	-0.145***	0.026**	0.116***
OpEnFu	-0.015***	-0.007*		0.047***	0.021***	-0.143***	0.150***	0.178***
LiPrCo	0.071***	0.048***	-0.053***	-0.074***	0.020***	-0.152***	0.000	0.221***
ClEnFu	-0.009*			-0.085***		-0.236***	0.024**	0.158***
REIT	0.117***	0.063***		-0.042***		-0.093***		
Cons	2.037***	1.568***	1.701***	1.871***	1.330***	3.216***	-0.231*	2.158***
Adj. R^2	0.900	0.944	0.958	0.903	0.930	0.871	0.927	0.941
Obs.	91,754	45,305	25,336	16,252	9,352	8,770	8,627	2,614

*Confidence Level: *10%, **5%, ***1%*

Table 4.2 Hedonic Valuation Models per Country

The explanatory variables included year dummies, with the base year 2002, followed by open market rental value (OMRV) and an occupancy indicator (OCC). Additional quantitative variables included the age (Age) and the leasable area in square meters (Area). The age variable was based on the more recent date of either the historical year of construction or the last major refurbishment. This proved to be a better estimation of age than using only the historical year of construction, especially in countries with a lot of older stock, such as Sweden and Switzerland, where the average historical ages were 56 and 53 years respectively.

The next set of dummy variables was the use type. The base were office properties, which were the largest group in most countries with the exception of the Netherlands, the UK and Spain, where retail properties were more prevalent. The next set of dummy variables were location variables. For simplicity, ten location groups, based on MSCI location categories and the country's population centers, were created for each country (Table 4.3). The regression models for Germany in previous chapters showed that only minor explanatory power, in terms of adjusted R^2, was lost when certain macro locations were combined into broader categories in order to keep the model concise.

	France	Germany	Italy	Netherlands	Spain	Sweden	Switzerland	UK
Loc1	Paris Central West	Berlin	Milan	North	Central Madrid	Stockholm CBD	City of Zurich	City of London
Loc2	Paris South	Hamburg	Lombardy	Arnhem/ Nijmegen	Madrid Other	Central Stockholm	Kanton Zurich	London Midtown
Loc3	Paris East	Munich	Piedmont	East	Greater Madrid	Greater Stockholm	Geneva	London West End
Loc4	Ile de France	Cologne	Veneto	Amsterdam	Central Barcelona	Central Gotenburg	Lausanne	London Other
Loc5	Rhone-Alpes	Frankfurt	North Other	Rijnmond	Barcelona Other	Greater Gothenburg	Lake Geneva Region Other	South East
Loc6	Provence-Alpes-Cote d'Azur	Dusseldorf	Emilia-Romagna	The Hague	Catalunia	Central Malmo	City of Basel	South West
Loc7	North East	Stuttgart	Central	Utrecht	Malaga	Greater Malmo	Kanton Basel-Aargau	East
Loc8	Central	South	Rome	West	Cadiz	Uppsala	Bern	Midlands
Loc9	South West	East	Sicily	North Brabant	Seville	Other Major Cities	Other West	North
Base	North West	West	South Other	Other South	Other	Other	Other East	Other

Table 4.3 Location Categories per Country

The final set of dummy variables in the regression model identified the investor type. The largest group in most countries (Germany, Netherlands, Sweden and UK) were pension and insurance funds, which formed the base case. The other owner categories included the public sector (Public), unlisted property companies (UnLiPrCo), listed property companies (LiPrCo), open-ended funds (OpEnFu), closed-ended funds (ClEnFu) and REITs. Some investor types were more prevalent in certain countries and almost or completely absent in others, such as the public sector in the Netherlands or REITs in France and Italy. In order to maintain consistency across models, the same investor categories were used in all regressions, even if they ended up being omitted due to absence of observations. From a theoretical point of view, the investor type should have no explanatory power over either the valuation or the price. A property's value should not depend on who owns it. Nevertheless, the investor dummies were significant in most regressions. This could either be due to inefficiencies in the market, for example client influence on valuations, or the investor dummies could be substitutes for other variables that were not included in the model.

The explanatory variables in the standard regression model in Table 4.2 were limited by the availability of data from MSCI. Nevertheless all regressions had very high adjusted R^2, ranging from 95.8% in the Netherlands to 90.0% in the UK. A small exception was the regression for Italy, which "only" had an adjusted R^2 of 87.1%. The comparatively high R^2s were expected based on the inclusion of OMRV, the most important explanatory variable to assess an investment property's values. OMRV alone could explain between 80% (France) and 90% (Italy) of the variation in value in a univariate regression. The variable OMRV is likely to capture a lot of additional variables that were not explicitly included in the regression model. For example, even though the model did not include a variable for the micro location, it seems plausible to assume that attractive locations were implicitly reflected in higher rental value.

Fitted values from the regressions in Table 4.2 were obtained for comparison with actual valuations in order to assess goodness of fit. The simple deviation between fitted values and actual values was derived by the following formula:

$$\frac{\text{Fitted Valuation}}{\text{Actual Valuation}} - 1 \qquad \textbf{Formula 4.1}$$

Since the fitted values were based on models that fit the average data best, there were bound to be some outliers. Therefore, the top and bottom 5% of observations were excluded from the comparison, in order to reduce the impact of these extreme and sometimes inexplicable outliers.

Figure 4.3 displays the median and spread between actual valuations and fitted valuations for each country. The median simple difference ranged from -2.1% and -2.3% in Switzerland and the UK, to -0.3% and -0.2% in the Netherlands and Italy. The negative numbers implied that in all countries, fitted valuations were slightly below actual valuations. The largest standard deviation was found in the UK (16.0 percentage points) and the lowest in the Netherlands (9.8 percentage points). The largest percentage of fitted valuations within 15% of actual valuations was found in Switzerland (86.5%) and the lowest in the UK (65.6%). A t-test did not detect a significant difference in sample means between fitted valuations and actual valuations in any country. Overall, it was concluded that the fitted valuations were good proxies for actual valuations. Only the fitted valuations of the sale observations were used in the subsequent analysis, to correct for sample selection bias.

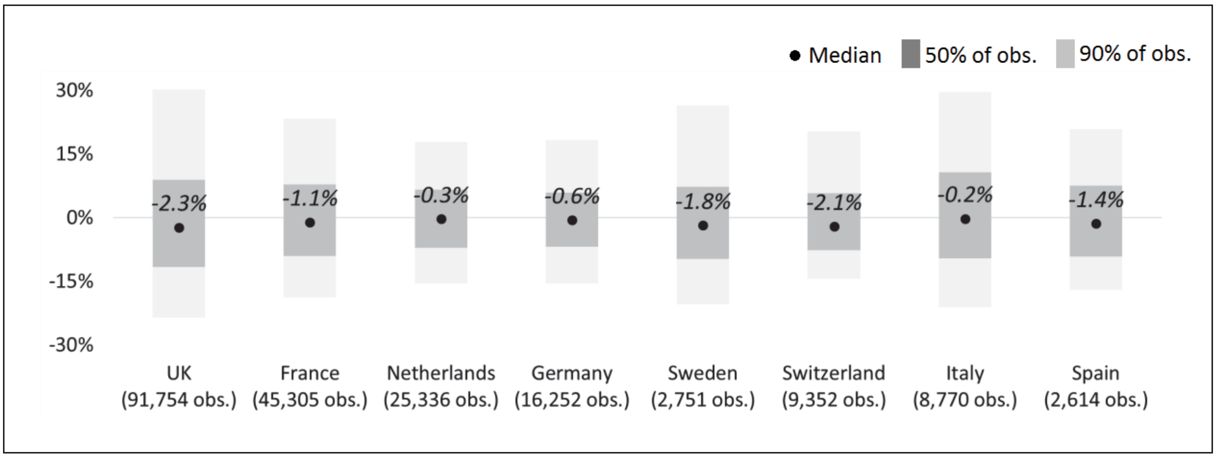


Figure 4.3 Simple Difference between Actual Valuations and Fitted Valuations

4.4 European Naïve Pricing Models

In order to derive a proxy for transaction prices, the actual sales data of the sample was used to derive fitted prices. Table 4.4 displays the results of the regressions using the natural log of price per square meter, ln(Price), as explained variable and the same explanatory variables as in the previous valuation regressions (Table 4.2). Fitted prices were obtained for further analysis. The fitted prices from the regressions were labelled *Naïve Prices* because they ignored sample selection bias. Only the fitted Naïve Prices of the valuations were used in the subsequent analysis, to correct for sample selection bias.

Just as before, all regressions had reasonably high adjusted R^2. Goodness of fit ranged from 90.2% in the UK to 72.7% in Germany. Interestingly, the adjusted R^2 in the UK was almost the same as in the valuation regression. In the other countries, adjusted R^2s were lower than before, implying that the standard regression model had a better goodness of fit when predicting the variation in values than the variation in market prices.

ln(Price)	UK	France	Netherlands	Germany	Switzerland	Italy	Sweden	Spain
Y2003	0.052***	-0.056	0.001	0.013	-0.395***	-0.305*	0.181**	-0.203
Y2004	0.149***	-0.020	0.038	0.008	-0.070		0.096	0.033
Y2005	0.230***	0.075	0.056**	-0.032	-0.122	-0.124	0.246***	0.419***
Y2006	0.368***	0.275***	0.138***	-0.128***	-0.371***	-0.181	0.344***	0.308**
Y2007	0.377***	0.345***	0.210***	0.057	-0.167*	-0.285*	0.221**	0.401***
Y2008	0.159***	0.288***	0.224***	0.083	-0.147	-0.346**	0.261***	0.276**
Y2009	-0.115***	0.216***	0.126***	0.019	-0.032	-0.373**	0.449**	0.136
Y2010	-0.057**	0.183***	0.081***	0.116*	-0.049	-0.398**	0.382***	0.159
Y2011	0.057**	0.265***	0.073***	0.006	-0.035	-0.375**	0.303***	-0.013
Y2012	0.053**	0.298***	-0.006	-0.001	0.096	-0.385**	0.398***	-0.138
Y2013	0.039	0.275***	-0.084***	-0.031	0.079	-0.299*	0.510***	-0.507*
ln(OMRV)	0.986***	1.010***	1.069***	0.929***	1.162***	0.967***	0.578**	0.917***
ln(Occ)	0.094***	0.081***	0.060***	0.047***	0.029	0.033**	0.117***	-0.014
ln(Area)	-0.029***	-0.016**	-0.018***	-0.017	-0.020	0.020	-0.007	-0.016
ln(Age)	-0.032***	-0.043***	-0.035***	-0.083***	-0.060**	0.037**	-0.058**	-0.061
Retail	0.192***	0.031	0.164***	0.029	0.038	-0.094*	0.155***	-0.094
Indus	-0.013	-0.118**	-0.005	-0.196	-0.009	-0.192***	-0.306**	-0.366*
Loc2	0.051	0.386***	-0.019	0.283***	0.146**	0.079	1.348***	0.261
Loc3	0.123***	0.252***	0.022	0.309***	0.037	-0.009	1.096***	0.312**
Loc4	-0.059**	0.062	-0.023	0.337***	0.097	-0.016	0.465***	0.086
Loc5	-0.169***	0.032	0.078***	0.113	-0.046	0.129	0.826***	0.314**
Loc6	-0.191***	0.009	-0.017	0.249*	-0.004	0.093	0.164*	0.099
Loc7	-0.198***	-0.019	0.007	0.239***	0.070	0.148*	0.842***	0.038
Loc8	-0.214***	-0.095***	-0.007	0.142*	-0.031	0.096	0.380***	0.340**
Loc9	-0.208***	-0.093**	-0.015	0.091***	-0.072	0.177**	0.506***	-0.182
Loc10	-0.225***	-0.061*	-0.009	-0.001	-0.099**	0.089	0.312***	0.092
Public	-0.379***	0.188***					-0.053	
UnLiPrCo	0.281***	-0.003	-0.012	0.072	0.105	-0.182	0.077	-0.417*
OpEnFu	-0.044***	-0.125***		0.089***	0.038	0.011	-0.044	-0.581**
LiPrCo	0.038*	-0.056*	-0.012	0.076	0.104***	-0.085	- 0.239***	-0.460*
ClEnFu	-0.020			-0.080		0.117	-0.400**	-0.567**
REIT	0.109**	-0.009		-0.145		0.122		
Cons	2.526***	2.125***	2.014***	2.935***	1.986***	2.577***	4.301**	3.704***
Adj. R^2	0.902	0.865	0.895	0.727	0.883	0.822	0.787	0.774
Obs.	9,289	3,016	1,490	1,351	352	418	970	137

*Confidence Level: *10%, **5%, ***1%*

Table 4.4 Naïve Pricing Regressions per Country

4.5 European Heckman Pricing Models

In order to correct for sample selection issues of the sale observations, the Heckman Correction was used. The valuation reserve (ValRes), comparing actual valuations to fitted Naïve Prices and actual prices to fitted valuations, was used as an additional explanatory variable in the selection equation. The higher a property's price in comparison to the valuation, the more likely it should be that a sale took place and vice versa.

	UK		France		Netherlands		Germany	
	Step 1 *Sale = 1*	**Step 2** *ln(Price)*	**Step 1** *Sale = 1*	**Step 2** *ln(Price)*	**Step 1** *Sale = 1*	**Step 2** *ln(Price)*	**Step 1** *Sale = 1*	**Step 2** *ln(Price)*
Y2003	-0.078***	0.142***	0.079	-0.042***	-0.194***	0.188***	-0.222**	0.332***
Y2004	-0.123***	0.300***	0.070	0.016	-0.563***	0.556***	-0.101	0.076***
Y2005	-0.064**	0.348***	-0.187***	0.347***	-0.096*	0.155***	-0.156*	0.142***
Y2006	-0.151***	0.541***	-0.207***	0.475***	-0.055	0.163***	0.809***	-1.253***
Y2007	-0.334***	0.619***	0.126**	0.200***	-0.098*	0.239***	0.699***	-1.088***
Y2008	-0.213***	0.192***	0.096*	0.154***	-0.134**	0.237***	0.253***	-0.426***
Y2009	0.001	0.006	0.051	0.180***	-0.325***	0.359***	0.006	-0.017
Y2010	-0.196***	0.291***	0.093*	0.158***	-0.191***	0.251***	-0.150	0.199***
Y2011	-0.321***	0.436***	0.051	0.234***	-0.286***	0.328***	-0.087	0.099***
Y2012	-0.319***	0.436***	-0.029	0.327***	-0.154**	0.153***	0.095	-0.172***
Y2013	-0.041	0.158***	0.099*	0.210***	-0.014	-0.001	0.204**	-0.348***
ln(OMRV)	-0.037***	1.044***	-0.201***	1.247***	-0.445***	1.506***	-0.104*	1.113***
ln(Occ)	0.004	0.215***	-0.126***	0.218***	-0.060***	0.128***	-0.057***	0.136***
ln(Area)	-0.053***	0.052***	-0.110***	0.132***	-0.057***	0.057***	-0.035*	0.061***
ln(Age)	0.057***	-0.117***	0.120***	-0.182***	0.080***	-0.077***	0.276***	-0.497***
Retail	-0.121***	0.343***	-0.280***	0.292***	-0.103***	0.262***	0.075*	-0.094***
Indus.	-0.142***	0.180***	-0.037	-0.071*	-0.571***	0.554***	-0.215**	0.088
Loc2	0.064	0.001	0.013	0.305***	0.162**	-0.164***	-0.135	0.376***
Loc3	-0.263***	0.275***	0.054	0.152***	0.006	-0.014*	-0.169**	0.423***
Loc4	-0.118***	0.076***	0.226***	-0.077**	-0.006	0.000	-0.178**	0.488***
Loc5	-0.032	-0.071***	0.224***	-0.165***	-0.059	0.070***	0.009	0.064
Loc6	-0.016	-0.114***	0.132***	-0.103***	0.000	-0.017***	-0.065	0.301***
Loc7	0.081**	-0.224***	0.145***	-0.121***	0.149**	-0.130***	-0.045	0.214***
Loc8	-0.022	-0.126***	0.185***	-0.200***	-0.029	0.017**	-0.046	0.231***
Loc9	0.006	-0.159***	0.062	-0.069***	0.072	-0.070***	0.016	0.023**
Loc10	0.105***	-0.278***	0.198***	-0.210***	-0.027	0.028***	0.336***	-0.492***
Public	0.202**	-0.363***	-0.165	0.195***				
UnLiPrCo	-0.955***	1.234***	0.212***	-0.207***	0.269***	-0.246***	-0.718***	0.908***
OpEnFu	-0.031**	0.037***	-0.493***	0.507***			0.121***	-0.109***
LiPrCo	0.048	0.035***	0.054	-0.005	-0.054	0.002	0.174*	-0.366***
ClEnFu	-0.126**	0.146***					0.157	-0.286***
REIT	-0.199***	0.345***	0.034	0.020			0.064	-0.252***
ValRes	0.854***		1.000***		1.018***		0.748***	
InvMills		-1.444***		-1.311***		-1.131***		-1.834***
Cons	-0.679***	3.532***	0.535***	2.023***	1.230***	1.222***	-1.397***	6.112***
Adj. R^2		0.980		0.979		0.993		0.916
Pseudo R^2	0.039		0.091		0.054		0.114	
Obs.	101,043	9,289	48,321	3,016	26,826	1,490	17,603	1,351

*Confidence Level: *10%, **5%, ***1%*

Table 4.5 Heckman Pricing Regression Models per Country

	Switzerland		Italy		Sweden		Spain	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
	Sale = 1	*ln(Price)*	*Sale = 1*	*ln(Price)*	*Sale = 1*	*ln(Price)*	*Sale = 1*	*ln(Price)*
Y2003	0.551	-0.500***	4.101***	-0.885***	-0.342***	1.070***	0.900***	-1.513***
Y2004	0.700**	-0.723***	3.170***		-0.184**	0.633***	-0.220	0.526***
Y2005	0.896***	-0.919***	3.679***	-0.411***	-0.041	0.273***	-0.044	0.381***
Y2006	1.216***	-1.277***	4.239***	-1.000***	-0.416***	1.635***	-0.244	0.724***
Y2007	1.163***	-1.141***	4.127***	-0.833***	-0.608***	2.333***	0.242	-0.118
Y2008	1.103***	-1.112***	3.970***	-0.695***	0.388***	-1.093***	-0.547*	1.199***
Y2009	1.171***	-1.146***	4.255***	-1.005***	-0.449***	1.906***	-0.436	0.826***
Y2010	1.269***	-1.231***	4.277***	-1.025***	-0.527***	2.038***	-0.517	1.130***
Y2011	1.487***	-1.431***	4.265***	-0.966***	-0.512***	2.074***	-0.203	0.500***
Y2012	1.171***	-1.073***	3.698***	-0.337***	0.036	0.224**	-0.348	0.718***
Y2013	1.079***	-0.977***	4.165***	-0.914***	-0.621***	2.541***	-0.112	0.066
ln(OMRV)	-0.332***	1.518***	0.058	0.814***	-0.127	1.273***	-0.191*	1.470***
ln(Occ)	-0.075**	0.154***	-0.150***	0.245***	-0.140***	0.596***	0.055	-0.063***
ln(Area)	-0.133***	0.146***	-0.043	0.022***	-0.053***	0.183***	-0.185***	0.259***
ln(Age)	0.261***	-0.289***	-0.003	-0.019***	0.095***	-0.386***	-0.099	0.098**
Retail	-0.246***	0.215***	-0.121	0.160***	-0.088	0.388***	-0.176	0.099
Indus.	-0.187	0.049**	0.332***	-0.615***	-0.002	-0.267**	-0.172	0.156
Loc2	-0.528***	0.583***	-0.016	0.187***	-0.471**	2.430***	0.085	-0.148**
Loc3	-0.162*	0.171***	-0.422***	0.595***	-0.418***	2.040***	-0.355	0.687***
Loc4	-0.626***	0.648***	-0.547***	0.674***	-0.297***	1.256***	-0.236	0.485***
Loc5	-0.890***	0.770***	-0.382***	0.543***	-0.321**	1.555***	-0.328	0.662***
Loc6	-0.351***	0.308***	0.000	0.124***	-0.087	0.447***	0.308	-0.597***
Loc7	-0.441***	0.466***	-0.205*	0.360***	-0.380***	1.842***	-0.476***	0.858***
Loc8	-0.130	0.127***	-0.097	0.170***	-0.130	0.695***	0.026	0.120**
Loc9	-0.541***	0.462***	0.094	0.054**	-0.154	0.903***	-0.038	-0.033
Loc10	0.012	-0.040***	-0.356**	0.451***	0.025	0.116***	-0.196	0.353***
Public					0.133***	-0.481***		
UnLiPrCo	-0.316	0.208***	0.441	-0.573***	-0.177**	0.501***	0.847**	-1.360***
OpEnFu	-0.623***	0.676***	0.468**	-0.652***	-0.751***	2.835***	1.423***	-2.419***
LiPrCo	-0.345***	0.372***	0.185	-0.199***	0.025	-0.148***	0.867*	-1.304***
ClEnFu			0.568***	-0.852***	-0.138	0.267**	1.324***	-2.210***
REIT			-0.325	0.485***				
ValRes	0.983**		0.798***		0.303**		0.365	
InvMills		-1.218***		-1.385***		-4.159***		-2.096***
Cons	0.075	2.068***	-5.551***	6.712***	0.781	2.912**	0.216	3.384***
Adj. R^2		0.990		0.982		0.926		0.939
Pseudo R^2	0.138		0.135		0.111		0.192	
Obs.	9,704	352	9,188	418	9,597	970	2,751	137

*Confidence Level: *10%, **5%, ***1%*

Table 4.5 Heckman Pricing Regression Models per Country *(continued)*

Table 4.5 displays the results of the two steps of the Heckman Correction for each county. The first step, the probit models, used the dummy variable for sales (Sale=1) as dependent variable. The impact of the valuation reserve (ValRes) was positive and significant in all countries, with the only exception of Spain. This meant that, ceteris paribus, the larger the price was compared to the valuation, the higher the probability of a sale. A positive relationship between the valuation reserve and the probability of a sale was expected based on theory, existing literature and previous chapters.

Step 2 in Table 4.5 displays the results of the outcome equations, including the inverse Mill's ratio (InvMills) as an additional regressor. The inverse Mill's ratio was highly significant in all countries. The adjusted R^2s of the Heckman models were higher than in the previous regression of Naïve Prices and ranged from 99.3% in the Netherlands to 91.6% in Germany. The fitted prices, called *Heckman Prices*, were obtained for further analysis.

Before analysing the difference between appraised values and market prices, the fitted Naïve Prices and fitted Heckman Prices were compared against actual prices in order to assess goodness of fit. The simple difference was calculated according to the following formula:

$$\frac{\text{Fitted Sale Price}}{\text{Actual Sale Price}}-1 \qquad \textbf{Formula 4.2}$$

Figure 4.4 displays the simple difference between actual sales prices and Naïve Prices (top) as well as between actual sale prices and Heckman Prices (bottom) for each country. Just as before, the top and bottom 5% of outliers were excluded.

A visual comparison of the two graphs in Figure 4.4 quickly shows that in all countries, the differences between actual sale prices and Heckman Prices were much smaller than between actual prices and Naïve Prices. Further, the spread of observations was much smaller among the Heckman Prices than the Naïve Prices. The median difference between actual sale prices and Heckman Prices ranged from -2.3% and -2.2% in Spain and France, to -0.7% and -0.9% in Sweden and Switzerland. The negative numbers implied that in all countries, fitted Heckman Prices were slightly below actual sale prices. The largest percentage of fitted prices within 15% of actual prices was found in the UK (100.0%) and the lowest in Sweden (73.7%). A t-test failed to detect a significant difference in means between actual sale prices and Heckman Prices in all countries. These conclusions were in line with previous chapters. Therefore, only the Heckman Prices were included in the subsequent analysis.

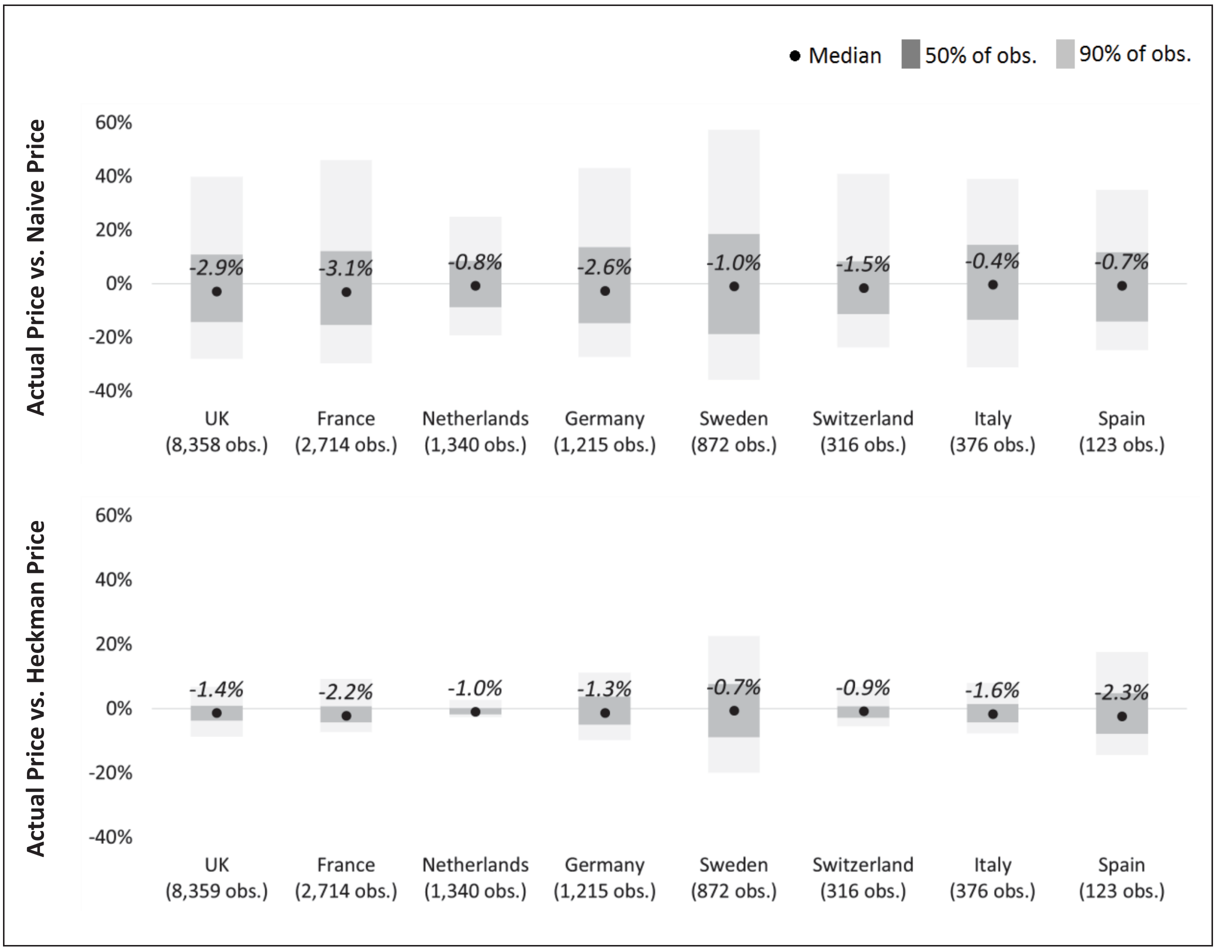


Figure 4.4 Simple Difference between Actual Sale Prices and Fitted Prices

4.6 Comparison of Actual Valuations and Fitted Sale Prices Across Europe

In order to approximate valuation accuracy, the difference between actual valuations and Heckman Prices was calculated according to the following formula:

$$\frac{\text{Heckman Sale Price}}{\text{Actual Valuation}} - 1 \qquad \textbf{Formula 4.3}$$

Figure 4.5 depicts the spread and median deviations between actual valuations and Heckman Prices for all countries. The top and bottom 5% of outliers were excluded. The numbers in brackets depict the number of observations. The comparison included the simple deviation (top) as well as the absolute deviation (bottom).

The median simple difference between actual valuations and Heckman Prices across all years ranged from +0.1% in the Netherlands to -9.4% in Germany. Interestingly, all countries except the Netherlands, had negative median differences, which meant that actual valuations were on average larger than fitted prices. This could indicate a tendency to overvalue rather than undervalue held properties across Europe during the years 2002 to 2013. This was in line with previous findings from the German market.

The absolute median differences were larger than the simple median differences in all countries. The smallest absolute differences were recorded in the Netherlands (7.8%) followed by Switzerland (11.3%). The largest absolute differences were found in Sweden (23.7%) and Spain (18.4%).

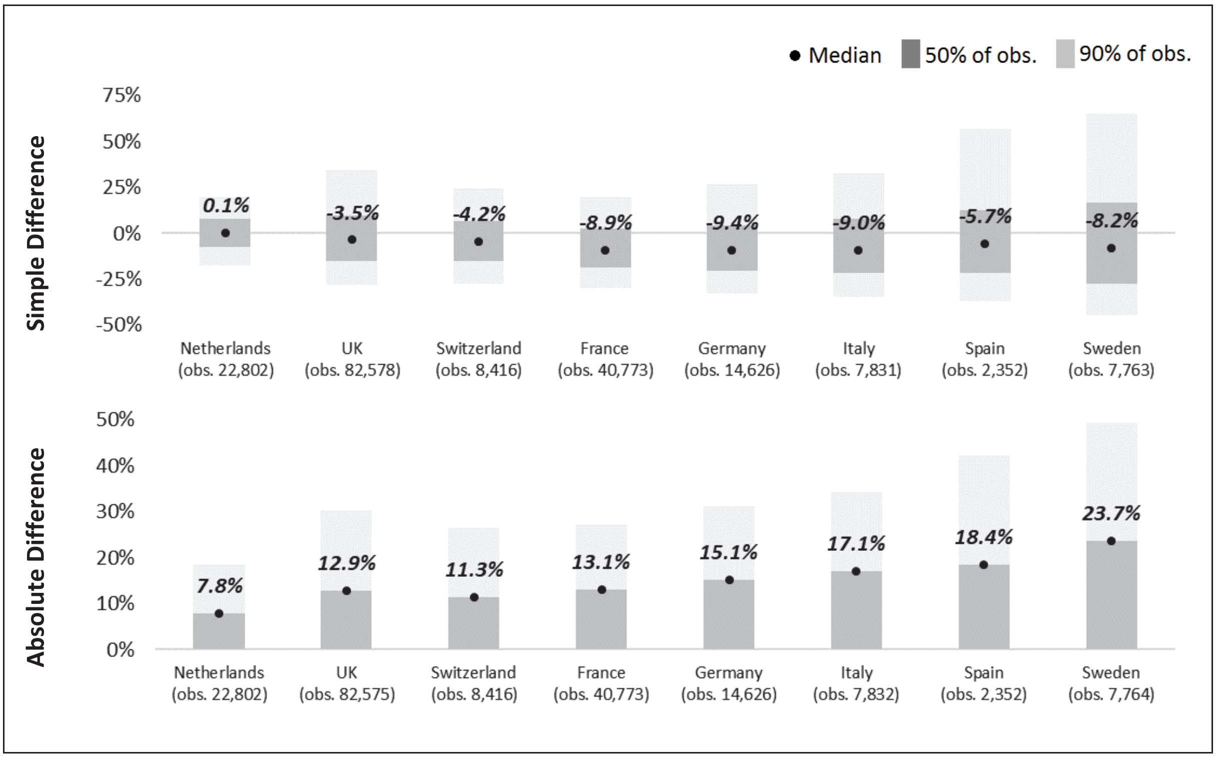


Figure 4.5 Differences between Actual Valuations and Fitted Prices in Europe

Table 4.6 displays the proportion of absolute differences between actual valuations and Heckman Prices within set thresholds. The data shows that only half of the countries in the comparison had a majority of observations within a margin of error of 15%. This is in line with other empirical studies, which identified a significant share of valuations outside the margin of error of 10-15% frequently applied by British Courts in negligence cases (Crosby et al., 1998). All countries, with the exception of Sweden, had a majority of observations within a 20% difference between actual valuations and fitted prices. The Netherlands and Switzerland were consistently the markets with the highest proportion of observations within the displayed ranges. Spain and Sweden were the markets with the smallest proportions. One interesting observation was that the UK initially had a larger proportion of observations within an absolute difference of 15% than France. However, the opposite was the case from the 20% threshold onwards. This seems plausible given the wider spread of observations in the UK than in France (Figure 4.5).

	Netherlands	UK	Switzerland	France	Germany	Italy	Spain	Sweden
Within 5%	33.1%	20.5%	24.0%	19.6%	16.8%	14.8%	14.2%	11.4%
Within 10%	61.3%	39.9%	45.3%	38.6%	33.6%	28.7%	28.6%	22.2%
Within 15%	81.0%	57.1%	62.9%	56.8%	49.7%	43.6%	41.8%	32.9%
Within 20%	93.2%	71.0%	76.7%	72.6%	64.8%	58.6%	53.7%	42.9%
Within 25%	100.0%	81.8%	87.6%	85.3%	77.7%	72.3%	64.7%	52.3%
Within 30%	100.0%	89.7%	95.4%	94.5%	88.0%	82.2%	74.1%	61.6%

Table 4.6 Proportion of Observation within an Absolute Difference of 30%

The comparison of valuation accuracy across different versions of the Valuation and Sale Price Comparison Report by MSCI showed that accuracy can vary by year. It was expected that annual differences would be even more pronounced in this analysis because the time period under investigation included the recent financial crisis. Further, it is possible that valuation accuracy is impacted by property cycles and the countries in the comparison could be on different points of their respective cycles. Therefore, valuation accuracy was split by year. Figure 4.6 displays the annual results of the absolute median difference between actual valuations and Heckman Prices for each country. On the right, the medians across all years were displayed for reference.

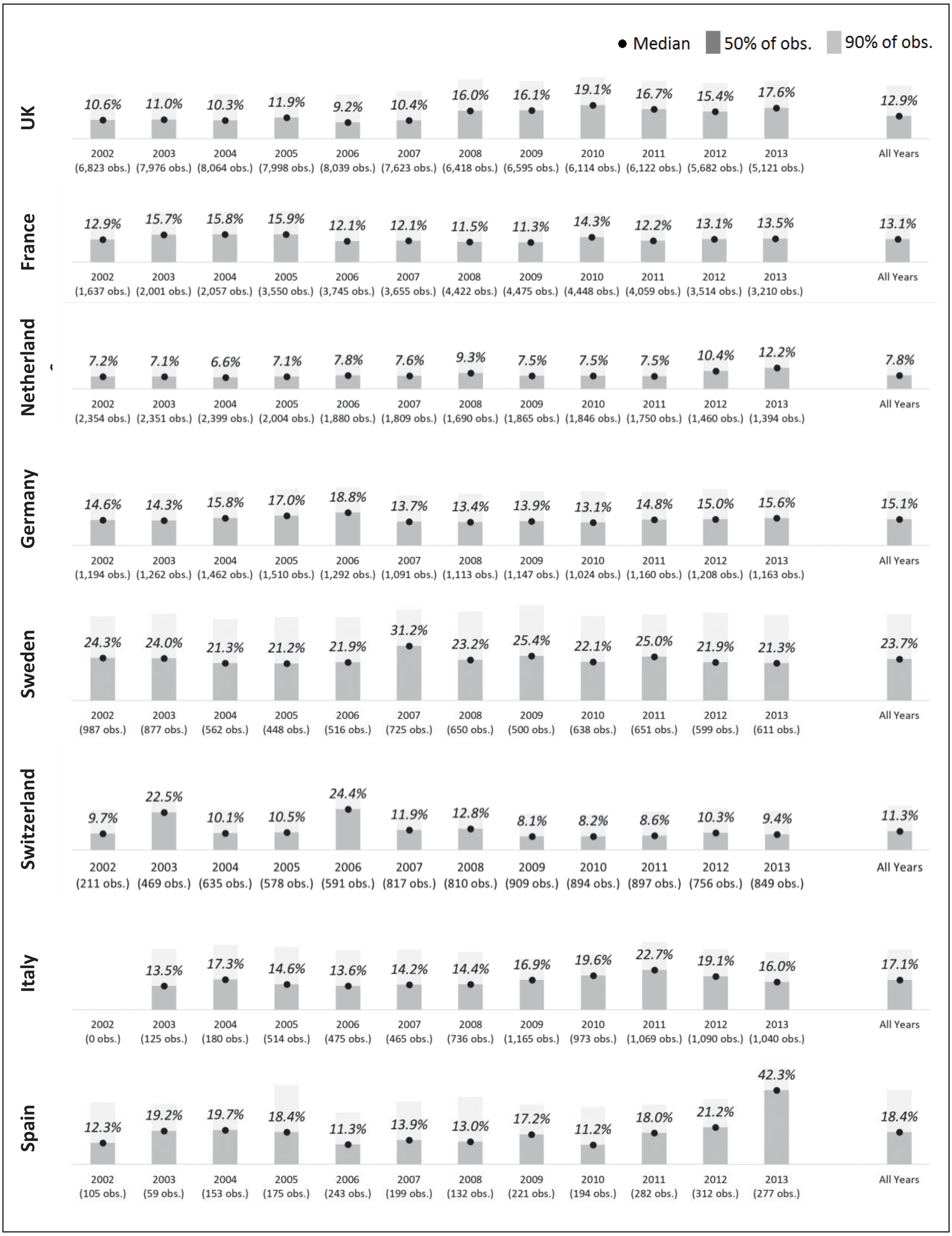


Figure 4.6 Absolute Difference between Valuations and Fitted Prices in Europe, 2002-2013

The country comparison of valuation accuracy over time showed that accuracy was more stable in some countries than others. The two markets with the highest standard deviation of median differences across time were Spain and Switzerland. The comparatively high standard deviations were caused by one or two exceptional years. For example, the high standard deviation in Spain was mostly due to an extremely high median in 2013. Since Spain was the market with the fewest observations, it was more likely that outliers biased results. If the year 2013 were not considered, the largest standard deviations would be found in Switzerland and the UK. The most consistent median differences between actual valuations and fitted prices across years were found in Germany and the Netherlands. Interestingly, the financial crisis was not particularly noticeable in terms of valuation accuracy in any country except possibly Sweden, which had a comparatively large median difference in 2007. The difference between actual valuations and Heckman Prices in the UK and Italy seems to have increased in the years following the financial crisis. Further, it looks like property cycles were not particularly noticeable in the annual levels of valuation accuracy of any country in Figure 4.6. Overall, the annual comparison confirmed the previous conclusions. The Netherlands had the lowest median difference of all countries in ten out of twelve years and Sweden had the highest, also in ten out of twelve years.

4.7 Conclusion Chapter 4

The aim of this chapter was to derive comparable indicators of valuation accuracy for eight major European property markets. To ensure comparability, the same time period, data source and methodology was applied to all countries. The emphasis was placed on the accuracy of held properties because previous studies showed that sold properties tend to be valued closer to the market than held properties. The sale observations in the dataset were used to derive hedonic sale prices. The first set of fitted prices, called Naïve Prices, ignored sample selection bias. The Heckman Correction was used to correct sample selection issues. The derived Heckman Prices were much better proxies for actual prices and the Naïve Prices were dropped from the analysis.

In order to assess valuation accuracy for unsold properties, the difference between actual valuations and Heckman Prices was derived. A simple difference comparison showed that actual valuations were on average above Heckman Prices in all countries except the Netherlands. This could indicate a tendency to overvalue rather than undervalue held properties across Europe between 2002 to 2013. Similar results for the German market have been confirmed in previous chapters and other studies (Weistroffer & Sebastian, 2015).

Another explanation for the possible overvaluation could be the real estate crisis with drastically falling prices and the fact that valuations tend to lag market movements. However, if this were the case, it appears that this has not been an issue in the Netherlands. Unfortunately, the dataset for this research only went up to 2013. Future research should make use of a longer time series to check if the conclusions from this study persisted in subsequent years.

A comparison of the absolute difference between actual valuations and Heckman Prices showed that valuation accuracy was lower than the simple comparison suggested. Across all years, the Netherlands and Switzerland were the countries with the highest level of valuation accuracy. Italy and Sweden on the other hand were the markets with the lowest median valuation accuracy and largest spreads of observations. All countries had significant shares of observations outside the 15% margin of error frequently applied by British Courts. This finding was in line with previous studies (Skitmore et al., 2007; Crosby at al., 1998) and challenges the appropriateness of the margin of error principle usually applied in negligence cases. All countries, except Sweden, had a majority of observations within an absolute difference of 20% between actual valuations and fitted prices. A comparison of valuation accuracy across time revealed that valuation accuracy was more stable in some countries than others. The Netherlands and Germany had the smallest standard deviations across time and Spain, Switzerland and the UK the highest. Neither the years of the financial crisis nor property cycles were particularly noticeable in any country in terms of valuation accuracy.

One interesting conclusion from the analysis was that Germany and Switzerland, the markets which displayed the smoothest property returns (Figure 1.1), did not differ significantly from the other markets in terms of valuation accuracy. Especially German property valuations are often scrutinized internationally for producing valuations that are excessively smooth and stable (Schnaidt and Sebastian, 2012; Crosby, 2007). However, the analysis placed Germany in the middle of the country comparison in terms of valuation accuracy. One possible explanation could be the definition of value. If the claims that German valuers see value as a sustainable, long-term average were true (Weistroffer & Sebastian, 2015; Schnaidt & Sebastian, 2012; Crosby, 2007; Mansfield & Lorenz, 2004) and if real market prices fluctuated evenly around such a long-term average, the median valuation error might not look worse than in other markets. For example, if real market prices fluctuated consistently within +15%

and -15% around a long-term average, the average valuation accuracy would be around 15% even though the underlying price could fluctuate up to 30%. A qualitative approach should be used to investigate this hypothesis.

Another interesting observation was that Sweden consistently displayed the lowest level of valuation accuracy. Even though a direct comparison across studies is not readily possible, this conclusion is similar to the result of MSCI's Valuation and Sale Price Comparison Report (IPD, 2014) which found that Sweden had the highest absolute difference between realised sale price and last valuation in 2013 as well as the years 2004-2013. Future research should focus particularly on the Swedish market to investigate the level of valuation accuracy further.

This study's main aim was to identifying cross-country differences in valuation accuracy of held properties. In the next step it would be useful to revisit individual countries with a more individual research approach in order to confirm potential issues and to identify possible implications for the valuation industry. Since OLS follows a best-fit approach and the universal regression model might fit the data in some countries better than others, it cannot be completely ruled out that the inter-country differences in valuation accuracy were not, at least partially, due to more suitable fitted values. However, it should be pointed out that there was no direct link between the goodness of fit of the regression models and the subsequent level of valuation accuracy.

5 Conclusive Summary

This collection of papers summarizes the analyses of different aspects of property valuations in Germany that may contribute to the observed stability of German property values in comparison to other countries (Figure 1.1). All papers included empirical analyses, based on real market data from the MSCI databank.

Chapter 2 compared valuations and valuation accuracy of the traditional German income approach with the discounted cash flow approach. The majority of institutional investors in Germany use the GIA while investors abroad prefer other methods, including the DCF. Many international observers dismiss the GIA for producing smooth and stable estimators of market prices. The debate around the two methods has been mostly theoretical, lacking large-scale empirical evidence. The available dataset included GIA valuations as well as German DCF valuations, which allowed for a direct comparison of the two approaches under the same market conditions. A performance analysis showed that GIA valuations displayed smoother total return performance due to less volatile capital value growth in comparison to DCF valuations. The available dataset included either a GIA or DCF valuation for each observation, never both at the same time. Therefore, in order to eliminate distortions caused by different underlying property characteristics, fitted GIA and DCF values were derived for all observations. A comparison of the fitted values showed that GIA valuations were on average lower than their DCF counterparts. However, the difference was small and both methods resulted in very similar fitted values. A further observation was that the difference between fitted values was not stable over time and decreased toward the end of the analysis period.

Since significant differences between GIA and DCF valuations were identified, further research into valuation accuracy of the two valuation approaches was carried out. The first part of the analysis consisted of a comparison of actual sale prices with market-adjusted valuations. The second part of the analysis used hedonic regressions to derive fitted sale prices that could be compared against valuations of held properties in order to assess valuation accuracy on a larger and more homogenous dataset. The Heckman Correction was used to reduce the impact of sample selection bias in the transaction regressions. The results of both analyses showed that both techniques produced on average a similar majority of observations within an acceptable range of valuation accuracy of 15%.

Chapter 3 analysed the valuation accuracy of external property valuations in comparison to internal property valuations, which are quite common in the German real estate industry. While all valuers are obliged to act impartially and transparently to reduce bias, the closer relationship between valuers and clients among internal valuations may raise additional concerns regarding the independence of the valuer and hence the objectivity of the result. If clients used their stronger influence over internal valuers to change the valuation result, this could be another contributing factor to the observed smoothness of German property valuations. At first, a *Market-Adjusted Valuation and Actual Sale Price Comparison*, based on sold properties, was carried out. It showed that a majority of both valuation types had a valuation error within the acceptable threshold of 15% but that external valuations were on average closer to sale prices than internal valuations. Due to sample selection issues, a second analysis, called *Actual Valuation and Fitted Sale Price Comparison*, was carried out. Real transactions were used to derive hedonic prices that could be compared against valuations of held properties. The results showed again that external valuations were on average closer to market prices than internal valuations but that both valuation types produced a majority of valuations within an acceptable difference to market prices.

The results of Chapters 2 and 3 raised questions over general valuation accuracy in Germany. Since no comprehensive empirical assessment of valuation accuracy across countries and time was available, a comparison of valuation accuracy between several European real estate markets was carried out. This made it possible to put the identified levels of valuation accuracy in Germany into a wider perspective. The analysis compared valuation accuracy across eight major European markets, using the same time period, data source and methodology, in order to make the results comparable. The emphasis was placed on the valuation accuracy of held properties because the previous analyses found evidence that sold properties were valued closer to the market than held properties. Real sales data was used to derive hedonic sale prices. A comparison of simple differences between actual valuations and fitted prices showed that valuations were on average below fitted prices in all countries, except the Netherlands. This could indicate a tendency to overvalue rather than undervalue held properties across Europe. Another explanation for the possible overvaluation could be the real estate crisis with drastically falling prices and the fact that valuations tend to lag market movements. A comparison of the absolute valuation difference showed that the Netherlands and Switzerland displayed the highest median valuation accuracy. Italy and Sweden on the other hand were the markets with the lowest median valuation accuracy and largest spreads of observations. All countries, except Sweden, had a majority of observations within an absolute valuation difference of 20%.

One interesting conclusion from the country comparison was that Germany and Switzerland, the markets that displayed the smoothest MSCI property returns (Figure 1.1), did not differ from the other markets in terms of valuation accuracy. The analysis placed Germany in the middle of the country comparison. One possible explanation could be the definition of value. If the claim that German valuers see value as a sustainable, long-term average were true and if real market prices fluctuated evenly around such a long-term average, the median valuation error might not look worse than in other markets. For example, if real market prices fluctuated consistently within +15% and -15% around a long-term average, the average valuation accuracy would be around |15%| even though the underlying price could fluctuate within a range of |30%|. Further research in this area is advisable.

The analyses presented in this collection of papers have shown that the valuation technique, at least with respect to DCF and GIA, as well as the large share of internal property valuations in Germany, are unlikely to be major contributors to the observed smoothness of the German MSCI index in Figure 1.1. Further, the country comparison revealed that valuations in Germany were on average comparable to other markets in terms of their valuation accuracy. These conclusions add empirical evidence to the largely theoretical debate of German property valuations in international comparison.

6 References

Baum, A. (2009). *Commercial Real Estate Investment: A Strategic Approach*. Routledge, Abingdon, UK.

Baum, A., Crosby, N. (1988). *Property Investment Appraisal*. Routledge, London.

Boyd, T., Irons, J. (2002). Valuation Variance and Negligence: the Importance of Reasonable Care. *Pacific Rim Property Research Journal*, Vol. 8 Issue 2, pp. 107-126.

Bretten, J., Wyatt, P. (2001). Variance in commercial property valuations for lending purposes: an empirical study. *Journal of Property Investment & Finance*, Vol. 19 Issue 3, pp. 267-282.

Brown, G. (1992). Valuation accuracy: developing the economic issues. *Journal of Property Research*, Vol. 9 Issue 3, 199-207.

Brown, G., Matysiak, G. (2000). Sticky Valuations, Aggregation Effects, and Property Indices. *Journal of Real Estate Finance and Economics*, Vol. 20 Issue 1, pp. 49-66.

Chen, F.-Y., Yu, S.-M. (2009). Client Influence on Valuation: Does Language Matter? A comparative analysis between Taiwan and Singapore. *Journal of Property Investment & Finance*, Vol. 27 Issue 1, pp. 25-41.

Clayton, J., Geltner, D., Hamilton, S. (2001). Smoothing in commercial property valuations: Evidence from individual appraisals. *Real Estate Economics*, Vol. 29 Issue 3, pp. 337-360.

Crosby, N. (2007). German open ended funds: was there a valuation problem?. *Working Papers in Real estate and Planning 05/07*, University of Reading, 2007.

Crosby, N., Lavers, A., Murdoch, J. (1998). Property valuation variation and the ‘margin of error’ in the UK. *Journal of Property Research*, Vol. 15 Issue 4, pp. 305-330.

Crosby, N., Lizieri, C., McAllister, P. (2010). Means, motive and opportunity? Disentangling client influence on performance measurement appraisals. *Journal of Property Research*, Vol. 27 Issue 2, pp. 181-201.

Devaney, S., Martinez Diaz, R. (2011). Transaction based indices for the UK commercial real estate market: an exploration using IPD transaction data. *Journal of Property Research*, Vol. 28 Issue 4, pp. 269-289.

Downie, M., Schulte, K., Thomas, M. (1996). Chapter 8: Germany. In Adair, A., Downie, M., McGreal, S., Vos, G. (Eds.), *European Valuation Practice: Theory and Techniques*. E & FN Spon, London, UK, pp. 125-152.

Eziukwu, N. (2019). Valuation Inaccuracy: Implication on Commercial Property Investment Performance in Akure, Nigeria. *Journal of African Real Estate Research*, Vol. 4 Issue 1, 92-107.

Fisher, J., Gatzlaff, D., Geltner, D., Haurin, D. (2003). Controlling for the impact of variable liquidity in commercial real estate price indices. *Real Estate Economics*, Vol. 31 Issue 2, pp. 269-303.

French, N. (2006). Value and worth: scenario analysis. *Journal of Property Investment and Finance*, Vol. 24 Issue 2, pp. 176-179.

French, N., Gabrielli, L. (2004). The uncertainty of valuation. *Journal of Property Investment &* Finance, Vol. 22 Issue 6, pp. 484-500.

Gallimore, P., Wolverton, M. (2000). The objective in valuation: a study of the influence of client feedback. *Journal of Property Research*, Vol. 17 Issue 1, pp. 47-57.

Gatzlaff, D., Haurin, D. (1998). Sample selection bias in local house value indices. *Journal of Urban Economics*, Vol. 43 Issue 2, pp. 199-222.

Geltner, D., MacGregor, B., Schwann, G. (2003). Appraisal Smoothing and Price Discovery in Real Estate Markets. *Urban Studies*, Vol. 40 Issue 5-6, pp. 1047-1064.

Geppert, H., Werling, U. (2009). A2: Verfahren der Wertermittlung. In Geppert, H., Werling, U. (Eds.). *Praxishandbuch Wertermittlung von Immobilieninvestments*, Immobilien Manager Verlag, Cologne, Germany, pp. 35-74.

gif e.V. (2006). *Standardisierung des DCF-Verfahrens*. Gesellschaft für Immobilienwirtschaftliche Forschung e.V., Arbeitskreis 3 Marktwertermittlung, Wiesbaden, Germany.

Greiner, M., Dildei, N. (2007). B2: Bewertung von Immobilienportfolios. In Schulte, K., Thomas, M. (Eds.). *Handbuch Immobilien-Portfoliomanagement*. Immobilien Manager Verlag, Cologne, Germany, pp. 181-222.

Glasner, S. (2010). *Return Patterns of German Open-End Real Estate Funds*. Peter Lang GmbH, Frankfurt am Main, Germany.

Heckman, J. (1979). Sample selection bias as a specification error. *Econometria*, Vol. 47 No. 1, pp. 153-161.

Hordijk, A., Van de Ridder, W. (2005). Valuation model uniformity and consistency in real estate indices: The case of the Netherlands. *Journal of Real Estate Investment & Finance*, Vol. 23 Issue 2, pp. 165-181.

IPD (2014). *IPD Real Estate Index Analyses: Valuation and Sale Price Comparison Report*. Investment Property Databank.

IPD (2012). *IPD Index Guide*. Investment Property Databank.

IPD (2011). *Erläuterungen zum Datenerhebungsblatt, Version 2011.0*. Investment Property Databank.

IVSC (2019a). *Glossary*. International Valuation Standards Council, https://www.ivsc.org/standards/glossary.

IVSC (2019b). *International Valuation Standards*. International Valuation Standards Council, 31 January 2020.

Isaac, D., O'Leary, J. (2013). 3: Discounted Cash Flow. In Isaac, D., O'Leary, J. (Eds.). *Property Valuation Techniques.* Palgrave Macmillan, Basingstoke, UK, pp.27-47.

Junius, K., Piazolo, D. (2008). C6: Research in der Grundstücksbewertung. In Junius, K., Piazolo, D. (Eds.). *Praxishandbuch Immobilien-Research*. Immobilien Manager Verlag, Cologne, Germany, pp. 339-360.

Kilbinger, S. (2006, August 25). Run on German Real-Estate Funds Exposes Flaws in Regulation. *Wall Street Journal Online*, Europe Business News, http://online.wsj.com/article/SB113814921513655366.html.

Kleiber, W. (2007). Ertragswertermittlung verlangt prophetische Gaben. *Immobilienzeitung*, Vol. 18, p.8.

Levy, D., Schuck, E. (2005). The influence of clients on valuations: the clients' perspective. *Journal of Property Investment and Finance*, Vol. 23 Issue 2, pp. 182-201.

Levy, D., Schuck, E. (1999). The influence of clients on valuations. *Journal of Property Investment & Finance*, Vol. 17 Issue 4, pp. 380-400.

Lizieri, C., Venmore-Rowland, P. (1993). Valuations, prices and the market: a rejoinder. *Journal of Property Research*, Vol. 10 Issue 2, 77-84.

Mallinson, M., French, N. (2000). Uncertainty in property valuation – The nature and relevance of uncertainty and how it might be measured and reported. *Journal of Property Investment & Finance*, Vol. 18 Issue 1, pp. 13-31.

Mansfield, J., Lorenz, D. (2004). Shaping the future: the impacts of evolving international accounting standards on calculation practice in the UK and Germany. *Property Management*, Vol. 22 Issue 4, pp. 289-303.

McAllister, P. (1995). Valuation accuracy: a contribution to the debate. *Journal of Property Research*, Vol. 12 Issue 3, 203-216.

McAllister, P., Baum, A., Crosby, N., Gallimore, P., Gray, A. (2003). Appraiser Behaviour and Appraisal Smoothing: Some Qualitative and Quantitative Evidence. *Journal of Property Research*, Vol. 20 Issue 3, pp. 261-280.

McNamara, P. (1998). Exploring liquidity: Recent Survey Findings. *Paper to the 7th Investment Property Databank Conference*, Brighton.

McParland, C, Adair, A., McGreal, S. (2002). Valuation Standards – comparison of four European countries. *Journal of Property Investment and Finance*, Vol. 20 Issue 2, pp. 127-141.

Parker, D. (1999). A note on valuation accuracy: an Australian case study. *Journal of Property Investment & Finance*, Vol. 17 Issue 4, pp.401-411.

RICS (2019). *Valuation and sale price*. Royal Institution of Chartered Surveyors, https://www.rics.org/globalassets/rics-website/media/knowledge/research/insights/valuation-and-sale-price-march-2019-rics.pdf.

RICS (2017). *RICS Valuation – Global Standard 2017*. Royal Institution of Chartered Surveyors.

Schrader, N., Aholt, H. (2013). *Bewertung und Wertsteuerung von Immobilien, Ergebnisse der Umfrage*. Deloitte Consulting GmbH, https://www.iz-shop.de/buch-7498/bewertung-und-wertsteuerung-von-immobilien.

Smolen, G., Hambleton, D. (1997). Is the real estate appraiser’s role too much to expect?. *The Appraisal Journal*, Vol. 65 Issue 1, pp. 9-17.

Schnaidt, T., Sebastian, S. (2012). German valuation: review of methods and legal framework. *Journal of Property Investment & Finance*, Vol. 30 Issue 29, 145-158.

Skitmore, R., Irons, J., Armitage, L. (2007). Valuation accuracy and variation: a meta analysis. *13th Pacific Rim Real Estate Society Conference*, Fremantle, WA.

Walvekar, G., Kakka, V. (2020). *Private Real Estate: Valuation and Sale Price Comparison 2020*. MSCI Research.

Weistroffer, C., Sebastian, S. (2015). The German Open-End Fund Crisis – A Valuation Problem?. *Journal of Real Estate Finance and Economics*, Vol. 50 Issue 4, 517-548.

Wolverton, M., Gallimore, P. (1999). Client feedback and the role of the appraiser. *Journal of Real Estate Research*, Vol. 18 Issue 3, pp. 415-31.

Worzala, E., Lenk, M., Kinnard, W. (1998). How client pressure affects the appraisal of residential property. *The Appraisal Journal*, Vol. 66 Issue 4, pp. 416-27.

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