NON-LINER ADJUSTMENTS BY REAL ESTATE APPRAISAL

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ABSTRACT

Real estate appraisal bases among others on the comparison of area of real estates (e.g. apartments), particularly when the market comparison approach is used. For very similar real estates the adjustment for area can be made by commonly used linear manner, but for the comparison of rather differently big real estates a non-linear relationship should be considered as relevant.

In the present article the non-linear relationship is discussed and an equation for non-linear adjustments is derived. The equation is based on the cost-to-capacity relationship, which is commonly used in machinery and equipment appraisal, but it is adopted for use in real estate appraisal. Equation is empirically verified on data from practice.

Presented non-linear adjustment process should increase usefulness of the market comparison approach, particularly when the market is weak and comparable recently sold real estates are hard to find. The non-linear equations will give the appraiser more space to look for suitable comparable real estates. The results of the non-linear appraisal are very transparent and accurate as long as the power *n* of the non-linear equation is determined exactly for every region.

INTRODUCTION

When appraising a real estate using market comparison approach, according to Jaffe and Sirmans (1995) five major adjustments in value must be performed:

(1) time, because sales are historical, therefore sales of comparable properties must be adjusted for time,

(2) location, which has a significant impact on the value, therefore if comparable properties are not in the same neighbourhood the adjustment will be necessary,

(3) financing, which can impact the behaviour of investors, therefore type of financing must be considered,

(4) conditions of sale; the appraiser must be certain that the buyers and sellers are motivated by

ordinary market motives; unless so, adjustment must be applied, and

(5) physical characteristics; this category involves size of building, age, number of rooms, and lot size, therefore if compared and appraised properties are not equal on each of mentioned factors, adjustment will be necessary.

Godec (1999) is more specific. He states ten categories which must be considered by performing adjustments, particularly when appraising apartments: (1) location, (2) regulation of neighbourhood, (3) number of stories, (4) story in which appraised property is located, (5) age of building, (6) construction materials, (7) standard of building and appraised apartment, (8) level of maintenance, (9) installations in apartment, and, (10) area of apartment.

CONSIDERATION OF AREA BY APARTMENT APPRAISAL

Experience shows that area of property has a great impact on property's value, particularly by apartments. The larger the area of apartment the lower is value per unit of area (e.g. value per square meter, value per square foot, etc.). In theory this lawfulness is usually considered by adjustments for physical characteristics, and also relevant international authors do not pay special attention to the question of area. Godec (1999) on the other hand expose area of apartment as a significant factor which influence the price per unit of area (square meter) of apartment, but he does not give the solution of the problem. In my article (Psunder, 2000) I have proposed the adjustment of area that can be calculated from equations 1 or 2 (for deeper discussion please refer to the stated article). The equations are valid for similar real estates (e.g. same type of apartment but different area):

$$Va_A \;\; ? \;\; \frac{C}{A} \; ? \, Va_{MAX} \, , \qquad (1)$$

where Va_A is adjusted basic value per unit of area (e.g. per square meter) of appraised apartment, C is minimum area of apartment of a type (e.g. minimum area of two-room apartment) where functionality is not mutilated, A is area of appraised apartment, and, Va_{MAX} is maximum value per unit of area, which is achieved by apartment of minimum area (area C) where functionality is not mutilated. Va_{MAX} can be deducted from the market if the minimum area for apartment of a type is known. The minimum area (area C) is a matter of regional and local characteristics, but it is also exposed to appraiser's subjective judgment.

The coefficient $\frac{C}{A}$ can be written as a factor of area adjustment f_a. The equation 1 gets now the

following form:

$$Va_A \;?\; f_a \;?\; Va_{MAX}\,, \qquad (2)$$

where f_a according to the stated article (Psunder, 2000) normally varies between 0,95 and 1,00.

WHY NON-LINEAR RELATIONSHIP INSTEAD OF LINEAR ONE?

There are several reasons why smaller apartments hold higher value per unit of area than larger ones. First, buyers are utility oriented, so they are not willing to buy excessive spaces (except for luxury real estates). They will rather spend the money for other benefits (e.g. location, orientation, etc.) over the extended space of apartment. Therefore we can establish that demand tend to smaller apartments rather than to larger ones. This could be one of the reasons why sellers slightly raise the price per unit of area by selling smaller second hand apartments. Also, companies usually offer discount for "quantity" when one is buying a bigger new built apartment. It the Table 1 prices per square meter of second hand apartments are shown, as valid in Maribor, Slovenia, in December 1999.

Table 1: Prices per square meter of second hand apartment as valid in Maribor, Slovenia, in December 1999 (Source: real estate agencies)

type of apartment	approximate average area (sq. m.)	average price (DEM/USD)	average price per sq. m. (DEM/USD)
one room apt.	30	46.800/24.800	1.560/827
two room apt.	55	80.850/42.850	1.470/779
three room apt.	80	114.400/60.630	1.430/758

Similar to buyers also tenants are utility oriented, tenants may be even more. For that reason rents are falling when increasing the area of apartment. In the Table 2 rents per apartment are shown as valid in December 1999 in Maribor, Slovenia.

Table 2: Apartment rents as valid in Maribor, Slovenia, in December 1999 (Source: real estate agencies)

type of apartment	approximate average area (sq. m.)	average monthly rent (DEM/USD)	average monthly rent per sq. m. (DEM/USD)
one room apt.	30	400/212	13.3/7.1
two room apt.	55	550/292	10/5.3
three room apt.	80	750/398	9.4/5

We can determine value of apartments using income approach. The calculation is based on equation 3:

$$V \;?\; \frac{rent}{k}, \qquad (3)$$

where *rent* is net income per year, *k* is capitalization rate, and *V* is value of appraised apartment. If a constant *k* is used, there will be even greater difference in apartments' value per unit of area compared to selling prices per unit of area (Table 1). However, in both cases relationship between prices per unit of area of differently large apartments can be interpreted as linear only when very similar apartment areas are used as comparables.

Lawfulness, shown in cases one and two (Table 1 and 2), is also seen in the third case, where prices for apartments are shown as they are calculated by construction companies. Construction prices of smaller apartments are higher than of larger ones. This is caused by different construction costs for kitchen, bathroom and toilet, and other (living- and bed-) rooms. In the Table 3 we can see approximate selling prices per square meter of new built diverse room types. The prices were valid in Maribor, Slovenia, in December 1999.

Table 3: Approximate prices for square meter of new built apartment spaces, valid in Maribor, Slovenia, in December 1999 (Source: Komunaprojekt, Inc., Maribor).

Type of room	Approximate price per square meter
bathroom / toilet	2.570 DEM / 1.355 USD
kitchen	2.395 DEM / 1.265 USD
living room / bedroom	1.830 DEM / 965 USD
anteroom / corridor	1.595 DEM / 840 USD
cellar	530 DEM / 280 USD

As larger apartments mostly gain on area of living- or bed-rooms, which are cheaper in construction then bathrooms or kitchen, the apartment's price per unit of area falls with increasing of apartment's area. As in previous two cases, also in this case the relationship can be presumed as linear only when very similar apartments are compared. When comparison is performed between different types of apartments or between apartments with significantly different areas the relationship is non-linear, what is graphically presented in the Figure 1. However, discussed lawfulness in not valid for luxury apartments, therefore apartments over 100 sq.m. of area are not considered in the figure.

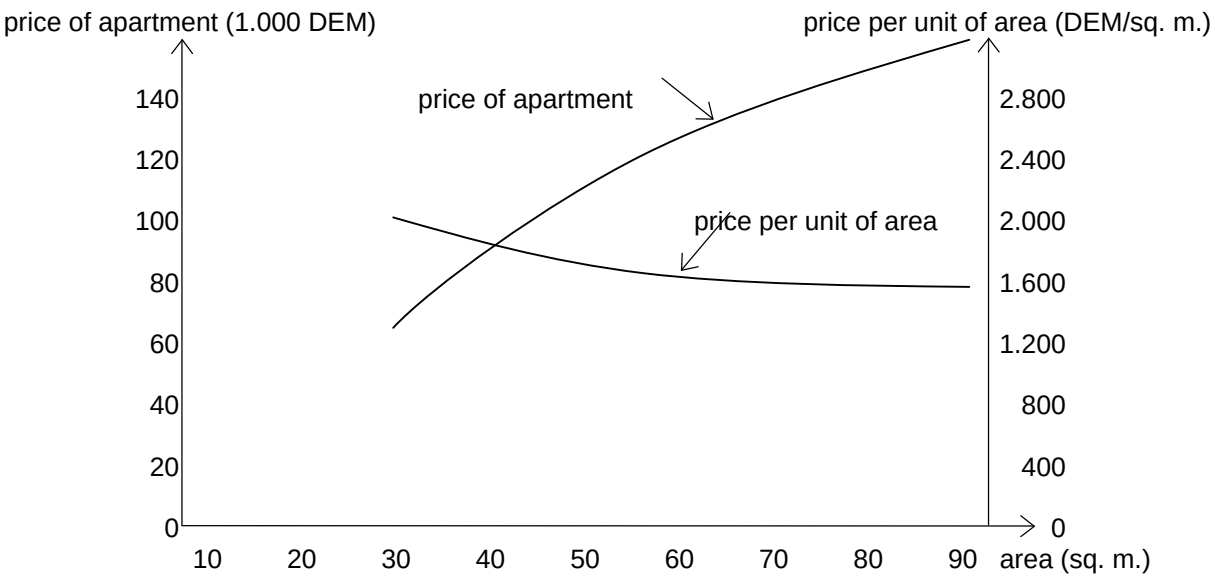

Figure 1: Relationship between area of apartment and its price/price per unit of area

NON-LINER ADJUSTMENT OF VALUE PER UNIT OF AREA

According to the statements in previous chapter, real estate appraisers and investment analysts should pay attention to area of apartment, particularly when using the market comparison approach. For similar type of apartments the linear relationship (equation 1 and 2) can be used, but for comparison of different types of apartments the non-linear relationship should be considered as relevant. For the non-linear equation the cost-to-capacity relationship from machinery and equipment appraisal can be used as a basis (refer to Svoboda, In: *Appraising Machinery and Equipment*, 1989) and adopted for use in real estate appraisal. The equation gets form of the equation 4 for real estate appraisal purposes:

$$\frac{Value\ per\ unit\ of\ area\ A}{Value\ per\ unit\ of\ area\ C} = \left(\frac{Area\ C}{Area\ A}\right)^{n}, \qquad (4)$$

where *n* means size power. From the equation 4 we can extract value per unit of area of appraised apartment A:

$$Value\ per\ unit\ of\ area\ A = \left(\frac{Area\ C}{Area\ A}\right)^{n} \cdot Value\ per\ unit\ of\ area\ C, \qquad (5)$$

where data of C refer to apartment which is compared.

Equations 4 and 5 imply power relationship where size power *n* varies according to regional and local characteristics. However, it is also exposed to appraiser's subjective judgment. In region of city of Maribor, Slovenia, this power varies around 0,1 for comparing of apartment prices, and around 0,4 when comparing apartment rents.

DISCUSSION AND CONCLUSION

The presented equations shell increase transparency of real estate appraisal. According to Svoboda (*Appraising Machinery and Equipment*, 1989) the original version of equation that is used in machinery and equipment appraisal (however, for different purposes as in real estate appraisal) was initially known as six-to-tenth factor as the power of 0,6 was the nearest to average ones. That does not mean the power of 0,6 should necessarily be used for real estate purposes. Empirical studies in the region of city of Maribor, Slovenia, has shown that the most convenient power for the presented price-to-area equation is approximately 0,1 for comparing apartment prices and 0,4 for comparing apartment rents. With this power the price-to-area equation (or sometimes rent-to-area equation) becomes a useful tool for advanced real estate appraisal, particularly for apartment appraisal. For accurate results regional power(s) should be determined precisely.

Implementation of the price-to-area equation by market comparison approach appraisal should abolish erroneous base values as well as rent-to-area equation should be a useful tool when determining a base rent. Results of the appraisal process should therefore gain on accuracy and fairness. Furthermore, the non-linear relationship should provide freedom to compare the prices per unit of area of different types of apartments. The critical point in the presented equations is the size power *n*, which should be determined very exactly for every region in order to preserve faulty result of the presented equations.

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