Price surfaces: visualization of dwelling market variations in Helsinki Metropolitan Area, Finland

Minna Halonen & Pekka Lahti
VTT Technical Research Centre of Finland
Espoo, Finland
minna.halonen@vtt.fi, pekka.lahti@vtt.fi

SUMMARY

Technical Research Centre of Finland (VTT) possesses a large database of dwelling prices based on real transactions from all over Finland starting from the year 1970. The database contains over 500 000 dwelling and real estate transactions. This paper presents the first attempt to visualize spatial and temporal changes of dwelling prices by using GIS based spatial analysis methodology. The product of the analysis process consists of a series of maps, so called price surfaces, which can be used to monitor the development of local dwelling markets by localizing its hot spots and stagnating areas. The pilot study covers the Helsinki Metropolitan Area and the time period of the last 23 years. The maps present surfaces of dwelling prices covering all the residential areas of the HMA. The initial point datasets are interpolated into regional grids by using Inverse Distance Weighting (IDW) method.

KEYWORDS: *price surfaces, dwelling prices, time series, GIS, spatial analysis, Helsinki*

DATA AND STUDY AREA

Dwelling price data

Technical Research Centre of Finland (VTT) possesses a large database of dwelling prices based on real transactions from all over Finland starting from the year 1970. The price data is based on the selling prices collected by ca. 50 real estate brokers. The database contains over 500 000 dwelling and real estate transactions, currently updated with about 2 500 – 3 000 new transactions per month.

Regular monitoring of dwelling markets with statistical methods (SAS) is made every quarter of year by VTT. These statistical analyses consist mainly of tailor-made statistics for real estate brokers. The contents of the statistical data for each purchase of a dwelling from the year 1970 consist of following data: address (postcode, street, number of the house), new/old dwelling, type of the house (block of flats/terraced house/detached house), age of the house (year of the construction), number of rooms (without kitchen), floor area (square meters), date of the transaction (day, month, year), price (FIM, €). Since 1980 also the following data has been collected: condition (good/satisfactory/poor), availability (free/rented), number of stories in the house, location floor, lift (yes/no), construction material (concrete/brick/wood/other), plot (owned/rented, area in square meters), housing company debt (FIM, €/m²/month), maintenance costs (FIM, €/m²/month), selling time (days), municipality (code).

The initial data has been processed in order to have reliable square meter prices. The dwelling prices have been deflated to the level of year 2003. Minimum and maximum square meter prices

have been stabilized for each year. The data undercutting or overrunning the limits have been eliminated as well as those missing data on floor area, selling price, house type or number of rooms. Also records with partial addresses have been removed to expedite the later geocoding process. Still approximately 19 500 transactions containing correct selling price have been located.

Only transactions of flats of two rooms (kitchen excluded) have been included in this study. The two-room-flats present the most prevalent dwelling type in Finland. For this reason, their price per square meter is considered as a good indicator of the dwelling market changes in general.

Study area

The Helsinki Metropolitan Area (HMA) includes the cities of Helsinki, Espoo, Kauniainen and Vantaa covering ca 764 km squares (figure 1). HMA is the core of the Helsinki region, which has ca 1.2 million inhabitants. The region has a relatively compact urban structure: a fifth of the Finnish population lives in the area's ca 500 000 dwellings. Helsinki Metropolitan Area was chosen as a pilot study area, because it was likely to have a sufficient density of price data covering large parts of the built-up areas thus enabling construction of a price surface.

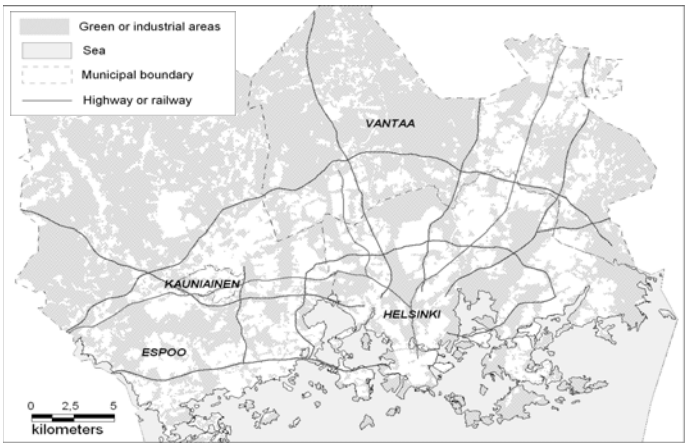

***Figure 1*:** The study area includes the cities of Helsinki, Espoo, Kauniainen and Vantaa. The price surfaces are calculated for the residential areas (in white) of the four cities.

AIM OF THE STUDY

This paper presents the first attempt to visualize spatial and temporal changes of dwelling prices by using GIS based spatial analysis methodology. The visualization of statistical data makes the comprehension of the spatial and temporal changes of the phenomena more immediate compared with pure statistical presentation.

The large amount of data enables basing the spatial analyses of the dwelling markets on the sole adjacency of the located transactions. The method takes into account the dwelling prices of the neighbourhood in the sense of Tobler's first law of geography "Everything is related to everything else, but near things are more related than distant things" (Barredo, 2002).

Hitherto visualizations of dwelling market variations have been made at the level of zip-code zones in Finland (see e.g. Lönnqvist & Vaattovaara, 2004). The thematic map presentations are too coarse to capture the spatial variation of dwelling prices. The price surface method enables a more accurate

dissection of the phenomenon (figure 2). At the same time it does not reveal the exact positions of the individual dwellings at issue. This is important for the confidentiality of the original database.

Figure 2: A comparison between a thematic map and a price surface map. Both maps represent the dwelling prices of the period 2001-2003. The coarseness of the thematic map can be noticed. Besides certain zones containing only few transactions can be overestimated for their large size (see arrows). The price surface allows also considerable zooming into selected sub-areas thus increasing the quality and accuracy of the information while the information content of a thematic map remains always the same.

The product of the analysis process consists of a series of maps, so called price surfaces, which can be used to monitor the development of local dwelling markets by localizing its hot spots and stagnating areas. In this context local goes from regional to block level. In this pilot study a city region scale has been adapted to review the effects of the economic trends to the fluctuation of the dwelling markets.

PRICE SURFACE METHOD

To test the power of the price surface method a series of maps was produced. The pilot study covers the time period of the last 23 years. The study period starts from 1980 and ends to 2003. The years are grouped into five datasets covering two to three years each (1980-1982, 1988-1989, 1992-1994, 1998-2000 and 2001-2003. The periods selected typify five specific economic cycles in the recent history of Finland: decline (80-82), economic boom (88-89), depression (92-94), rise (98-00) and techno hype (01-03). This means approximately 4 000 located dwelling transactions for each period i.e. price surface map.

The maps present price surfaces covering all the built-up areas of the HMA. The initial point datasets are interpolated into regional grids by using Inverse Distance Weighting (IDW) method of commercial MapInfo Vertical Mapper software. In this method the original data points lying within a prescribed radius of a new grid node are weighted according to their distance from the node and then averaged to calculate the new grid cell value (Vertical Mapper User guide, 1999).

A valuation between the best cell size and search radius length was made. It seems that 50 meters per side is the fittest cell size in order to reach a visually sufficient smoothness at the edges of the surface. The optimum search radius length varies between 500 and 1 500 meters depending on the required level of geographical distinction between neighbouring areas. Minor lengths give an overly punctual surface and create artificial and random variation based on too few data per time period and area. On the other hand, protracted lengths seem to give too generalized results and lose important information on locally interesting peaks/cavities. The right balance between cell size and search radius length depends on the regional extension of the study area, on the coverage of the original point dataset, the density of data points per area and time period and the required level of

variation details. In this study, a cell size of 50 meters per side and a search radius of 1 200 meters was assessed the fittest. A display radius of 1 000 meters was adapted for the output.

The final visualization of the price surface maps was done by overlaying the result of the interpolation with green and industrial areas and the sea. In this way, the price surfaces result only for the residential areas.

The results of the interpolation were carefully considered in order to discover the fittest categories of dwelling prices for the final price surfaces. If the purpose is to find out the local hot spots or stagnating areas the categories can be fixed for certain percentiles. In this study, the price scale was fixed for six values: 1 000, 1 250, 1 500, 2 000, 2 500 and 3 000. The final product of the study is visualized in five price surface maps, which cover the time period of 23 years (figure 3).

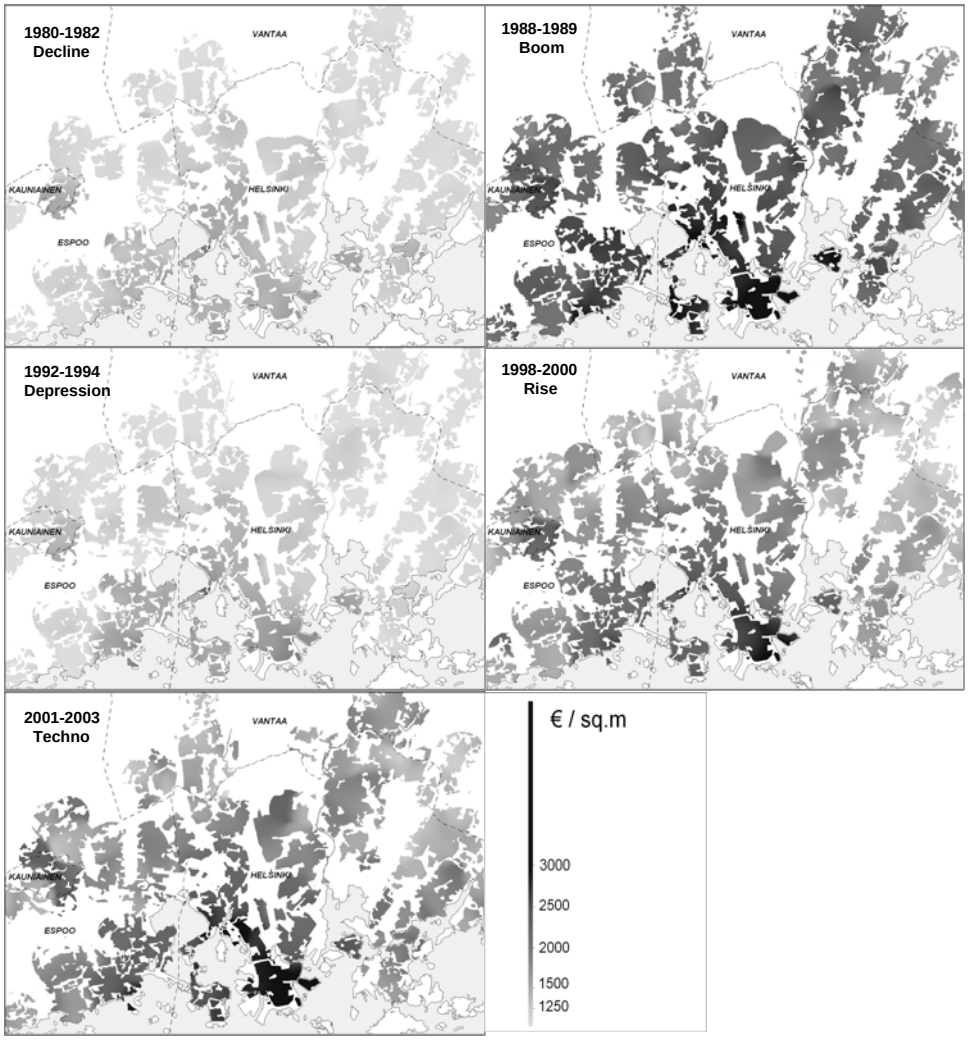

Figure 3: Price surface maps of five different economic cycles of the Helsinki Metropolitan Area. The price level (€/square meter) is the same (year 2003) for each time period.

CONCLUSIONS

The selected method proved to be effective. The price surface maps show clearly the trend of the development and the fluctuations of the dwelling market. Especially, the economic depression periods (1980-1982 and 1992-1994) can be distinguished for their light-grey colouring and the economic boom (1988-1989) for its dark-grey colour. Also the differences in internal price variations within each time period can be distinguished clearly (high in boom, low in decline). Based on experience, using colour images, multi-colour scales or 3D presentations the visualization power of the price surface method becomes even more evident.

The potential ways of using of price surface maps vary from the annual monitoring of dwelling markets to the study of spatially more limited phenomena like social segregation inside certain residential areas of HMA. A further step will be to extend the study area to cover also other big cities of Finland like Tampere, Turku and Oulu. In the near future also some other variables will be analysed such as selling time, which can be considered as a first weak signal of the emerging conjuncture of dwelling markets.

BIBLIOGRAPHY

Barredo, José I., Kasanko Marjo, McCormick Niall & Lavalle Carlo, 2002. Modelling dynamic spatial processes: simulation of urban future scenarios through cellular automata. Landscape and Urban Planning 64: pp. 145-160.

Dwelling price database of VTT (coverage: years from 1970 until present, 30 biggest dwelling market areas of Finland, updated monthly by around 3 000 new transactions, current volume over 500 000 transactions, 20 individual pieces of data recorded per each transaction)

Lönnqvist, Henrik & Vaattovaara Mari, 2004. Asuntomarkkinoiden vuoristorata. Ovatko kaikki alueet samalla radalla? Helsingin kaupungin tietokeskus, Finland. ISBN 952-473-339-0. 68 p.

Vertical Mapper™ Contour modelling & display software for MapInfo Professional User Guide, 1999. Northwood Geoscience Ltd. Canada. 268 p.