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Methodological proposals for estimating the price of climate in France

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A current project linking economists, geographers and mathematicians evaluates the price of climate in France. The economic data are mainly from housing surveys conducted by the INSEE. It consists in a total of 9,640 buyers of single-detached houses, 2,658 buyers of apartments, 3,447 tenants of single-detached houses and 8,615 tenants of apartments. Each transaction is located in space by X-Y geographical coordinates.
The climatic data are derived from the Meteo-France data base (normal 1970–2000). They are related to (1) mean annual temperature, (2) mean temperature for January and July, (3) number of days with temperatures of less than –5 °C in January and more than 30 °C in July, (4) mean monthly rainfall, (5) rainfall in January and July, (6) number of days' precipitation in January and July. These data are recorded by a network of scattered weather stations. A raster GIS composed by ten data layers derived from a DEM and remote sensing images at 250 m resolution is used to initiate interpolations. Four types of interpolation techniques were tested. First we used regressions between climatic data (variables to be explained) and explanatory variables stored into the GIS. Second we used ordinary kriging; third a double step method linking regression and then kriging of the regression residuals. Finally we used a local interpolation method. Based on standard deviation values obtained by cross validation and R^2 values, the comparison between the four methods shows that the last one reduces the residuals to the minimum and explains the maximum of variance. It was retained in our project to compute continuous field of the climatic data. The predicted values are then merged with the housing survey data.

We use the hedonic price method (Rosen, 1974) to determine the price of climatic attributes, which are capitalized in land rents. Three econometric methods are used: a fixed-effects model estimated by OLS or PLS method and a mixed model with random intercepts. The identification problem, well-known in hedonic literature, is not a problem here, because climate is a non-produced good. Some explanatory variables may be endogenous; thus, we use the instrumental method. Finally, multicollinearity, detected by the condition number, occurs between climatic variables; thus we use a second estimation procedure, Partial Least Squares.

The mean annual temperature has a positive significant effect on the housing price for owner occupiers: a rise of 1 °C entails an increase in housing prices of 5.9–6.2% (according to the equation and estimation method). The sign is also positive for tenants, with values between 2.5 and 3.9%, which are roughly half as much as for owner-occupiers. The effect of warmer summers (mean July temperature minus mean annual temperature) is compounded with the preceding one for single-detached houses: an extra 1 °C entails a price increase of 3.7 to 8.4% (depending on the model). This effect is insignificant for apartments. Hot summer days (more than 30 °C) have a significant effect for owner-occupiers of single-detached houses and renters of apartments. At the median point, an extra day of heat lowers the value of housing by 4.3% (owner-occupiers) or by 1% (tenants). This effect is quadratic, probably due to seaside sites where hot summers are appreciated. French households are insensitive to cold winters, either the January temperature minus the mean annual temperature or the number of coldest days (less than – 5 °C). The number of days' rain in January and July has a significant effect on real-estate values. The January sign is the expected: prices or rents fall by almost 1.2–2.3% for an extra day's rain. The number of days of rainfall in July also exerts a positive effect on the price of apartments (but not on the price of single-detached houses), indicating that households pay more for their housing (1.4 to 4.4%) for an extra summer day's rain.

Rosen S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. J. of

Polit. Economy 82: 34-55.