Urban and real estate economics

Sponsored by a Grant TÁMOP-4.1.2-08/2/A/KMR-2009-0041

Course Material Developed by Department of Economics,
Faculty of Social Sciences, Eötvös Loránd University Budapest (ELTE)
Department of Economics, Eötvös Loránd University Budapest
Institute of Economics, Hungarian Academy of Sciences

Balassi Kiadó, Budapest

ELTE Faculty of Social Sciences, Department of Economics

Urban and real estate economics

Author: Áron Horváth

Supervised by Áron Horváth

June 2011

ELTE ECON

Urban and real estate economics

Week 5

Spatial patterns in cities I

The monocentric city

Áron Horváth

ELTE ECON

Contents

1. Ricardian rent and the monocentric city
2. Testing the monocentric city

1. Ricardian rent and the monocentric city

Ricardian rent

The annual fee for using a flat can be called rent

We suppose that

- The only difference between the flats is their distance from the centre
- The moving per km costs *k* dollars a year
- The households are alike, the same number of people work (or travel) per household
- Those live in the flats for whom it is most worth (in the long run).

Ricardian rent

$$U = U(x) \rightarrow \max$$

$$y = x + k \cdot d + R(d)$$

- R is the rent of the dwelling,
- d is the distance from the center,
- k is the cost of travelling one distance unit
- x is the sum of money spent on consumption.

$$x = y - k \cdot d - R(d) \rightarrow \max$$

$$-k = R'(d)$$

The areas depreciate in k rate.

ELTE ECON

Ricardian rent

The consumption spending equalizes.

If not the demand for places where the consumption is more will increase, which will also increases the rents as long as the consumption in those places decreases as much as in other places.

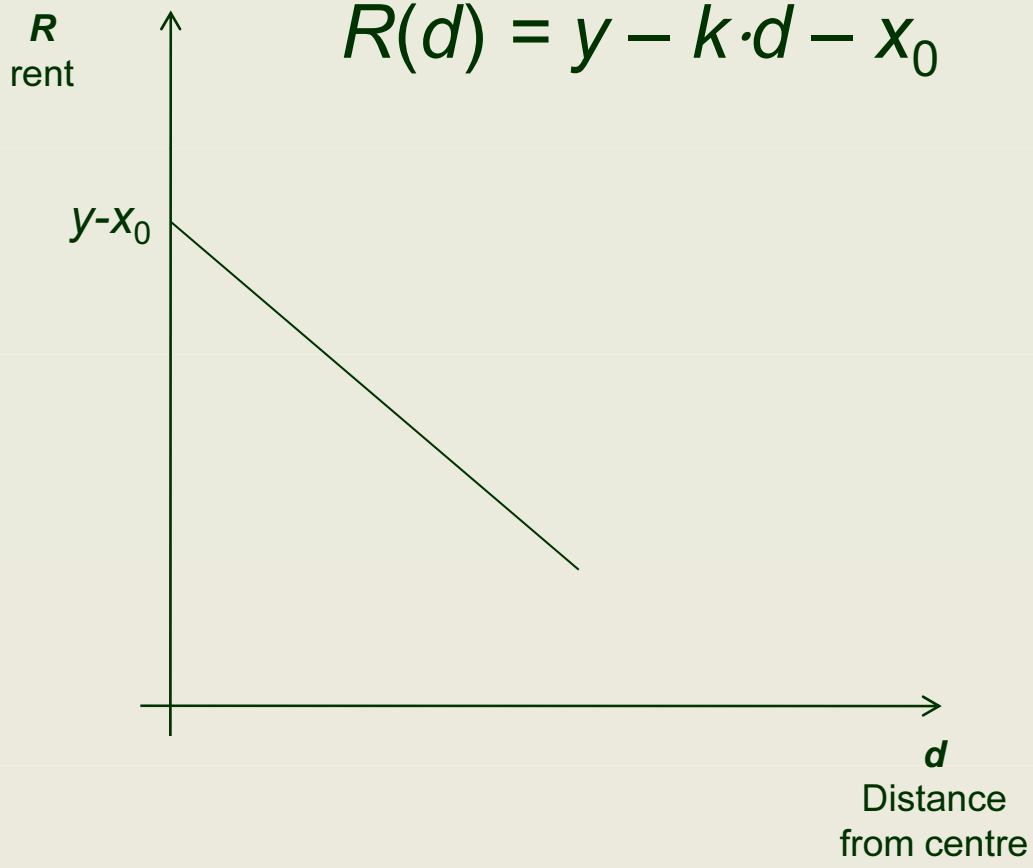
By given x_0 the former coherence define the aggregated demand for dwellings R(d), the so-called bid-rent curve

$$R(d) = y - k \cdot d - x_0$$

ELTE ECON

The bid-rent curve of dwellings

$$R(d) = y - k \cdot d - x_0$$



Ricardian rent

- In some areas different amounts of dwellings are built.
- Extent of building plot per dwelling: *q*. (What does 1/*q mean*?)
- Rent of unit building plot: *r(d).*
- You can get the unit building plot from rent:

$$r(d) \cdot q + c = R(d) = y - k \cdot d - x_0$$

c is the building cost of one dwelling (annual)

ELTE ECON

Ricardian rent

- The absolute value of the area can be defined by fixing one point on the *bid-rent* curve.
- The edge of the city is the reference point because alternative usage is feasible and more accessible building area is available there.
- The rent of the agricultural areas on the edge of the city is r^a.
- b is the distance between the edge of the city and the centre.

Find $r(d)$, the *bid-rent* curve of the building plots!

Find $R(d)$, the *bid-rent* curve of the dwellings!

ELTE ECON

Ricardian rent

- On the edge of the city:

$$r(b) \cdot q + c = r^a \cdot q + c = y - k \cdot b - x_0$$

- The consumption gets evened up:

$$x_0 = y - k \cdot b - r^a \cdot q - c$$

- In the other areas of the city:

$$x_0 = y - k \cdot d - r(\mathrm{d}) \cdot q - c$$

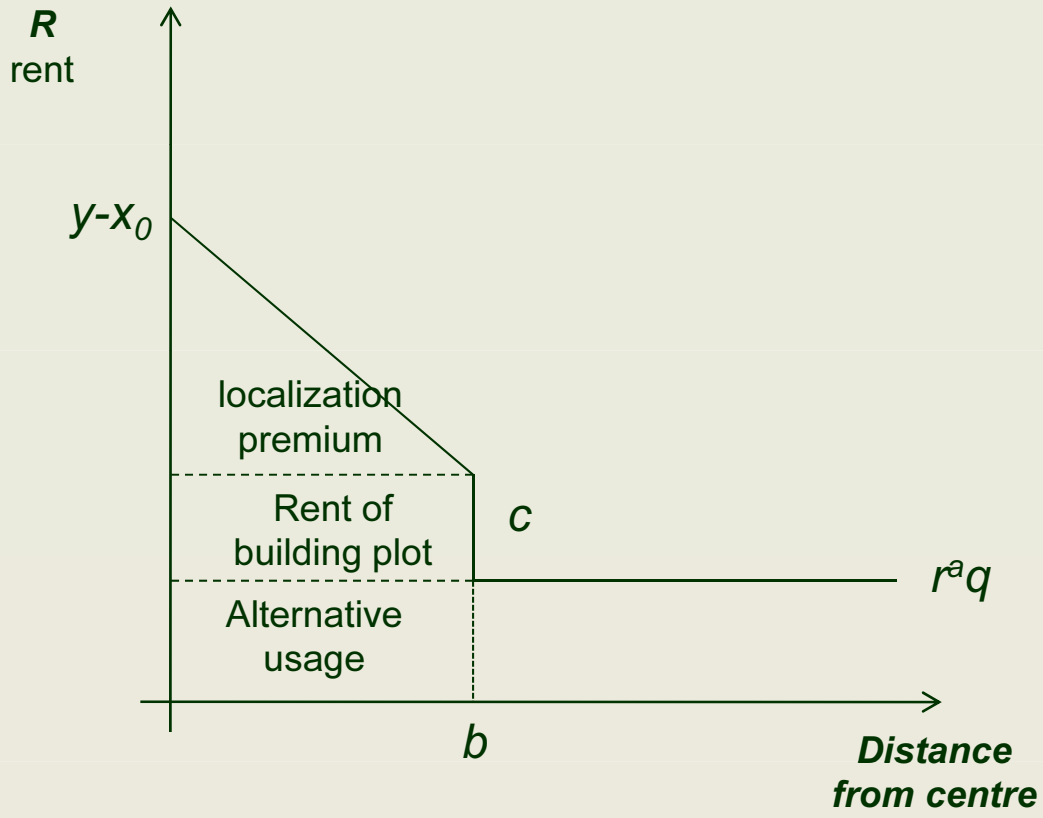
- Joined

$$y - k \cdot b - r^a \cdot q - c = y - k \cdot d - r(\mathrm{d}) \cdot q - c$$

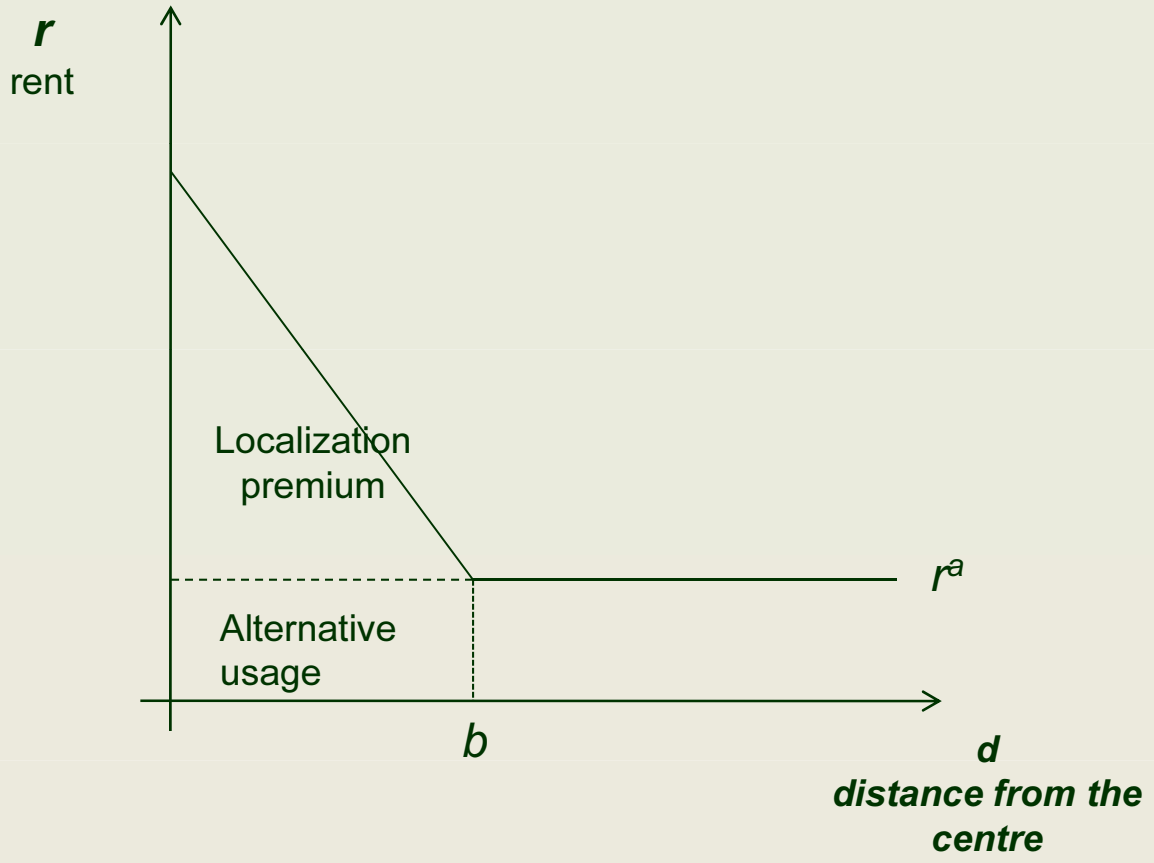
- The rent of one unit of building plot: $r(d) = r^a + \frac{k(b-d)}{q}$

- The rent of the dwelling: $R(d) = r^a q + c + k(b-d)$

The bid-rent curve of dwellings



The bid-rent curve of building plots



Ricardian rent
Comparative statical questions

- How do average flat prices depend on
  - the size of the city?
  - the cost of traffic? (quality?)
  - the demand for non-residential building plots around the city?

- How does the price of building plots depend on the built-up density?

Ricardian rent
Comparative statical consequences

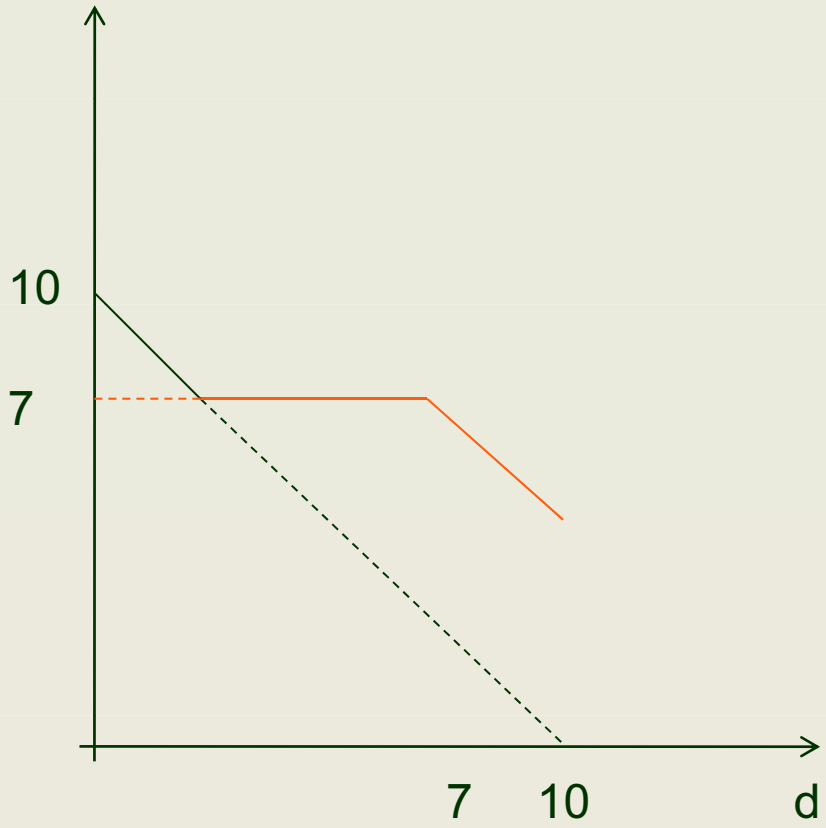
- In bigger cities the price of dwellings is higher because you can save traffic cost by living closer to the centre.
- The more expensive the traffic, the more expensive the dwellings.
- The higher price of alternative usage also makes the dwellings more expensive.
- The higher built-up density raises the price of building plots, because q is lower.

Task

- An industry transports its products by water. The firms have 1400$ revenue per month and the cost of production is 400$. Now the cost of transportation to the dock is 100$/street. With the help of a new technology it will be possible to transport with a fix cost of 300$ if the location of the firm is at most 7 streets away from the dock.
- Draw the demand curve for a firm that uses and for another one that does not use the new technology. Illustrate a distance of 10 streets!
- Where will we find the firms that transport with the new technology? Will anybody still transport by truck?

ELTE ECON

Task: solution



Ricardian rent: size of cities

- If not the city size but the level of consumption is exogenous, we can calculate the city size.
- The consumption gets evened up between the cities:x_0.
- The city-dwellers produce with diminishing returns: $y = z \cdot b^{0,5}$.

Ricardian rent: size of cities

On the edge of cities:

$$x_0 = y - k \cdot b - r^a \cdot q - c$$

Availiable income in cities:

$$y = z \cdot b^{0,5}$$

City size:

$$x_0 = z \cdot b^{0,5} - k \cdot b - r^a \cdot q - c$$

$$0 = k \cdot b - z \cdot b^{0,5} + (r^a \cdot q + c + x_0)$$

ELTE ECON

2. Testing the monocentricity

Ricardian rent: size of cities

- The higher the productivity, the bigger the city size.
- The more expensive the traffic, the smaller the city size.
- The higher the costs of construction, alternative usage and the expected consumption level reduce the city size.

Testing Ricardian rent

$$\ln y_i = \alpha - \beta x_i + u_i$$

Which dependent variable should be used?

- It can be the price of dwelling, the population density, the built-up density.

What shall the specification be?

- They try to fit other curves apart from logarithms: Arnott–McMillen Chapter 8.

Testing the monocentricity

$$\ln y_i = \alpha + \beta_1(x_i - x_0) + \beta_2(x_i - x_0)^2 + \beta_3(x_i - x_0)^3 + \gamma_1(x_i - x_1)^3 D_1 + \gamma_2(x_i - x_2)^3 D_2 + \gamma_3(x_i - x_3)^3 D_3 + \varepsilon_i.$$

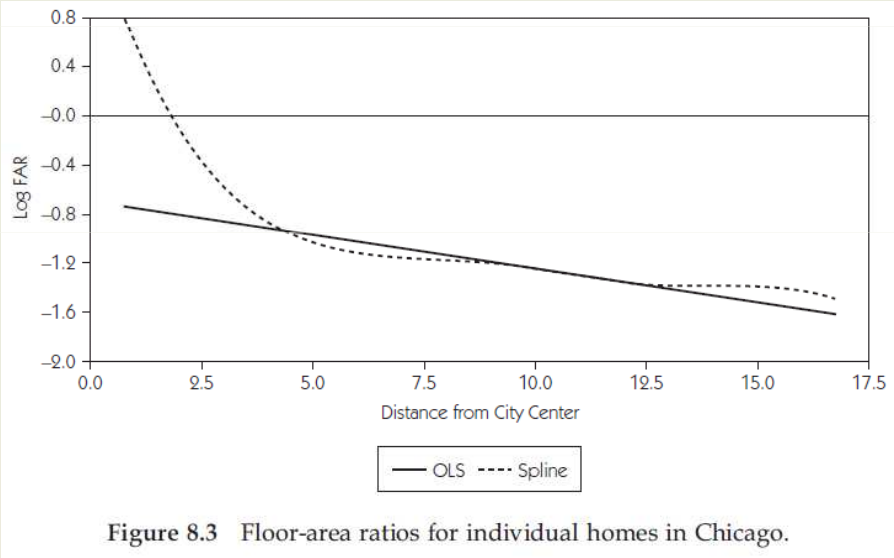


Figure 8.3 Floor-area ratios for individual homes in Chicago.

Table 8.1 Floor-area ratio regressions

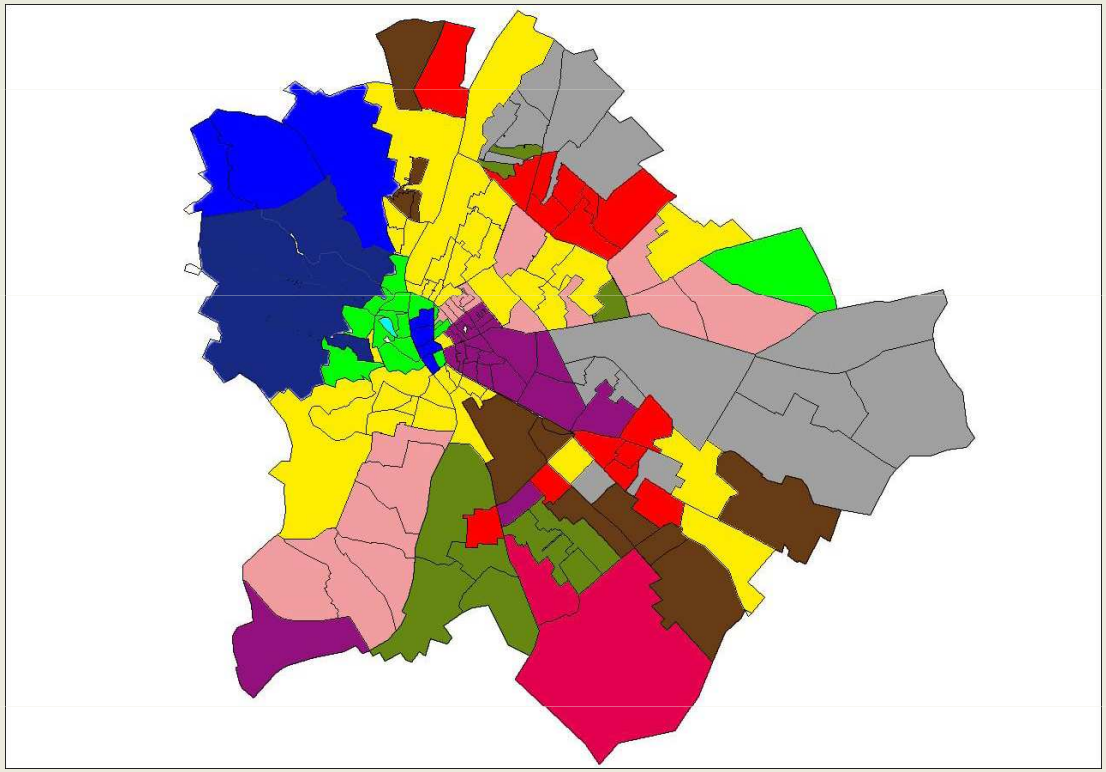
	Chicago homes	*Chicago homes*	*Cook County Census tracts*	*Cook County Census tracts*
Constant	−0.700	0.782	−0.626	0.268
	(268.518)	(34.604)	(35.829)	(4.465)
x	−0.055		−0.055	
	(205.472)		(39.540)	
$x - x_0$		−0.903		−0.490
		(41.215)		(14.099)
$(x - x_0)^2$		0.151		0.061
		(23.229)		(10.427)
$(x - x_0)^3$		−0.009		−0.003
		(15.332)		(9.534)
$(x - x_1)^3 \times (x \geq x_1)$		0.005		0.004
		(6.814)		(8.776)
$(x - x_2)^3 \times (x \geq x_2)$		0.007		−0.001
		(33.797)		(4.367)
$(x - x_3)^3 \times (x \geq x_3)$		0.007		0.001
		(14.510)		(0.773)
R^2	0.151	0.207	0.556	0.692
Number of observations	237,420	237,420	1,251	1,251

Notes: The dependent variable is the natural logarithm of the floor-area ratio. Absolute t-values are in parentheses. The evenly spaced knots for the Chicago spline function begin at $x_0 = 0.780$, with an increment of 4.007 between knots. Comparable values for the Cook County spline function are 0.782 and 8.312.

ELT ECON

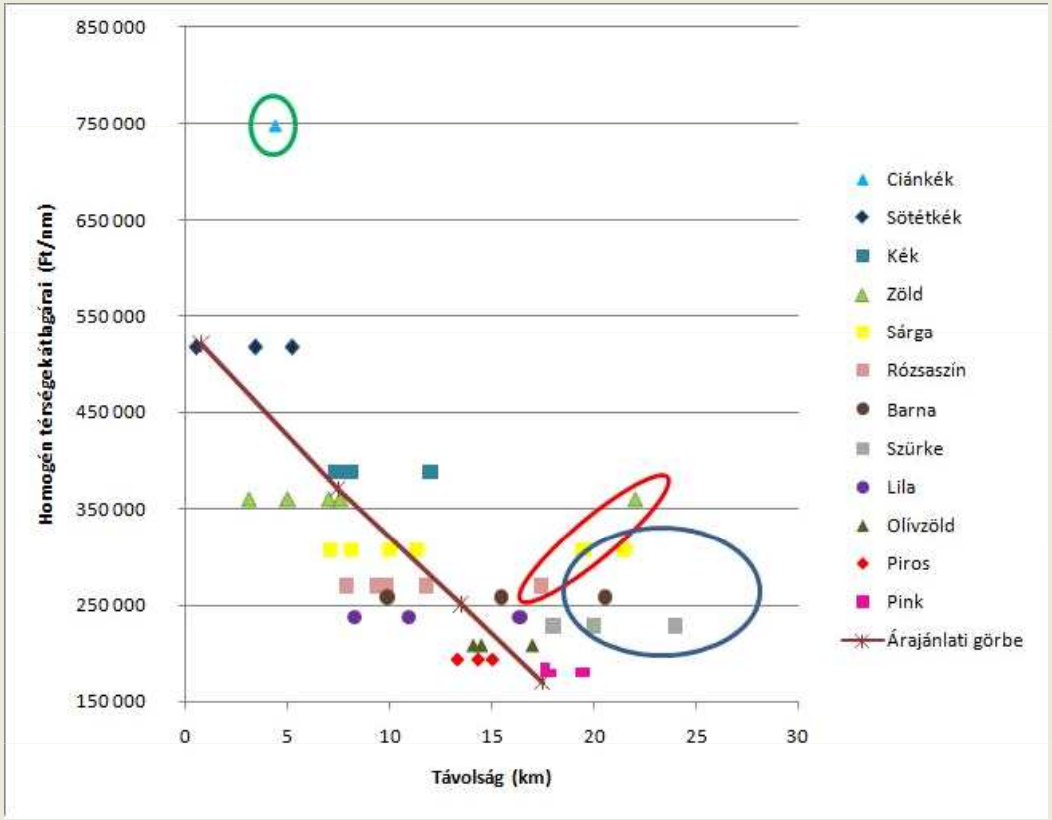
The monocentric Budapest

In his thesis Gergely Éliás analysed the monocentricity on the price of dwellings.



The monocentric Budapest

The figure illustrates the dominance of monocentricity convincingly.



Curriculum

- Denise DiPasquale–William C. Wheaton [1996]: *Urban Economics and Real Estate Markets*. Chapter 3.
- Richard J. Arnott–Daniel P. McMillen (ed.) [2008]: *A Companion to Urban Economics*. Chapter 6., 8.