Price Trends Dynamic Model of Housing Premises Rent

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1. ANNOTATION

Housing premises rent has been big socio-economic and political issue in the Czech Republic for a long time. The calculation model has been changed several times since the year 1994. As a consequence of this was expensive housing premises rent particularly in Prague. A new law concerning one-sided rent increase should bring a clearer concept. The law will be authorized by parliament next year, exactly on 1st March 2006 and will come into force by 1st October 2006. The purpose of the project has been to create a price trends dynamic model of housing premises rent in Czech Republic in this period. The paper has been divided into two parts.

First one includes price trends of rent analysis between the years 1994 and 2005. There are introduced approaches to rent calculations and its values in Prague for various flats categories including rent increases. The second part deals with a dynamic model of rent according to the new law. The calculation model is described in chapter 3.4.

2. KEY WORDS

A law concerning one-sided rent increase
Calculation model
Causal loop diagram
Dynamic model
Housing premises rent
Maximal rent increment
Price trends of rent
Stock and flows diagram

3. PRICE TRENDS OF RENT FROM 1994 UNTIL 2005

The price of housing premises rent calculations were not based on dynamic models and they were derived from only a few factors. The first one was an „inflation“ (Ki), the second one was a „government decision-making coefficient“ (Kr) and the last one was a „city size coefficient“ (Kv). The rent was calculated for four housing categories. Number I. housing category represented the highest standard flats, whereas number IV. housing category represented the worst standard ones. The determination of rent value was not difficult as there was a direct relation among categories. In 1999 a ministerial housing rent regulation was amended and since then price increase has been

influenced by only one factor expressing average change of construction works prices – the so called „construction works price index“ (Ks). The rent has been regulated in such a way until this year.

We can see an example on the following chart where are displayed price trends of housing premises rent in Prague from the year 1994 until the year 2005 for all housing categories.

	YEAR	Coefficients				Increment %	I.cat. CZK/m^2	II.cat. CZK/m^2	III.cat. Kč/m^2	IV.cat. CZK/m^2
		Ks	Ki	Kr	Kv	1994 - 2005				
		Prague				792,52%	792,32%	792,09%	791,32%	792,04%
PRAGUE	1/7/94		-	-	-		6,00	4,50	3,50	2,50
	1/7/95		1,100	1,000	1,190	1,3090	7,85	5,89	4,58	3,27
	1/7/96		1,091	1,040	1,190	1,3502	10,60	7,95	6,18	4,42
	1/7/97		1,088	1,100	1,670	1,9987	21,19	15,89	12,35	8,83
	1/7/98		1,085	1,000	1,300	1,4105	29,89	22,41	17,42	12,45
	1/7/99	1,0930				1,0930	32,67	24,49	19,04	13,61
	1/7/00	1,0490				1,0490	34,27	25,69	19,97	14,28
	1/7/01	1,0400				1,0400	35,64	26,72	20,77	14,85
	1/7/02	1,0999				1,0999	39,20	29,39	22,84	16,33
	1/7/03	1,1000				1,1000	43,12	32,33	25,12	17,96
	1/7/04	1,0501				1,0501	45,28	33,95	26,38	18,86
	1/7/05	1,0499				1,0499	47,54	35,64	27,70	19,80

Figure 1 – ***The chart of price trends of housing premises rent in Prague in years 1994 - 2005***

It is evident from the chart that the rent in Prague has been increased almost up to 793% from the year 1994.

4. PRICE TRENDS OF RENT FROM 2006 UNTIL 2012

The purpose of this second part has been to create a dynamic simulation price trends model of housing premises rent in Czech Republic from 1/10/2006 to 30/9/2012. A model has been created according to new law concerning one-sided rent increase. The law that is to be authorized by parliament on 1/3/2006 will come into effect by 1/10/2006 and will be valid until 31/9/2012

This simulation model was based on Systems Dynamics (SD) methods. PowerSim Studio 2005 was used as modelling software. Systems Dynamics is a science that has been described in a many professional literature [1,2,4,5].

4.1. Identify main variables and constants

Firstly, the main variables and constants have been identified as reference modes of system and its units have been defined. Reference modes represent variable behaviour in time.

On the basis of analysis model have been identified these:

- **Constants:** - Actual value of monthly rent [CZK/m^2]
  - Basic flat price [CZK]
  - Total flat surface [m^2]
- **Variables:** - Basic flat price for 1 square metre of flat surface [CZK]
  - Final value of monthly rent [CZK/m^2]

- Final value / actual value ratio (of monthly rent)
- Annual increment
- Increase coefficient
- Year coefficient
- Coefficient "p" expressing an annual rent share on the basis flat price
- Rent (new value of monthly rent in current year)

4.2. Causal loop diagram

Secondly, a causal loop diagram (CLD) has been designed. CLD is a tool that helps to show causal relationship among a set of variables (or factors) operating in a system. In our case the CLD has been built from the following variables: "Final value of monthly rent", "Proportion final & actual value (of monthly rent)", "Annual (rent) increment" and "Rent" (new value of monthly rent in current year).

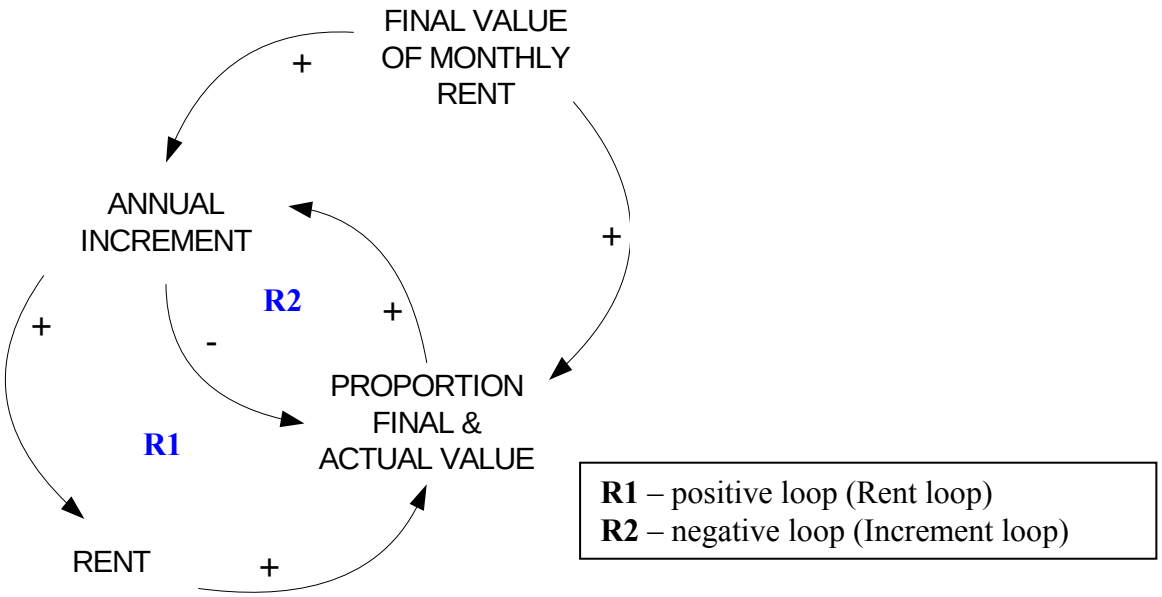

Figure 2 – ***Causal loop diagram***

4.3. Simulation model

A simulation model created in Powersim Studio 2005 is one of the main outcomes of the project. This software uses Stock-flow diagrams as a basic tool for modelling. All identified constants and variables have been used. A graphical software interface has been designed to make the operation of simulation as simple and comfortable as possible.

4.3.1. Setting of input values

Before the simulation runs for the first time it is necessary to set important input values according to instructions in presentation mode. At first, the flat type depending

on its standard and location will be set. The model describes six flat types and each of them sets different input value "p" that is important for calculation of final value of monthly rent. These six types of flats are "low-quality flats that are located in Prague 1 area", "low-quality flats that are located in Prague 2 area", "all other low-quality flats", "all other flats that are located in Prague 1 area", "all other flats that are located in Prague 2 area" and finally "all other flats". Low – quality flat means flat without central heating and with shared basic accessories or flat without central heating and without basic accessories or finally flat with central heating but without basic accessories.

Next, another three input factors such as "Total flat surface" in m^2, "Basic house price" and "Actual monthly rent value" will be set. A total flat surface means flooring surfaces summation of all rooms in the flat and its accessories, and also out of flat if they are used purely by the flat's renter. Floor surface of cellars that are not lodging-rooms, and flooring surface of balconies, loggie, terraces is calculated for only one half a flooring surface. A basic flat price is net value of the flat specified in a contract or by expert's report.

4.3.2. Initiation of simulation

Having set all the input values we can finally run the simulation in presentation mode.

For demonstration purpose, there is an example on the screenshot below this text. It is a case of a low-quality flat rent calculation that is located in Prague 2 area. Total flat surface is 79 square metres, basic flat price is 2,455.600 CZK and actual monthly rent is 78 CZK for squared metre. A chart presenting most important simulation results is placed at the bottom of the screenshot. (e.g. such as "Maximal monthly rent value" and "Maximal monthly increment" in particular years always on 30th September).

The simulation shows that maximum monthly rent value depends mainly on input values and does not increase as a rule.

In Powersim Studio 2005 presentation mode, the model can also be viewed in Stock-Flow diagram form. For this purpose a hyperlink "Go to Model" has been placed at the upper right corner of the graphical interface. In order to return a hyperlink "Back" has been placed under the diagram at the lower right corner. The screenshot of the model is placed below the screenshot from simulation set-up (see page no. 6)

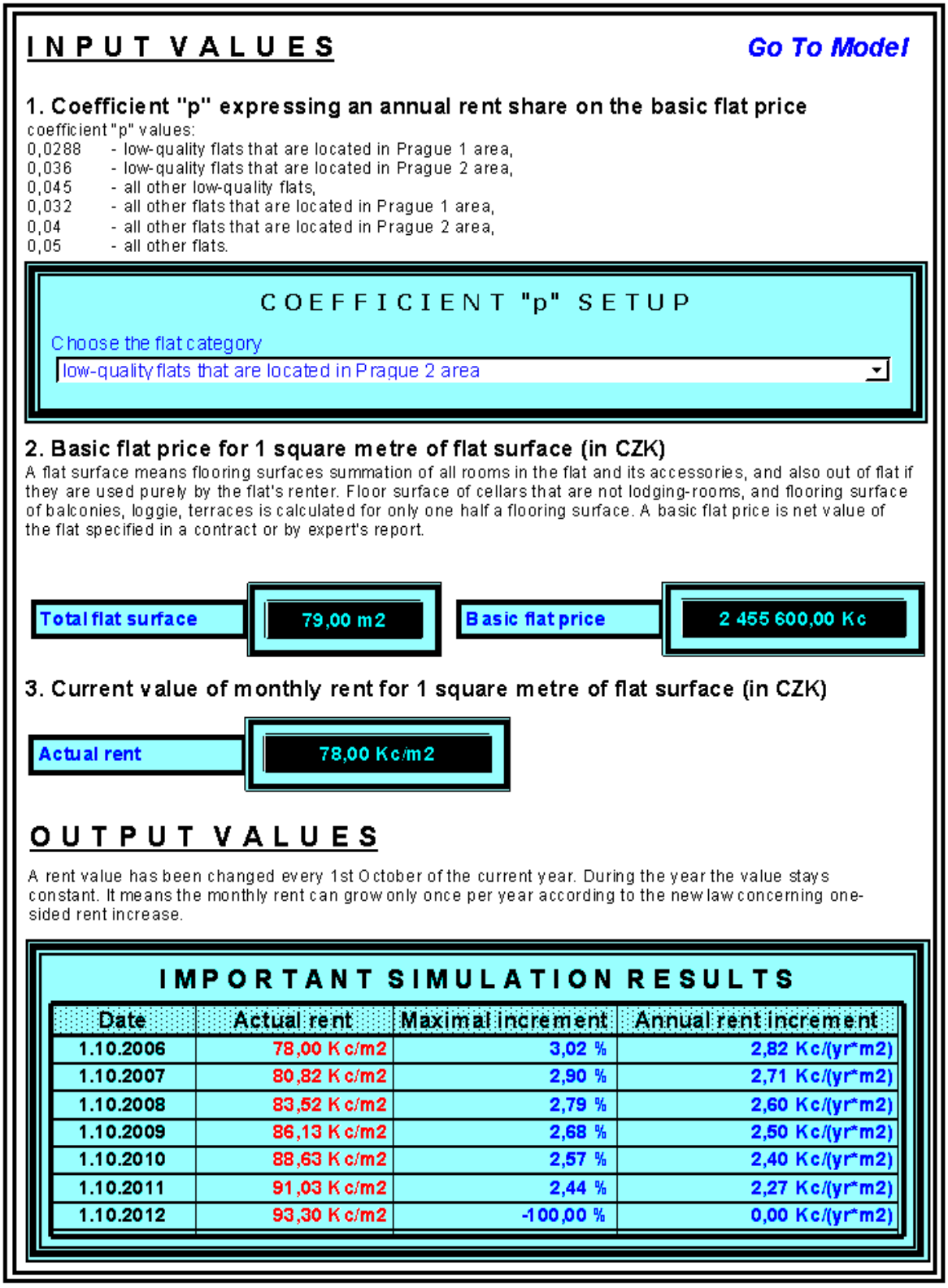

Figure 3 – ***Screenshot from the simulation set-up***

Next screenshot shows a model in a form of Stocks and Flows diagram that forms the basis for the whole simulation.

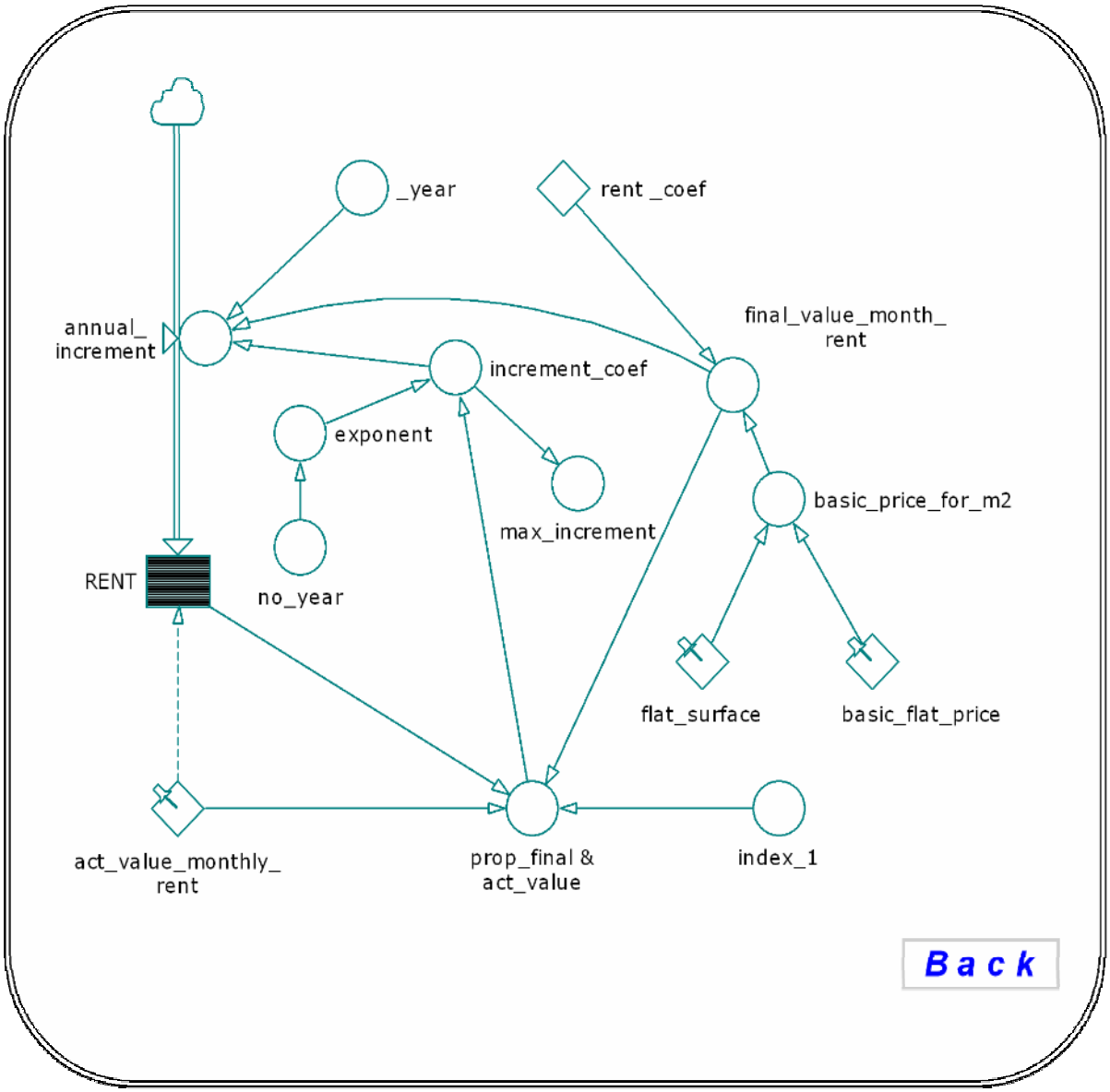

Figure 4 – *Model – Stock & Flows Diagram*

4.4. Analysis model according to new law

In conclusion there is state a process of rent calculation according to law and its maximal increments in this chapter.

The final value of monthly rent for 1 square metre of the flooring surface is calculated by the following formula:

$$\mathbf{CN = 1/12 * p * ZC,}$$

where:

CN is a final value of monthly rent for 1 square metre of the flat surface,
ZC is a basic price for 1 square metre of the flat surface,
p is coefficient expressing an annual rent share on the basis flat price;
p values:

a) $p = 0{,}0288$ - low-quality flats that are located in Prague 1 area,
b) $p = 0{,}036$ - low-quality flats that are located in Prague 2 area,
c) $p = 0{,}045$ - all other low-quality flats,
d) $p = 0{,}032$ - all other flats that are located in Prague 1 area,
e) $p = 0{,}04$ - all other flats that are located in Prague 2 area,
f) $p = 0{,}05$ - all other flats.

Maximal increment of monthly rent calculates by the following formula:

$$\mathbf{MP} = (\sqrt[6-k+1]{CN/AN} - 1) * 100\,\mathbf{,}$$

where:
MP is a maximal increment of monthly rent in %,
CN is a final value of monthly rent for 1 square metre of the flat surface in CZK/m^2,
AN is an actual value of monthly rent for 1 square metre of the flat surface in CZK/m^2,
k is sequential number of year:

k = 1	for period	1/10/2006 – 30/9/2007
k = 2	for period	1/10/2007 – 30/9/2008
k = 3	for period	1/10/2008 – 30/9/2009
k = 4	for period	1/10/2009 – 30/9/2010
k = 5	for period	1/10/2010 – 30/9/2011
k = 6	for period	1/10/2011 – 30/9/2012

Note: For more information about new law see parliament websites (www.psp.cz), article no. 1059/0 [9]. There is a full statute at large with all details and supplements.

5. CONCLUSION

This work outlined how we may use SD methods in the field of housing construction. It is just a small sample of that SD may really have usage in any branch where we identify feedback. The needs of the market and the building growth (not only in housing) cause that the modelling of dynamic systems appears as a very helpful tool for decision making and there is a good offer of wide field for using the simulation based on SD principles.

I am responsible to give a short notice herein. The model is just demonstration of SD utilization in this field of work and should provide a clue for many scientists or

researchers from all over the world. The model is available at large for extension and there are many others market and macroeconomic aspects (such as "construction works price index" - Ks), which can affect the behaviour of the model.

One more of the SD utilization in the building industry has been also included in my doctoral dissertation. I have decided to solve a dynamic simulation model of housing construction in Prague (Czech Republic) depending on evolution of population and urban undeveloped area. The project should model the situations up to the year 2050. This simulation will be based on statistic data and data from long-term evolution of population published by Czech Statistical Office and also data from the conception of housing policy authorized by parliament of Czech Republic. This project should present trends in housing construction, how the city will be developed in population question and finally for example how many flats will need to be completed in current year (a flat means also flat from family house). A final model should be universal it means applicable for any other town or area that has determinate its borders. It is one of the targets of the project.

Figure list:

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[9] Parlament České Republiky ČR: URL: < www.psp.cz >, *article no. 1059/0*

Used software:

- Powersim Studio 2005
- MS Office 2003
- FinePrint v5.46cze