

## The Model for Evaluation of Mortgage Affordability

### Overview

The proposed model is designed as an instrument of evaluation of the capacity of credit products to make housing more affordable for various household groups. The housing affordability is defined as the capacity of a household to buy a specific housing unit (so-called target house) with (or without) a mortgage loan within a fixed period of time. The model considers three target dwellings (see Block 3 for more details) to control for differences in housing market.

Two major estimates of credit product capacity are produced in the model: maximum capacity of mortgage product and potential demand for mortgages and housing. Maximum capacity of mortgage product is defined on the basis of conditions and underwriting standards of mortgage products and main characteristics of household. This indicator reflects only the possibility of household to apply for a mortgage loan and does not count the possibility of household to buy any dwellings.



The potential demand for mortgages and housing considers the ability of households to buy target dwellings. According to this definition, the maximum capacity of mortgage product will be always larger than the potential demand for mortgages since many of households will not be able to buy any target dwelling. Even if household can afford a target dwelling, it still could be out of market since trade-up could decrease its living conditions. To control for such situation the household will be considered as a potential mover only if it is able to increase its living conditions. The increase in living conditions is defined as a percentage increase in dwelling value which should be at least 25%.

The present demand for mortgages will be definitely lower than the potential demand because many households that are able to purchase any of target dwelling will not buy it right now.

The most difficult things to deal with are the estimation of household intention to move and its desire to sell dwelling in order to improve living conditions.

In theory, if household does not have any intention to move, it will be out of market. In practice, only few surveys contains such data<sup>1</sup>, so it is assumed in the model that by default that all households have intention to move<sup>2</sup>.

The household decision to sell dwelling depends on many factors, such as household size and composition, preferences, availability to buy larger unit and others. The model suggests dividing all households into 3 groups:

-  renters, who does not own any dwelling and lives in rented apartment
-  splitters, large families, who owns a dwelling and definitely wants to improve living conditions and could sell or not owned dwelling. For instance, the household, consisted of parents, their son and his wife, could probably want to split and begin to live separately. It means that such household will be looking for an additional unit. On the other hand, they may decide not to split and continue to live together. So, they will be looking for a dwelling with more space and finance purchase by selling owned unit.

<sup>1</sup> For example, latest household survey in Hungary, conducted in 2003, has such question, but the survey was specially designed to be a source of the data for this project.

<sup>2</sup> In Russia, for instance, households opinion polls showed that more than 80% of all households are not satisfied with their living conditions. ("Trud" daily, 10/09/2002).

🏠 movers, who are interested in making trade-up, i.e. who wants to finance new purchase by selling owned dwelling. Other words, such households will prefer to move to better dwelling. Probably, it will be households that for any reasons do not want to split and to live separately.

The model will estimate the maximum capacity of loans, potential demand for mortgages and housing for 2 cases.

First case (“new purchase”) deals with the households who want to buy an additional unit (i.e. renters and splitters). The estimates will show the ability of such specific group of households, who has limited savings and no equity to sell, to increase their living conditions.

Other case (“trade-up”) estimates the total potential demand for mortgages and housing for all households (renters, splitters and movers), assuming that splitters will finance new purchase by selling owned unit. Other words, we assume that everyone who owned a dwelling will sell it to finance a purchase of new one. The estimates will illustrate the potential ability of all household to improve living conditions.

The model is static in nature because it covers only one time period. For example, the size of a mortgage loan, which in fact hinges on possible future incomes of a household, is evaluated only on the basis of current household income<sup>3</sup>. As a result the model ignores the risk of possible future insolvency of a household when calculating the maximum affordable size of a loan, which in fact just reflects the current income status of a household and the size of a downpayment it is supposed to make.

The model uses a broad selection of variables<sup>4</sup>, which makes it possible to examine various instruments of mortgage lending including subsidizing of downpayments and/or interest rates. To put it differently, the model is very helpful when there is a need to evaluate the market advantages of various forms of subsidizing and distinguish most affordable lending instruments and terms.

The model uses the current housing prices as one of input variables. It is not obvious that the potential demand predicted by the model will not influence the prices. In event of material increase in the housing demand prices will most likely boost, that means time will be needed to increase the supply to an adequate level. Slow response of the housing supply does not permit the market to reach the balance, which subsequently implies the relative price volatility. The price increase will apparently deteriorate the housing affordability.

The model is static and therefore is unable to deal with consequences of price increases. Moreover, the model is unable to show the size of the housing demand at a specific point of time. The model just demonstrates the aggregate demand for housing without time differentiation

The simulations could be of the impact of a real housing price increase of 15 or 20% on the affordability calculations. This would be the upper limit of the price increase for sure because the volume of mortgage financing will for the foreseeable future be quite modest.

The proposed model may be extended either by adding extra variables of mortgage lending or exposing it to the time factor. The use of the time factor is associated with some difficulties, the most important of which is the difficulty of accurate prediction of changes in the income status of a specific household. The discussion of this problem falls outside the scope of this paper and requires a special research.

### ***Features of the Model***

The model is used to evaluate the capacity of credit products to improve the affordability of housing for various household groups. Below is the description of the key features of the model.

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<sup>3</sup> This assumption does not seem to be realistic, but beneficial for the model formalizing.

<sup>4</sup> See Appendix 3 for a more detailed description of loan product standards.

- ✚ *Maximum capacity for loans and potential demand for loan and housing estimation* in total and for specific groups of housing units.
- ✚ *Static nature of the model.* The model evaluates only the household's capacity to make a downpayment.
- ✚ *Option to use various sources of data.* Alongside with official statistics the model may also use expert opinions (for example, in view of lacking statistics on household savings it is assumed that savings of households are pro rata their incomes).
- ✚ *Facility in changing input data files.* The input data is grouped into three independent files: household specifications, estimated value of dwellings occupied by households, and target house indicators.
- ✚ *Flexibility in describing mortgage lending programs.* 23 criteria used to create a mortgage product profile make easy the description of any product available.
- ✚ *Accounting of the household's motivation to sell the occupied dwelling..* The model takes into account various factors affecting the household's motivation to sell the occupied dwelling in order to buy a new better one. These factors include the feasibility of sale as it is (if there is no dwelling, nothing is to sell), the size of a household (large families or multigeneration households usually have a greater motivation to purchase an extra dwelling).
- ✚ *Accounting of various types of payments made in the course of execution of loan and housing purchase documents.* The model takes into account the need to make payments to cover the following costs: loan execution costs, costs of property appraisal services, costs of real broker services, costs of notary certification, costs of state registration, transaction tax.
- ✚ *Accounting of a borrower's credit history.* Banks do not perform underwriting of households that have various types of debts and arrears.
- ✚ *Facility in adding and/or changing resultant indicators.* The simple program code and the option to save interim estimations as a separate file make easy the process of adding or correcting of resultant indicators.
- ✚ *A user-friendly interface suggesting flexible customization tools.* The user may choose the location of the program and storage areas for data files and estimates.
- ✚ *Option to select between two methods of assessment of the household creditworthiness:* either by estimating the share of loan payments in the total household income, or using the concept of minimization of other types of household expenses..
- ✚ *Option to compare results of the use of various mortgage products.* All estimates are recorded as one file, the structure of which permits conducting a comparative analysis.
- ✚ *Evaluation of various programs of home purchase subsidizing.* The model suggests evaluation of three modes of subsidizing: subsidizing of the interest rate and subsidizing of the downpayment (either in a fixed amount, or as a percentage of the home purchase price). The model uses instruments of the cost-benefit analysis for evaluation of subsidizing programs.
- ✚ *Option to export evaluation results into most formats available.*

## ***Structure of the Model***

The model has 5 blocks, 3 of which constitute the core of the model (in Fig. 1 it is dotted):

- ✚ Block 1. Housing unit price estimation (optional)

- ✚ Block 2. The mortgage model
- ✚ Block 3. “Target house” analysis
- ✚ Block 4. Housing affordability analysis
- ✚ Block 5. Cost-benefit analysis of subsidies

Fig. 1 shows the structure of the model. The model is implemented by blocks in accordance with their consecutive order when findings of the previous block serve as an input data for the next block.

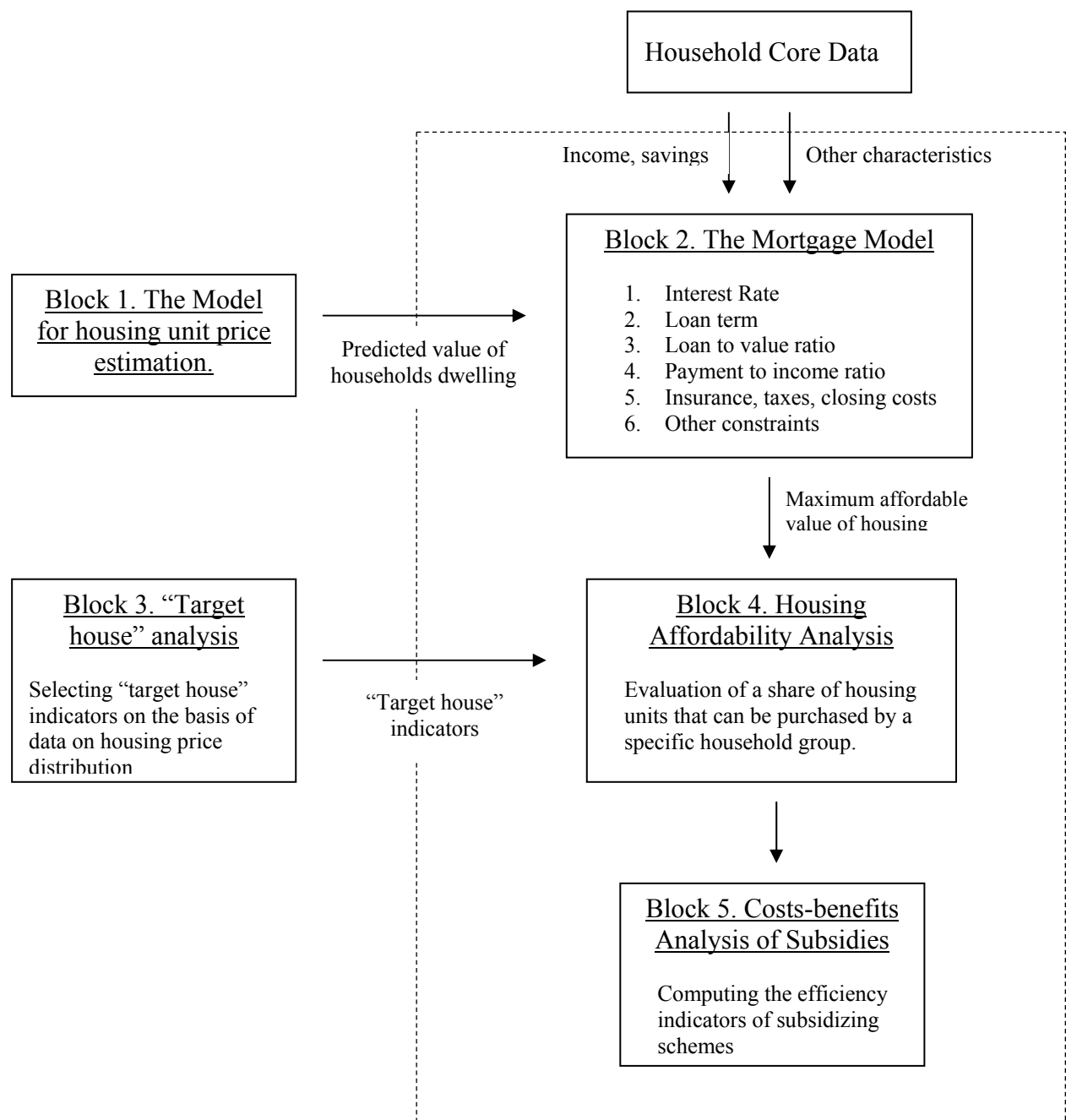


Fig. 1. Structure of the Model




**Block 1. Housing unit price estimation (optional)**

Some schemes of mortgage finance cannot be computed without housing price data. This block of the model is optional since it is only used where there are no statistics on dwelling prices. Because our main dataset lacks price information the model is extended to include the determination of this indicator by way of an econometric analysis that used a second data set that includes unit price. If the housing price data for the currently occupied unit is available for each current owner-occupant included the data set employed in the analysis, this block of the model may be ignored otherwise, if some recent data on dwelling prices in area exists, it is suggested to predict the prices basing on econometric model:

$$V_i = f(c, X_i) + \varepsilon_i$$

where  $V_i$  - dwelling price,  $c$  – constant,  $X_i$  - vector of dwelling characteristics,  $\varepsilon_i$  - error term.

The functional form  $f$  of the regression will be chosen by the following criteria:

-  Statistical quality of results
-  Good interpretation of estimated coefficients
-  Good forecasting properties of the model

For each household, which owns a dwelling, the housing unit price will be determined as:

$$\tilde{V}_i = \tilde{f}(c, X_i)$$

where  $\tilde{V}_i$  - predicted dwelling unit price for household  $i$ ,

$\tilde{f}$  - estimated functional form of regression

Appendix 7 demonstrates the procedure of dwelling prices estimation in Moscow, based on this model.

## ***Block 2. The Mortgage Model***

The Mortgage Model computes the maximum house price for which buyers can qualify based on household financial characteristics. By using loan terms required by a specific mortgage product and statistics on household profiles the Mortgage Model will determine the size of a maximum loan affordable for each household profile. The size of maximum affordable loan is determined on the basis of standard annuity formula (assuming fixed, non-changeable interest rate since the model is static). Bearing in mind the static nature of the model, it is important to understand that the maximum affordable size of a loan determined in such manner is related only to current household incomes and is not adjusted to the risk of possible future insolvency of a household.

It is implicitly suggested that everyone household is interested in applying for mortgage with maximum size they can afford.

The model determines the maximum affordable size of a loan by using the following variables:<sup>5</sup>

1. Interest rate
2. Time to maturity
3. *Loan size limits*<sup>6</sup>
4. Max loan to value ratio
5. Max mortgage payments to net income ratio

<sup>5</sup> See Appendix 2 for detailed description of the variables, Appendix 3 – for detailed description of mortgage products, and Appendix 4 – for detailed description of correlations.

<sup>6</sup> Variables in italic are optional, i. e. are left at users' option to use or not to use them.




6. Transaction costs: closing costs including cost of processing of a loan application, cost of appraisal of a dwelling that a household is going to purchase, cost of broker's, notary's and state registration services
7. Property and life insurance payments
8. *Borrower's and co-borrower's age limits*
9. *Credit history*
10. Minimum value gap, i. e. the minimum gap between the value of a purchased dwelling and the value of an existing dwelling, which demonstrates the likelihood of the household's move to a new home. Large gaps are assumed to indicate a greater gain from moving.
11. *Downpayment and/or interest rate subsidy and its characteristics.*

The Mortgage Model may be also used for evaluation of complementary indicators of the market capacity for each mortgage product, for example, an indicator showing the aggregate value of housing that households may purchase by using a selected mortgage product.

### **Block 3. “Target house” analysis**

To understand what type of housing is affordable for a specific household it is necessary to determine the value of a housing unit a household would like to purchase (the so called “target house”). The model suggests using more than one “target house” indicators<sup>7</sup>.

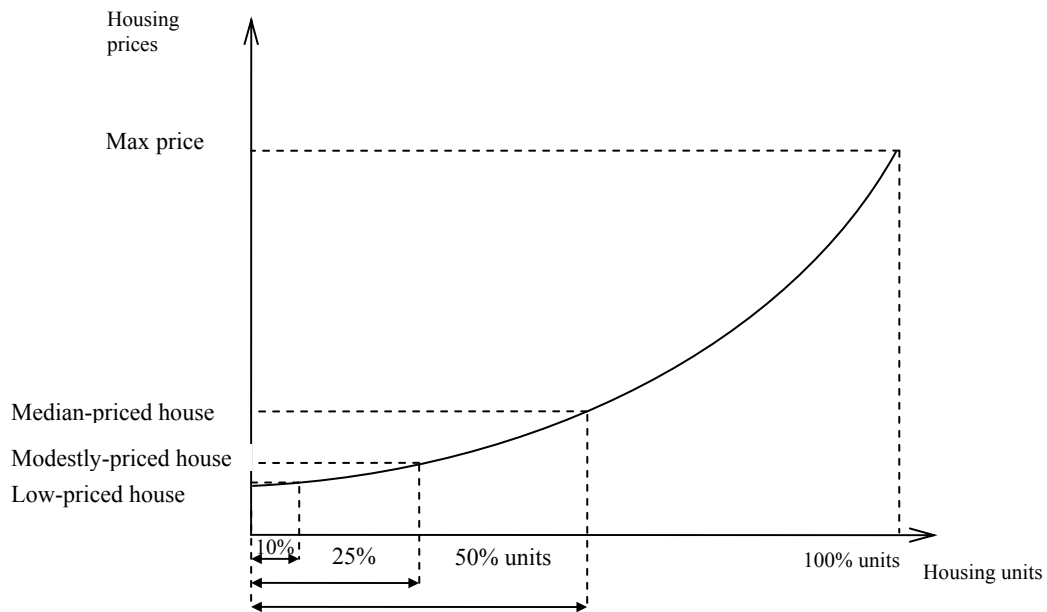
The purpose of this block is to determine target house prices, without which the evaluation of housing affordability is impossible. For the purposes of this model the following units are treated as “target house”:

-  median-priced house (50% point of the housing price distribution line)
-  modestly-priced house (25% point of the housing price distribution line)
-  low-priced house (10% point of the housing price distribution line)

Target house indicators may be either determined by the user himself, or used as an input data (for example, when it is provided by real estate brokers), as the case may be.

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<sup>7</sup> Several analytics (for example, Listokin, et al., 2002) assume that the type of “target house” relies on the household's preferences. This assumption appears to be rather realistic, but its practical testing is difficult because it can be made only on the basis of large and detailed database on real estate transactions. Therefore, the proposed model will use only target house indicators that are common for all types of households.

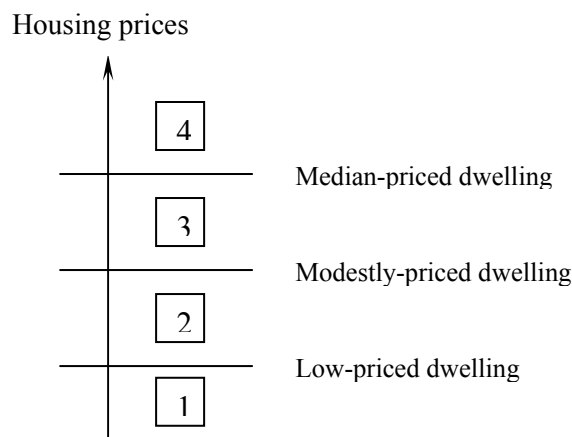


*Fig. 2. Price distribution of housing units*

#### **Block 4. Housing affordability analysis**

Under this block the findings about the maximum affordable value of housing obtained in the second block will be compared with several “target house” indicators, obtained in block 3, in order to classify the household by the level of its affordability into four brackets (see Fig. 3):

1. Households that cannot afford a low-priced house
2. Households that can afford a low-priced house, but cannot afford a modestly-priced house
3. Households that can afford a modestly-priced house, but cannot afford a median-priced house
4. Households that can afford a median-priced house



*Fig. 3. Types of households*

Some characteristics of households in each bracket, like income range, are calculated. It is very easy to extend or modified the output indicators since they are basing on main result – the classification of households into brackets.

#### ***Block 5. Cost-benefit analysis of subsidies***

This block is designed to carry out an additional analysis of mortgage products suggesting the payment of subsidies at the expense of budgetary resources. Subsidies can be provided for making a downpayment (a lump-sum grant or a percentage of the purchase price of a dwelling) or for decreasing interest rate (interest rate subsidy) or both.

The purpose of this block is to estimate indicators of costs and benefits of subsidizing of borrowers. When interest-rate subsidies are evaluated it is suggested to make additional calculations of an amount of resources needed to cover the whole period of subsidizing. This indicator is estimated in the base year terms with an assumption that the market interest and discounting rates remain unchanged.

Benefits of subsidizing are evaluated by way of determining the number of households for whom the purchase of a better or extra home has become affordable. A particular emphasis is placed on the analysis of the aptitude of subsidies to make housing more affordable for low-income households (30% households with lowest income).

#### ***Data used***

In developing or transitional economies the official statistics may not always be used as a reliable and easily accessible source of information about the true state of facts. This factor considered, the model was designed so that to permit using a variety of data sources.

The model suggests using available official statistics collected by way of conducting household surveys. A household survey typically collects the following data about households: net aggregate income of a household, the size of a household, the age of the household head, and the amount of household savings. Additionally, a set of variables is determined to study the household motivation and capacity to improve housing conditions with simultaneous sale of an occupied dwelling.

Evaluators of subsidizing programs may also use supplementary household data, if needed (for example, such data as the number of minors in a household, the age of spouses, etc.)

Biased estimators are one of the most common problems that analytics meet when using household survey statistics: in the course of the survey it is rather difficult to identify and interview households with very low and very high incomes. Particularly serious this problem is when hidden incomes of respondents turn out to be rather sizeable. One more problem lies in the fact that during



interviews respondents are inclined to misrepresentation, because, first, they are not held liable for this, and, second, they beware of the risk of disclosure of confidential information and employment of survey results for illegal purposes.

Therefore, there is a general opinion that household survey statistics should be interpreted with care and subject, if possible, to the data quality checking. One of the ways of removing the problem of misrepresentation is the use of weights permitting to expand survey results over the total population. However, there is one difficulty in implementation of this method: that is the accurate selection of weights.

The evaluation of affordability of housing mortgages is impossible without definition of target house prices for crosschecking the household capacities to pay them. The housing price statistics may be obtained from various sources including national statistical surveys. For this model it is sufficient just to define target house prices rather than the total price distribution of housing.

A more detailed specification of data presentation standards that the model requires to observe is provided in Annex 2.

### ***Technical specification and system requirements***

The model is designed to work under SPSS 11.0, so it is required to have this software installed. The reasons for choosing SPSS are following:

- ✚ SPSS is designed specially for statistics and econometrics;
- ✚ SPSS provides more powerful tools for data processing and programming;
- ✚ Almost all large databases are stored in SPSS format (e.g. data of Moscow State Statistics Committee, RLMS);
- ✚ All results can be easily transferred from SPSS to anywhere.

System requirements of the program are dictated by the SPSS software parameters. The program size is less 1 Mb not including files with databases and resulting indicators.