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**Title of paper:**

“The Quantification of Social Benefit derived from Housing Financing:  
An Application to the Needs of Young Home Buyers in Madrid”.

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**Abstract:**

The paper presents a methodology to quantify the increase in social benefit to be derived through the use of various home financing systems as well as the changes in social benefit caused by changes in the terms and conditions of housing financing.

The social benefit will increase as the social price decreases. It is a benefit of a subjective nature. It is this subjectivity, which we are trying to quantify, in order to be able to rank the greater or lesser social well-being derived.

The methodology is tested using data on the needs of young people for housing in the province of Madrid (Spain). The results obtained indicate that the methodology is a good tool to assist in decision making in the area of housing policy and to help governments reduce expenditure in this area.

**Key words:**

Social benefit, consumer surplus, financing, housing, quantification, methodology, young home buyers.

## 1. THE THEORY

Most Spanish people want to live in a house which they own. However, when they start setting up a home they cannot pay for one in cash because it is beyond their financial means. As a result they must resort to some sort of financing to make their initial purchase.

We can safely say that for the vast majority of people the purchase of the housing good is only possible thanks to financing. Now we would like to know to what extent a specific measure contributes to easing the problem of access to housing and how to place a social value to society on the possibility of having the resource “*housing financing*”.

The social valuation of the resource “*housing financing*” is perceived by the home buyer as equivalent to the possibility of acquiring housing by paying in cash, since it allows him to purchase a home, by adjusting the purchase to his level of income and his possibilities of repaying the loan.

In this situation the price for the buyer becomes:

$$\text{PRICE} = \text{DOWNPAYMENT} + \text{DEFERRED PAYMENTS (LOAN)} \quad \text{Equation (1)}$$

The market price of a house with deferred payments can be written in mathematical terms as follows:

$$\text{PRICE} = \text{DOWN PAYMENT} + P / (1+t) + P / (1+t)^2 + \dots + P / (1+t)^x \quad \text{Equation (2)}$$

We might call the second part of this equation the “*social price of housing*” and this quantity is undervalued by individuals. In other words, there exists a component of *financial illusion* that makes people perceive the cost of the home - when part of the payment has been deferred – to be less than the real cost and which allows them to accede to owner occupied housing through borrowing. From a social point of view, and therefore from a subjective viewpoint, the previous equation transforms in collective terms into an inequality since the valuation of the left side of the equation (price) is perceived by buyers to be greater than the right side (down payment + loan):

$$\text{PRICE} > \text{DOWN PAYMENT} + \sum P / (1+t)^n \quad \text{Equation (3)}$$

From Equation (3) it is clear that the price of the housing is not the same for all individuals. The value of the social price will depend on the financing conditions for each case, and basically on the following factors: the principal of the loan, the rate of interest, the term of the loan and the system of amortization.

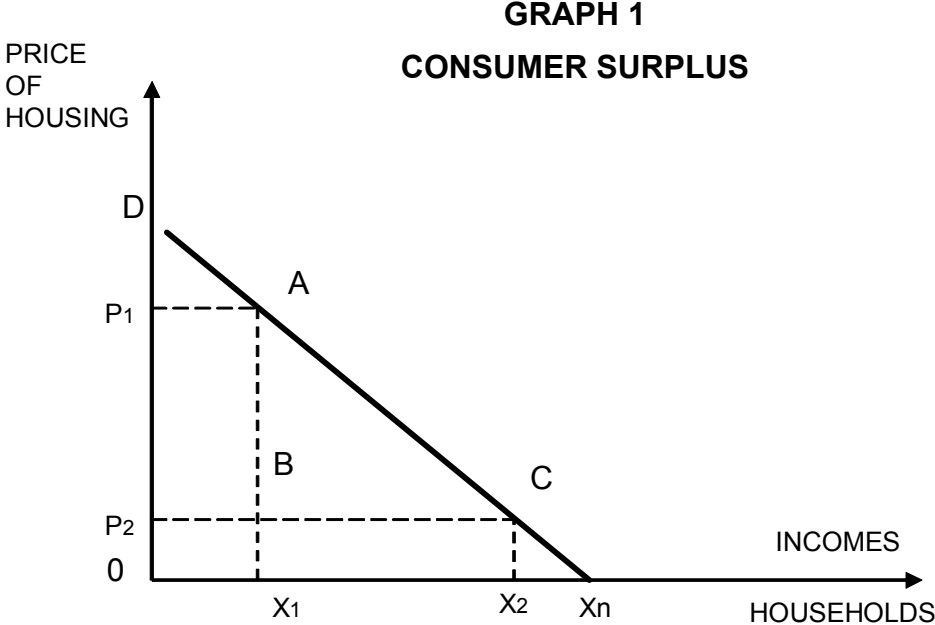
The social benefit will increase as the social price decreases. It is a benefit of a "subjective" nature. It is this subjectivity, which we are trying to quantify, in order to be able to rank the greater or lesser social well-being derived.

Social benefit is a concept with somewhat imprecise borders. It can be said, in a general way, that the social benefit is that which raises the well-being of society (Azqueta 1985: 58). We are not speaking about benefits to the society as a whole, but about a benefit of a "social type". That is to say a benefit that affects people in specific groups in the society which are being assisted.

The increase in consumer surplus is a good measure of the change of well-being, if it is defined with reference to a level of constant utility (Albi et al. 2004: 274). The concept "*increase in consumer surplus*" can be a way to measure the contribution of housing financing to the increase of the well-being of a society through facilitating the provision of this good considered preferential.

The consumer surplus is defined as the difference between the price that the consumer is prepared to pay to purchase a good and the price that he actually pays to purchase it (Albi et al, 2004: 272).

If we considered the relationship between the price of a good and the demand for it as a linear function of the type  $p = a + bx$ , it can be represented graphically as demand curve for housing with the price "p" as the dependent variable and the number of housing units "x" as the independent variable.



Source Albi et al. (2004: 273) and the author.

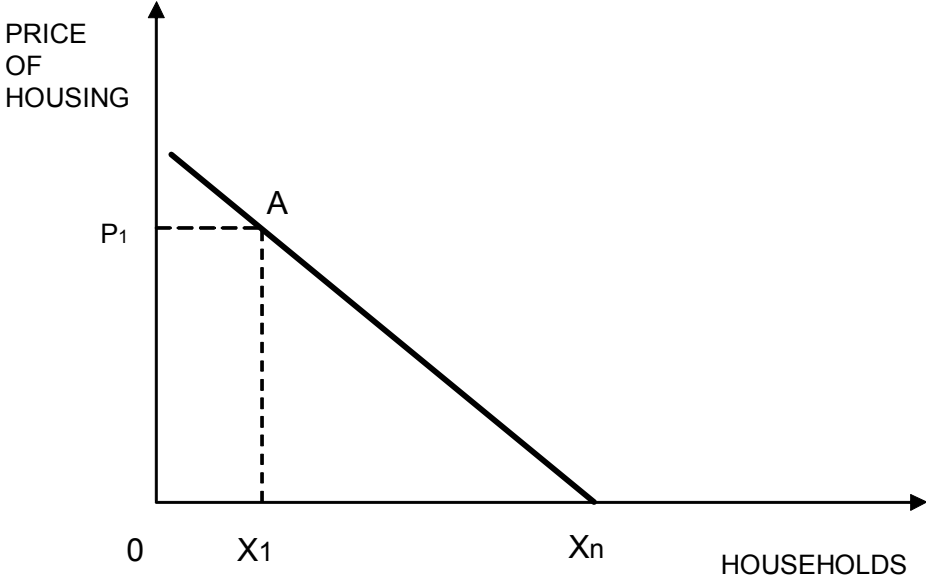
In Graph 1, the consumer surplus for home buyer who can pay a price D but pay a price of  $p_1$  is the saving he realizes by buying at price  $p_1$ ; that is to say, as the price diminishes from D to  $p_1$ . This set of combinations is contained in the area of the triangle  $Dp_1$ , for which the consumer surplus can be measured by calculating the area of the triangle  $Dp_1$ .

If the price decreases from  $p_1$  to  $p_2$ , the increase of the consumer surplus would be the difference between the areas of the triangles  $Dp_2$  and  $Dp_1$ . Therefore, the increase in the consumer surplus when the price decreases from  $p_1$  to  $p_2$  is the area of the trapezoid  $p_1Ap_2$ .

The triangular area graphically represents the possibilities of different households to buy at different prices. In this example in Graph 2 at the price  $p_1$  (market price) there are  $x_1$  households which can purchase housing. Therefore, this is the demand that would be satisfied without any type of external financing.

Now then, if the amount of necessary housings required is  $x_n$ , it means that there are other households which can only afford housing at lower prices and which, therefore, cannot purchase a house. Therefore, the social deficit of housing measured in monetary terms would be represented by the triangular area  $Ax_nx_1$ .

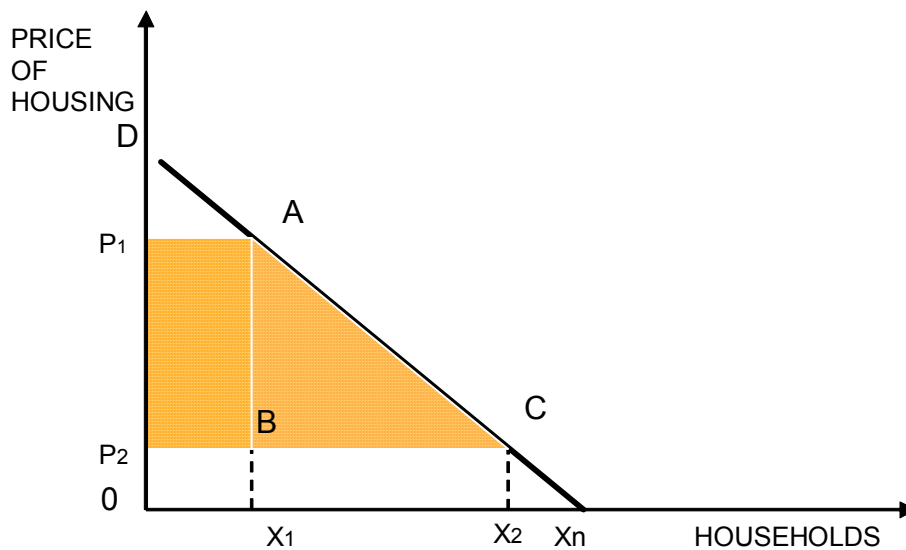
**GRAPH 2  
DEFICIT OF HOUSINGS**



It would be possible for a greater number of households to have access to housing

by lowering the social price of housing, that is to say, by modifying the conditions so that the financial expenditure is adjusted to what each household can afford. Following this logic, as shown in Graph 3 if new households from  $x_1$  to  $x_2$  could acquire housing, the social deficit of housing would decrease by  $Cx_nx_2$ .

**GRAPH 3**  
**INCREASE IN CONSUMER SURPLUS AND HOUSING**



But modifying the possibility of acquiring housing produces another effect: a consumer surplus.

In Graph 3, the initial price of the housing (without intervention of any type) is  $p_1$  and the consumer surplus at this price is represented by  $DAP_1$ . We will assume that as a result of the introduction of new measures through changes in economic and social policy the new social price of housing decreases to  $p_2$ . The amount that the consumers will pay is now  $p_2x_2$ , that is to say, the area  $Cx_2Op_2$ . Given that consumers who are willing to pay higher prices – those between  $p_2$  and  $D$ , that is to say they are willing to pay  $DCx_20$  and now they are going to pay  $Cx_2Op_2$ -, the new consumer surplus will be given by the area  $DCp_2$ . Therefore, there will be an increase in the consumer surplus equal to the area  $p_1ACp_2$ .

This increase in the consumer surplus can be divided into two parts:

- The increase in the consumer surplus caused by the additional households which can afford to buy because of the decrease in price: area  $ACB$ .

- The increase in the consumer surplus because some households could be consuming at higher prices: area  $ABp_2p_1$ .

The sum of all new households ( $x_2-x_1$ ) that acquire housing as a result of the decrease in the social price of the housing from  $p_1$  to  $p_2$  have a consumer surplus  $ACB$ . It is not the greater area, because these households would not buy at a price higher than  $p_1$ .

The social benefit (as stated earlier for this study is the same as increase in consumer surplus ) attributable to financing which allows households that can pay a social price between  $p_2$  and  $p_1$  to enter the market, is equal to the area  $ACp_2p_1$ . The social deficit resulting from the financial inability of the households to acquire housing would be  $Cx_1x_2$ , since these households continue to be able to acquire housing in spite of the price decrease derived from changes in the determinants of financing.

We are only measuring the benefit to specific groups of persons; consumers who cannot accede to housing under certain conditions and whether they can do so under other conditions.

Obviously the changes in the financing affect not only consumers, but also producers; but not only consumers and producers, but also third parties in the society in terms of “social well-being” and, certainly, the public sector. A global analysis would require a broader cost-benefit analysis and subsequently an analysis of the change in the well-being of the groups under consideration, an analysis that the author did not want to do nor wishes to get involved in in this article.

Another important matter is that real-estate prices do not go down as a consequence of improvements in financing. On the contrary, they rise. And it has been measured for the Spanish case. The increase in the possibilities of acquiring housing produces an increase in the real demand for housing. If a sufficient supply of finished housing does not exist, it will have two effects: a displacement towards the right and an increase in the convexity of the supply curve. These effects are of apparently opposite signs: on one hand, it produces an increase in consumer surplus and, on the other, there is a shift in the point of equilibrium for supply and demand with the consequent increase in price. Both aspects have been looked at by the research departments of different institutions, among them, one of which should be pointed out, is a very recent one done by the Bank of Spain which shows that clearly an interaction exists between credit for home buyers and the price of housing. According to this study a growth of 1 point in financing results in an increase in the price of housing of 0.15 points.

The empirical study presented in this paper considers only the benefit that accrues to the social group analyzed (young people in Madrid); this is because it is a partial analysis that attempts to look at specific effects that can be produced by specific means of housing financing. Therefore, if cost-benefit analysis is to be used, it

must be carried out using a general equilibrium model.

## 2. TESTING THE THEORY USING EMPIRICAL EVIDENCE

For the empirical testing of the theoretical concepts, the housing needs and the possibilities of acquiring housing by a specific group are analyzed. In this case the young homebuyers in the Community of Madrid are used. The different effects produced in social well-being derived from the existence of housing financing is contrasted with the nonexistence of such financing, as well as the effects of changes in the determinants of home financing.

The study will measure the social benefit derived from the existence of financing for housing by quantifying the increase in consumer surplus. First, consumer surplus is calculated when there is no financing available and then a comparison is made when it is available. Secondly, the changes in consumer surplus are calculated for various changes of the determinants, from their initial values.

For this study, the price of the housing and the income to acquire it are considered to be determined by the market.

The social group looked at in this study are young people from 20 to 34 years of age. This group is made up of potential new households and possible first time home buyers looking for a primary residence, without sufficient saving to afford to make a cash purchase. The group of young people from 20 to 34 years of age is the institutional reference group which represents first time home buyers (See for example CONSEJO ECONOMICO Y SOCIAL (2002): *La emancipación de los jóvenes y la situación de la vivienda en España*, Madrid, p. 84.)

Obviously, it is possible to calculate the social benefit of housing financing for other groups, simply by changing the reference determinants. If it is of interest to study other groups rather the age groups used here, one only needs to define them.

First, it is necessary to emphasize that the vast majority of tenancy in Madrid is owner occupied housing with very little rental housing (Table 1), As a result, the concepts that have been previously stated are directed at the purchase of owner occupied housing as a primary residence.

**TABLE 1**  
**HOUSINGS BY TYPE OF TENANCY**  
**IN THE COMMUNITY OF MADRID - 2001 CENSUS**

<b>Total</b>	<b>1.873.671</b>	<b>100 %</b>
Owner Occupied	1.536.836	82,02 %
Rental	255.154	13,62 %
Other	81.681	4,35 %

SOURCE: National Institute of Statistics (INE): "Census of Population and Housing 2001" and the author.

(In this paper the European system of decimal points is used, i.e. 1.000.000,00 € )

For the present study, the information relative to the average income of the group being considered, classified by income bracket and by age group, are summarized in Table 2 below:

**TABLE 2**  
**POTENTIAL HOUSEHOLDS AND AVERAGE INCOME**  
**IN THE COMMUNITY OF MADRID FOR YEAR 2002**

	Total	Interval 0-10		Interval 11-25		Interval 26-50		Interval 51-75		Interval 76-90		Interval 91-100	
	Households	Households	Income	Households	Income	Households	Income	Households	Income	Households	Income	Households	Income
20-24 años	17.483	1.748	6.229,2	2.622	15.015,3	4.371	19.832,1	4.371	24.969,4	2.622	32.114,0	1.748	39.225,5
25-29 años	76.044	7.604	8.562,3	11.407	19.919,9	19.011	26.140,8	19.011	35.835,9	11.407	49.793,1	7.604	62.606,0
30-34 años	161.269	16.127	9.178,1	24.190	21.535,9	40.317	30.217,6	40.317	45.200,4	24.190	66.254,1	16.127	85.542,2

Source: the author developed from the Survey of Wage Structure of the National Institute of Statistics (INE) for the year 2002 and of the Survey of Active Population (Methodology 2005).

Grouping of potential households (couples) and average income allows us to obtain 18 sub-groups which can be put in order. In this case, the households are classified by average income, ranging from highest to lowest income.



**TABLE 3**  
**HOUSEHOLDS CLASSIFIED BY AVERAGE INCOME - YEAR 2002**

INTERVAL	€ / YEAR	HOUSEHOLDS	AGE GROUP
91-100	85.542,2	16.127	30-34
76-90	66.254,1	24.190	30-34
91-100	62.606,0	7.604	25-29
76-90	49.793,1	11.407	25-29
51-70	45.200,4	40.317	30-34
91-100	39.225,5	1.748	20-24
51-75	35.835,9	19.011	25-29
76-90	32.114,0	2.622	20-24
26-50	30.217,6	40.317	30-34
26-50	26.140,8	19.011	25-29
51-75	24.969,4	4.371	20-24
11-25	21.535,9	24.190	30-34
11-25	19.919,9	11.407	25-29
26-50	19.832,1	4.371	20-24
11-25	15.015,3	2.622	20-24
0-10	9.178,1	16.127	30-34
0-10	8.562,3	7.604	25-29
0-10	6.229,2	1.748	20-24
<b>TOTAL HOUSEHOLDS</b>		<b>254.796</b>	

Source: The author developed from the Survey of Wage Structure of the National Institute of Statistics (INE).

This classification allows us to sum the number of households with income greater than a specified amount in descending order. This is carried out by adding the number of households in each successive income bracket to the sum of households in all the higher income brackets.

**TABLE 4**  
**HOUSEHOLDS ACCUMULATED BY INCOME**  
**IN DESCENDING ORDER - YEAR 2002**

N° HOUSEHOLDS	€ / YEAR
16.127	85.542,2
40.317	66.254,1
47.922	62.606,0
59.328	49.793,1
99.646	45.200,4
101.394	39.225,5
120.405	35.835,9
123.027	32.114,0
163.345	30.217,6
182.356	26.140,8
186.726	24.969,4
210.917	21.535,9
222.323	19.919,9
226.694	19.832,1
229.316	15.015,3
245.443	9.178,1
253.048	8.562,3
254.796	6.229,2

Source: The author developed from the Survey of Wage Structure of the National Institute of Statistics (INE).

## **2.1. SOCIAL BENEFIT DERIVED FROM BASIC FINANCING OF HOUSING**

### **2.1.1. PURCHASE WITHOUT FINANCING**

To calculate the price of housing, government data was used supplied by the Department of Housing in the above-mentioned document. The average price per square meter of housing was obtained for the Autonomous Community of Madrid, for the last quarter of the year 2002. Therefore, the price used will be 168,192€, which corresponds to a theoretical dwelling of 90 square meters.

The purchase of housing without financing requires on average 4.5 times the

combined average annual income of both members of a household of young people in the Autonomous Community of Madrid in the year 2002 (2 times the income of households in the highest income bracket and 27 times that of the lowest), if we take into account the weighted average income for each of the interval groups in which the groups have been divided. This agrees with studies done by the Central Bank of Spain (Banco de España) which estimate that in the year 2003, at the national level, the price of housing was 5,5 times the gross disposable income per household, 6,2 times in 2004 and 6,7 times in 2005 (See *Síntesis de Indicadores Económicos*. Banco de España. April 2006).

Therefore, paying for a home in cash does not appear to be a reasonable assumption, given that the price of housing is equivalent to several times annual income of the group being analyzed, even of the highest income bracket. Therefore, the purchase must be made using a system of financing within the possibilities of the existing market structure.

### 2.1.2. PURCHASE THROUGH FINANCING

There are a few conditions in the purchase of housing using financing which must be agreed on, i.e. the amount of the loan, the term of the loan, the interest rate and the system of amortization.

The present exercise starts out with the basic assumption of using the standard financing conditions which existed in the Autonomous Community of Madrid, for the time period of the statistical data being used i.e. (4<sup>th</sup> Quarter, 2002). The conditions which existed at that time were:

Amount of the loan:	80% of the appraised value of the property
Term of the loan:	25 years
Rate of interest:	5% per annum
System of amortization:	French system of fixed payments
Ratio of indebtedness:	30%
The payments are considered to be made annually to simplify the calculations.	

The amount of the loan has a direct relationship with the appraised value of the property, and this, in turn, with its market price. One of our basic assumptions is that the appraised value of property is the same as its market price; although this is not always true. But it is a reasonable assumption.

Given the above conditions, the loan would be 134.554€, and the annual payments to repay the loan would be 9.547€, calculated according to the formula of the French system of fixed payments:

$$P = \frac{t \times C \times (1+t)^n}{(1+t)^n - 1}$$

The financial institutions analyze the financial ability of each borrower to repay the mortgage being requested. This involves the use of a variety of complex tools to analyze each mortgage application in an attempt to estimate the probability of non-compliance with the conditions of repayment on the part of the mortgage applicant. Nevertheless, a standard exists among mortgage lenders which states that, as a general rule, a household needs 70% of its income to cover expenses apart from those of the mortgage. Or stated in another way, the households can only use 30% of their income to repay their mortgage.

For the calculations below the following simplifying assumption is made: every household can utilize a maximum of 30% of its income to repay the mortgage. Using this assumption, it is possible to establish the ability to repay the mortgage of each of the groups of households previously defined (Table 5).

**TABLE 5**  
**MAXIMUM ANNUAL PAYMENT FOR EACH ACCUMULATED GROUP OF HOUSEHOLDS**

N° HOUSEHOLDS	ABILITY TO REPAY (€ / YEAR)
16.127	25.662,7
40.317	19.876,2
47.922	18.781,8
59.328	14.937,9
99.646	13.560,1
101.394	11.767,7
120.405	10.750,8
123.027	9.634,2
163.345	9.065,3
182.356	7.842,2
186.726	7.490,8
210.917	6.460,8
222.323	5.976,0
226.694	5.949,6
229.316	4.504,6
245.443	2.753,4
253.048	2.568,7
254.796	1.868,8

Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

This ability to repay can be changed, by modifying the conditions of the financing, as will be seen later.

Once the number of households which are able to afford housing thanks to financing has been obtained, the next step is to calculate the increase in consumer surplus, as defined in the previous Section, which in turn will give a measure of the social benefit derived from the financing of housing.

To do this, the observations are plotted on a graph in a series of points, giving a trend line. Next the function that relates the number of households to their ability to meet the annual payment based on mortgage financing is calculated. This is done by fitting the data points to the various functions in the following table, using the statistical criterion of maximum coefficient of determination  $R^2$  (or coefficient of multiple correlation), which gives the following results:

**TABLE 6**  
**FITTING THE OBSERVATIONS TO DIFFERENT FUNCTIONS**

TYPE OF FUNCTION	EQUATION	COEFFICIENT OF DETERMINATION ( $R^2$ FIT)
LINEAR	$y = -0,0782x + 22.066$	$R^2 = 0,9252$
LOGARITHMIC	$y = -8.273,28\text{Ln}(x) + 107.096,15$	$R^2 = 0,9680$
POLYNOMIAL	$y = 2\text{E-}07x^2 - 0,1447x + 25.368$	$R^2 = 0,9553$
POWER	$y = 108.540.717,04x^{-0,8107}$	$R^2 = 0,7484$
EXPONENTIAL	$y = 29.959e^{-9\text{E-}06x}$	$R^2 = 0,8908$

Source: the author using Microsoft Excel

The logarithmic function below gave the best fit:

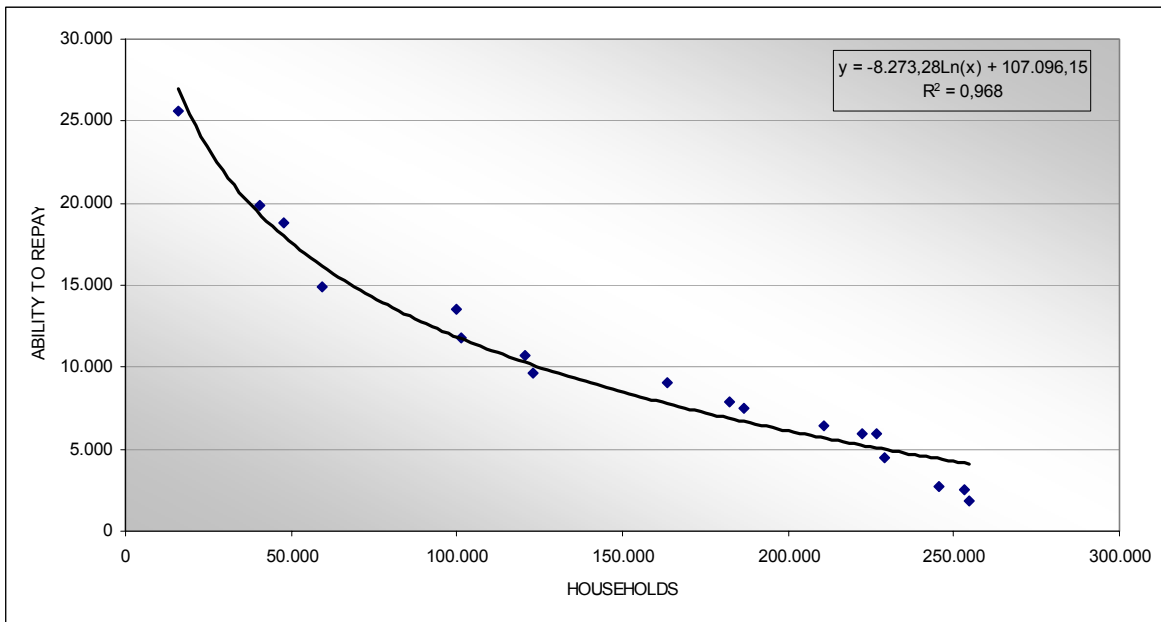
$$y = -8.273,28\text{Ln}(x) + 107.096,15$$

as it has the highest coefficient of determination  $R^2$  of all the equations tested, and where

(x) = number of households  
(y) = maximum annual payment to repay mortgage financing.

The above function is shown in Graph 4, where the upper left point representing 16.127 households estimated to be able to make a maximum annual payment of 25.662,7 €.

**GRAPH 4**  
**FUNCTION OF ABILITY TO REPAY OF YOUNG HOUSEHOLDS**  
**IN THE COMMUNITY OF MADRID - YEAR 2002**

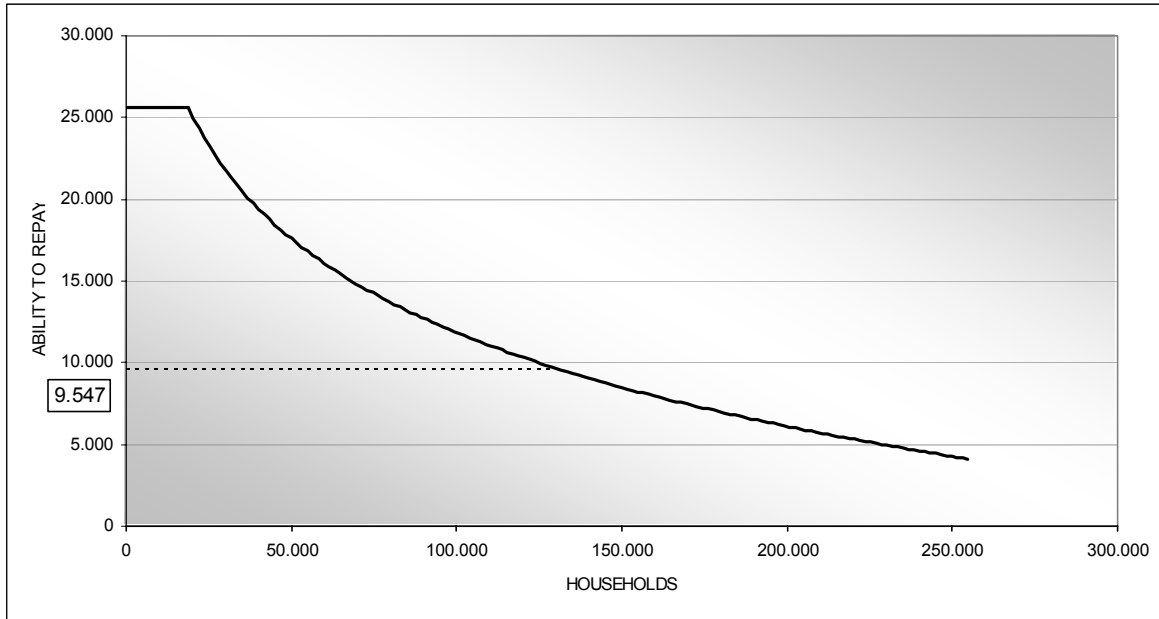


Source: the author developed from the Survey of Wage Structure and the Survey of the Population Active of INE.

Given that the income distribution is not known for the upper section of the function (those households with the highest incomes), the assumption is made that all 16.127 households in the section have the same income which in this case is an estimated average income. If this is not done, some households would have infinite income, which is, of course, impossible.

With the standard mortgage conditions describe above, for a mortgage of 134.554€, the annual payments would be 9.547€ per year. This is shown in Graph 5 below.

**GRAPH 5**  
**FUNCTION OF THE ABILITY TO REPAY AND MINIMUM ANNUAL PAYMENT**



Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

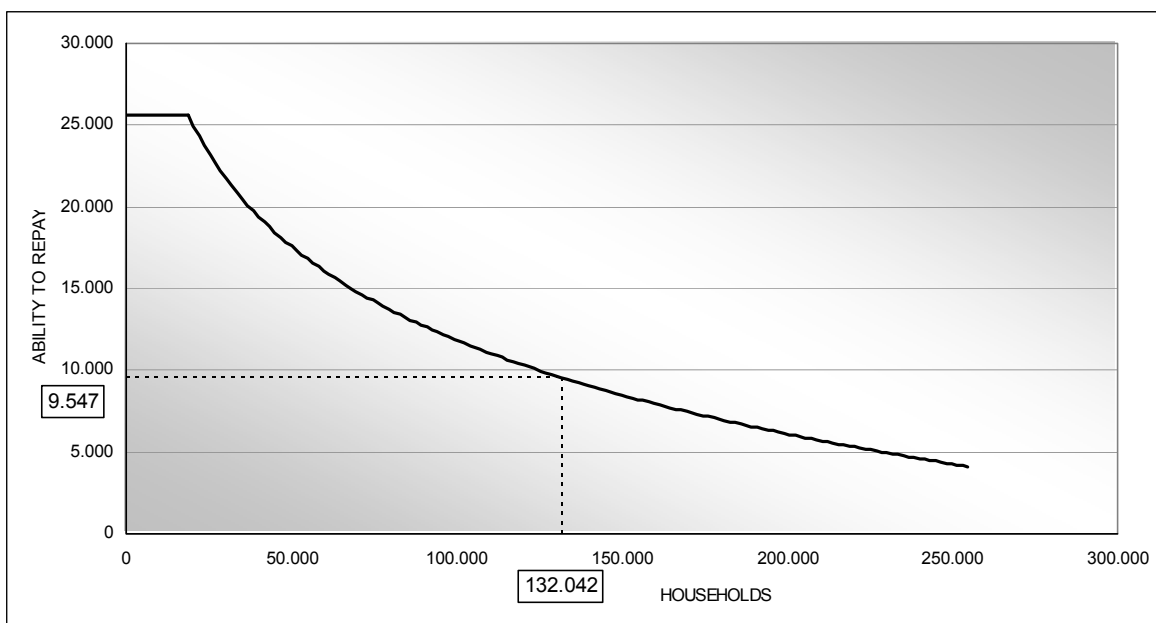
The point of intersection of the straight line representing the necessary annual mortgage payments with the demand curve will give us the maximum number of households which can acquire housing under the financing conditions described above.

$$y = -8.273,3 \ln(x) + 107096$$

$$y = 9.547$$

Solving the previous system of equations, the number of young households able to make an annual payment of 9.574€ in the Community of Madrid in the year 2002, is calculated to be 132.042 households, as shown in Graph 6.

**GRAPH 6**  
**FUNCTION OF THE ABILITY TO REPAY AND MINIMUM ANNUAL PAYMENT**  
**MAXIMUM NUMBER OF HOUSEHOLDS THAT CAN ACQUIRE THROUGH**  
**BASIC FINANCING**



Source: the author Developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

Once the function of the Ability to Repay of the young households in the Community of Madrid in the year 2002 has been determined, the number of households that can acquire financing for a mortgage of 134.554€, (at an interest rate of 5% per annum, amortized over 25 years according to the French system) is calculated. The following step in the process of calculating the social benefit derived from the financing of housing in the given year in the Community is to determine the demand function of the population of households with sufficient income to acquire mortgage financing, i.e. which can make a down payment of 20% of the price of the housing at the time of purchase. This down payment can come either from the saving of the prospective buyers or from financial assistance of relatives not directly involved in the purchase of the home.

First the price of housing which households in each interval can afford is calculated. (See Table 7 below).



**TABLE 7**  
**ABILITY TO REPAY AND THE PRICE OF HOUSING**

<b>Nº HOUSEHOLDS</b>	<b>ANNUAL ABILITY TO REPAY</b>	<b>AMOUNT OF LOAN ( € )</b>	<b>PRICE OF HOUSING ( € )</b>
16.127	25.662,7	361.688,2	452.110,2
40.317	19.876,2	280.134,5	350.168,1
47.922	18.781,8	264.709,5	330.886,9
59.328	14.937,9	210.534,4	263.168,0
99.646	13.560,1	191.115,6	238.894,4
101.394	11.767,7	165.852,8	207.316,0
120.405	10.750,8	151.520,8	189.401,0
<b>123.027</b>	<b>9.634,2</b>	<b>135.783,8</b>	<b>169.729,8</b>
163.345	9.065,3	127.765,4	159.706,8
182.356	7.842,2	110.528,2	138.160,2
186.726	7.490,8	105.575,3	131.969,1
210.917	6.460,8	91.057,8	113.822,3
222.323	5.976,0	84.225,1	105.281,4
226.694	5.949,6	83.853,6	104.817,0
229.316	4.504,6	63.487,6	79.359,5
245.443	2.753,4	38.806,8	48.508,5
253.048	2.568,7	36.203,1	45.253,9
254.796	1.868,8	26.338,1	32.922,6

Source: the author Developed from the Survey of Wage Structure and the Survey of the Active Population of INE, as well as other indexed sources.

From this table, a series of observations can be obtained that relate the number of households to the price of housing.

The set of observations of "households" and "the price of housing" can be represented by a series of points, giving a trend line that relates price of the housing and number of households that can afford it.

Using the function that has the best coefficient of determination  $R^2$ , the Housing Demand Function in the Community of Madrid in the year 2002 is obtained based on the ability to repay mortgage of the potential homebuyers. The equation of the

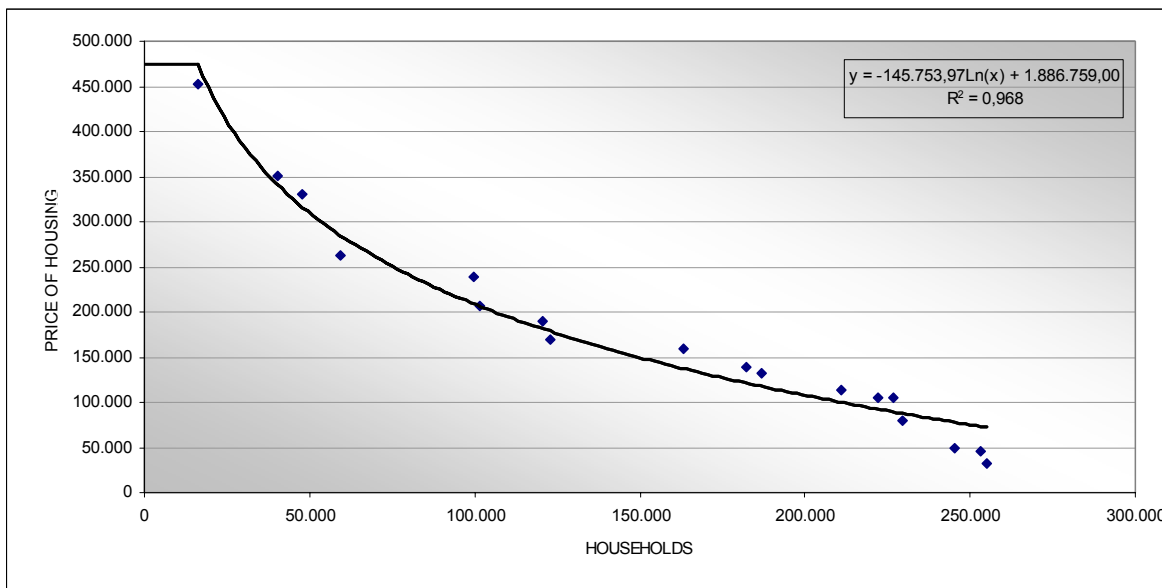
demand function is as follows:

$$D = -145.754,00 \ln(x) + 1.886.704,00 \quad R^2 = 0,968$$

where (x) is the quantity of housing demanded at price (D)

The demand function is shown in Graph 7.

**GRAPH 7**  
**HOUSING DEMAND FUNCTION OF THE SELECTED HOUSEHOLDS**



Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

In the above function,

$$y = -145.754,00 \ln(x) + 1.886.704,00$$

it is possible to replace (y), the price of the housing that it is possible to acquire, with the ability to repay.

Given that the ability to repay is established as the limit, that is to say 9.547€, which corresponds to a price of housing which in this case is 168.136€. (y) is replaced by the above mentioned value, to obtain the number of households that can acquire the above mentioned housing.

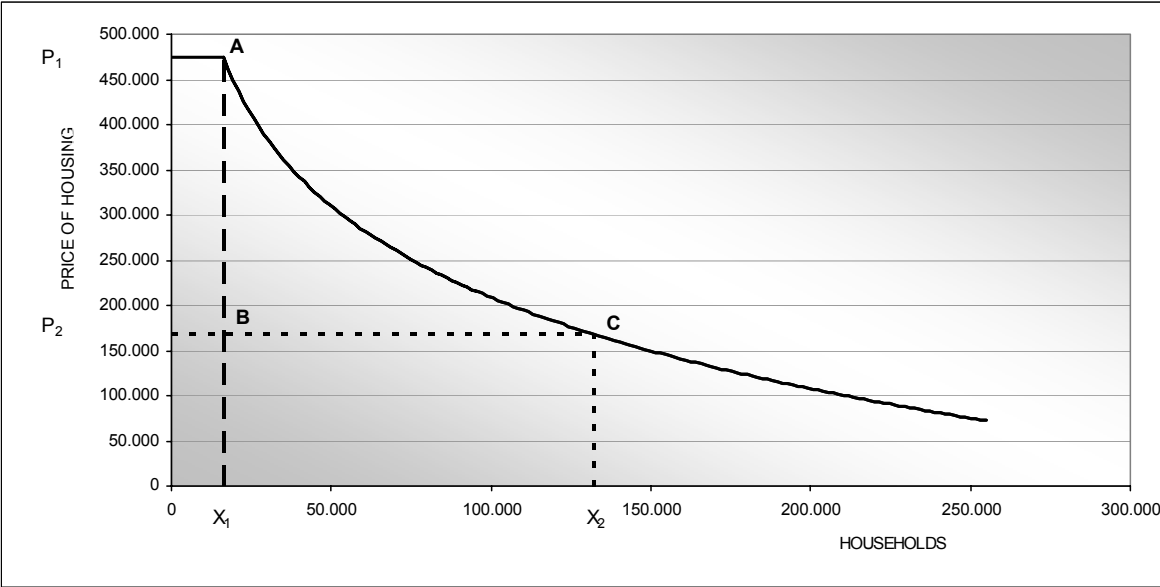
The value of (x), that is to say, the number of households that can acquire - and, therefore, the number of housing units which it is possible to acquire - is 132.042 units. This is the same as in the previous case since the maximum annual payment

and the price of the housing are proportional in the example being developed.

It is worthwhile at this point to remember the discussion in the first Section about consumer surplus. Consequently, when the price decreases from  $p_1$  to  $p_2$ , the consumer surplus is defined by the area of the trapezoid  $p_1ACp_2$ , as shown in Graph 8

Given that the price of the financed housing as perceived by the buyer, which for our purpose is defined as the social price of housing, becomes lower as the annual payment to amortize the mortgage corresponding to the above mentioned housing decreases. It is possible to calculate the increase in consumer surplus after the perceived price has decreased from  $p_1$  to  $p_2$ . (See Graph 8)

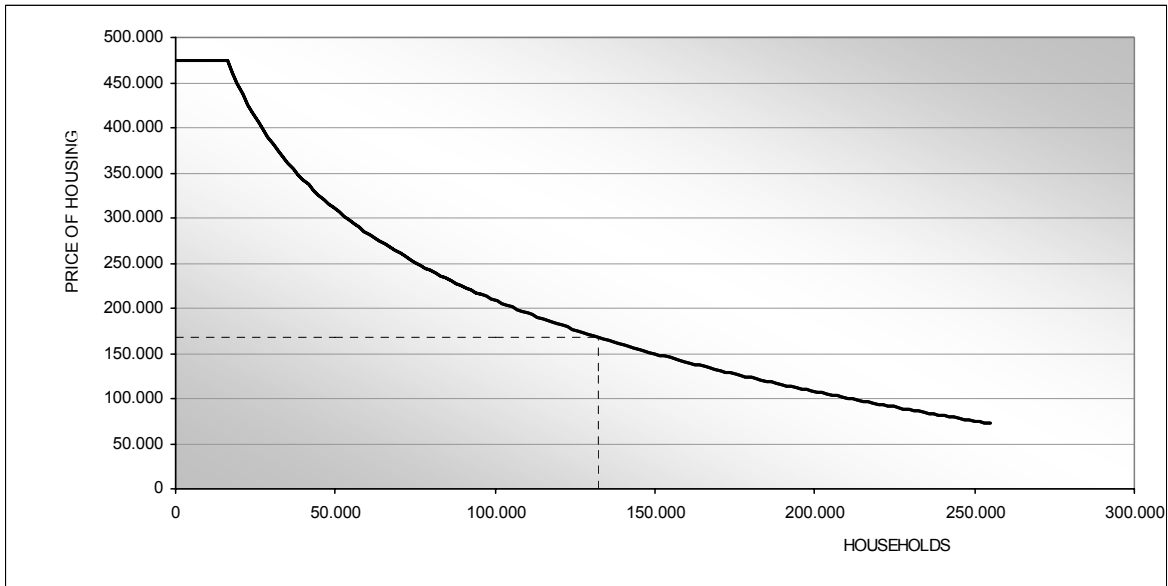
**GRAPH 8  
CONSUMER SURPLUS**



Source: the author Developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

To make the calculation of increase in consumer surplus as a measure of the increase in social well-being, it is necessary to first determine the maximum number of households given their ability to repay, which are qualified as potential buyers of housing.

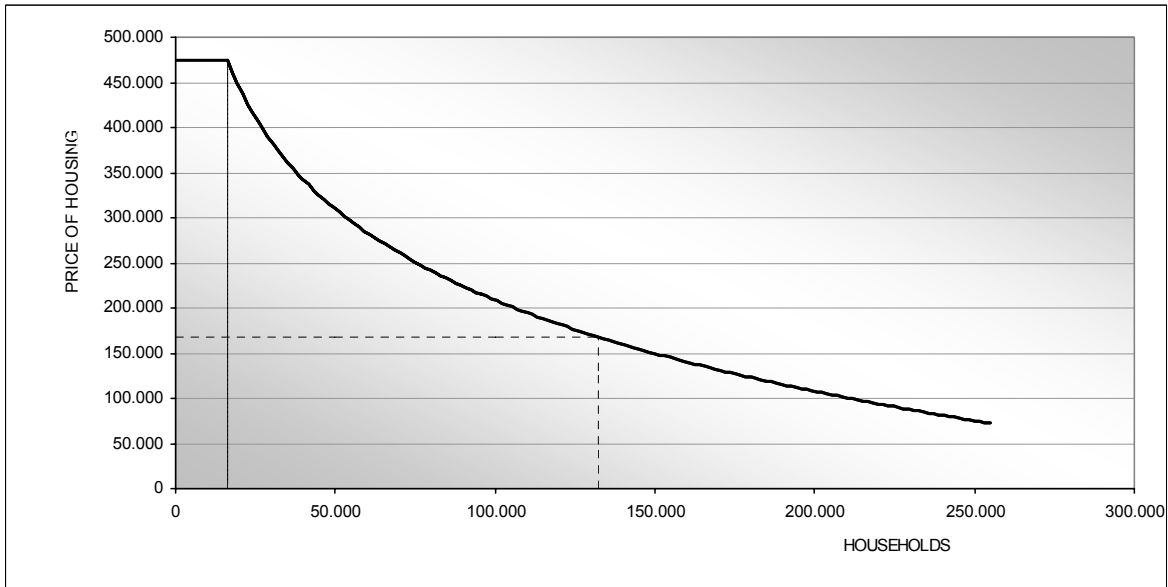
**GRAPH 9**  
**HOUSING DEMAND FUNCTION WITH FINANCING**  
**FOR YOUNG PEOPLE IN THE COMMUNITY OF MADRID - YEAR 2002**



Source: the author Developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

In our case, the financing will permit 132.042 households access to the purchase of housing at a price of 168.136€. These are households which can make payments of 9.547€ per year. (See Graph 10)

**GRAPH 10**  
**MAXIMUM NUMBER OF HOUSEHOLDS THAT CAN ACQUIRE FINANCED**  
**HOUSING**  
**AT A MARKET PRICE OF 168,136€ PER UNIT**



Source: the author Developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

Given that no household in the study group can acquire housing without financing (based on prices and income as seen in the previous paragraph), the increase in consumer surplus consists of the area defined by  $p_1ACp_2$ .

The increase in consumer surplus (social benefit measure), therefore, is defined by the equation

$$ICS = \int_{16.127}^{132.042} (-145.754 \ln(x) + 1.886.704) dx - \text{area } BCx_2x_1 + \text{area } p_1ABp_2 =$$

$$= 16.532 \text{ million Euros}$$

## 2.2. SOCIAL BENEFIT DERIVED FROM CHANGES IN THE DETERMINANTS IN BASIC HOUSING FINANCING

As has already been shown, none of the households of the analyzed group can acquire housing without financing. With standard financing as described above,

132.042 households can obtain housing. Nevertheless, 48,2% of prospective home buyers of our study are still unable to acquire housing.

Now we will study the effect that changes in the type of financing and the values of the basic determinants have on the 48,2% who are unable to acquire housing because they do not qualify for financing under the basic mortgage assumptions.

Now then, it is possible to change one of the determinants of financing, or make changes simultaneously in several of them, replacing them with different values. As an example, the calculations are made below after changing the type of amortization and the value of two parameters: the term of the mortgage, and the interest rate.

Market price of housing:	168.192€
Amount of the loan:	134.554€
Interest rate:	4% per annum
Term:	30 years
System of amortization:	geometric progression
Ratio of the progression:	2% per annum

With these changes and all other conditions remaining constant, the mortgage can be amortized with an initial annual payment of 6.095€. This payment is based on calculations using the geometric progression formula below.

$$y = P = \frac{C \times (t - r) \times (1 + t)^n}{(1 + t)^n - (1 + r)^n}$$

Substituting this value of the initial payment in the function,

$$y = -8.273,28 \ln(x) + 107.096,15$$

the number of households that can qualify for the above mentioned loan is obtained. In this case, it is **200.408 households**.

Substituting this number of households in the demand function,

$$y = -145.754,00 \ln(x) + 1.886.704,00$$

it is calculated that 164.528 households can accede to housing costing **107.323€**, which is lower than the minimum price established in the model using the basic conditions. Given that these households can accede to housing costing 168.192€, for these households the social price has gone down from 168.192€ to 107.323€.

When this study says that the price has lowered to 107.323 euros, it is an appraisal of a subjective nature. It is the price perceived by the consumer, his "social price", which seems to have diminished, since it is the price that he could afford before the

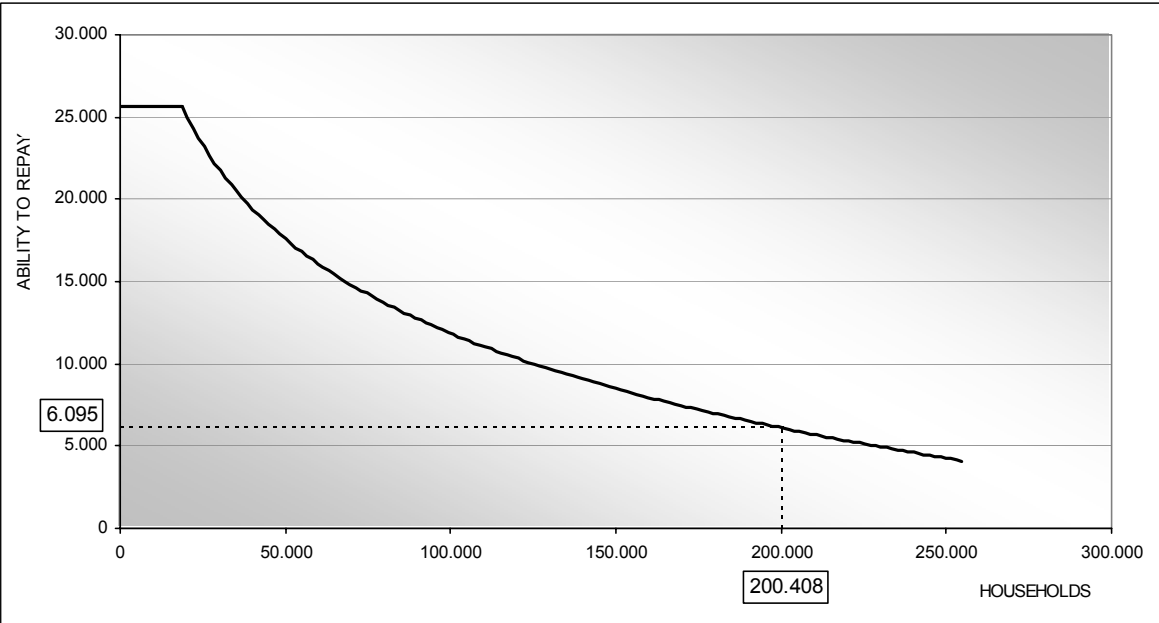
modification to financing, and therefore the accessibility for this consumer. This does not mean that the price has been lowered in the market up to this point.

Using the new limits for number of households and social price of housing, the social benefit of the financing can be calculated for the new mortgage conditions described above. This is done by integrating the demand function for housing between the above mentioned limits and calculating the area corresponding to the increase of the consumer surplus using the same methodology as in the basic case. The result of this calculation is an **increase in the consumer surplus of 26.497 million€**. This is equivalent to 20,78% of the GDP of the Autonomous Community of Madrid for the year 2002.

Therefore, the changes in the values of the financing determinants, described above, produce an increase in the social well-being valued at 9.965 million Euros, as compared to financing under the basic conditions. This is an increase of 60,3%, as a result of the 68.366 additional households that are able to acquire housing.

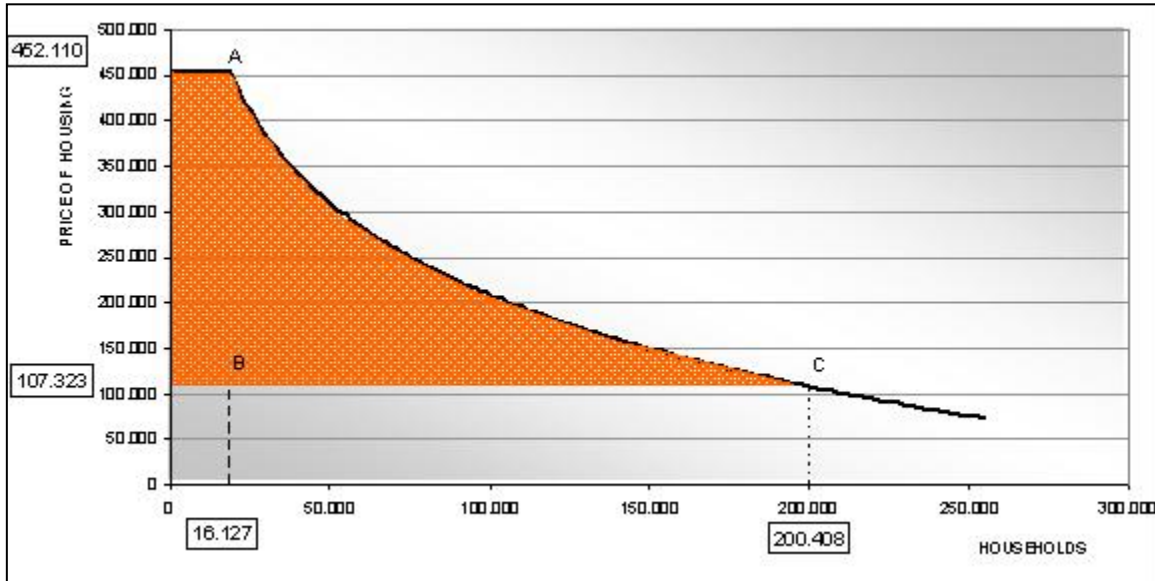
Below in Graphs 11,12, and 13, the maximum number of households that qualify for housing, the social price of the housing and the increase in consumer surplus, as well as the increase in consumer surplus resulting from the changes in mortgage conditions are compared with their corresponding values in the basic case.

**GRAPH 11**  
**MAXIMUM NUMBER OF HOUSEHOLDS**  
**SIMULTANEOUSLY CHANGING VARIOUS DETERMINANTS**



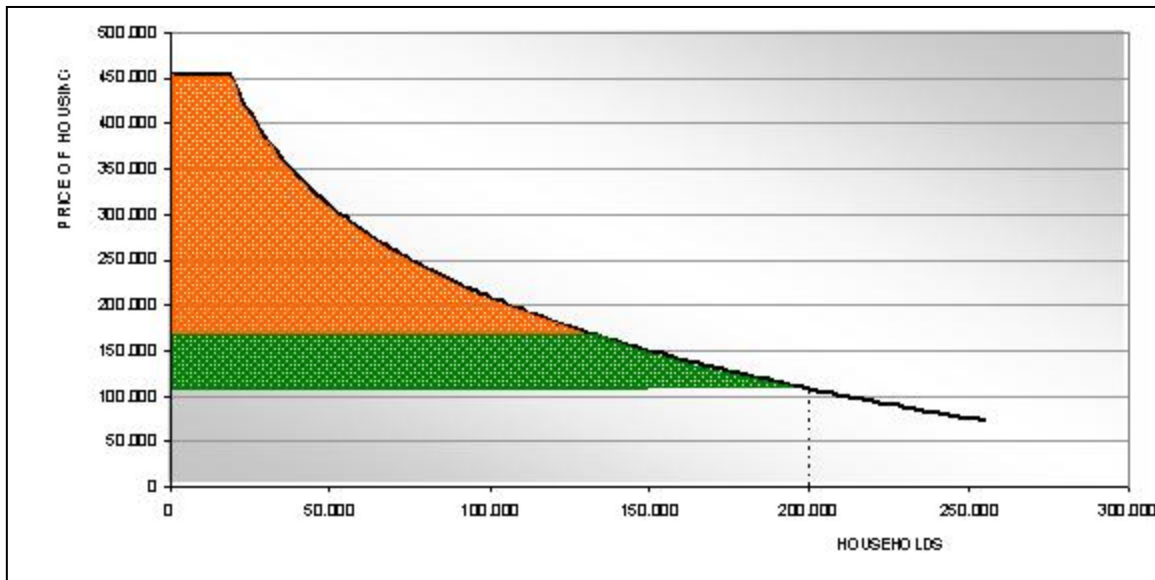
Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

**GRAPH 12**  
**SOCIAL PRICE OF HOUSING AND CONSUMER SURPLUS**  
**SIMULTANEOUSLY CHANGING VARIOUS DETERMINANTS**



Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.

**GRAPH 13**  
**INCREASE OF THE CONSUMER SURPLUS**  
**SIMULTANEOUSLY CHANGING VARIOUS DETERMINANTS**



Source: the author developed from the Survey of Wage Structure and the Survey of the Active Population of INE.



### 3. SUMMARY OF THE RESULTS OBTAINED FROM VARIOUS SIMULATIONS

This study has used as a reference population the group of emancipated young people in the Autonomous Community of Madrid, between 20 and 34 years of age, as appears in the Survey of Active Population corresponding to the first quarter of the year 2003. Estimated income comes from the latest edition of the Survey of Wage Structure corresponding to the fourth quarter of the year 2002. The housing prices used are government data for the Autonomous Community of Madrid for the fourth quarter of the year 2002, supplied by the Department of Housing.

The conclusions which can be drawn from using the criterion of increase in consumer surplus to measure the social benefit derived from the housing financing are the following:

1 ) It is not possible for the young people in the Autonomous Community of Madrid, to afford to purchase housing on the free market without financing because the current price of housing is many times the annual income for the group.

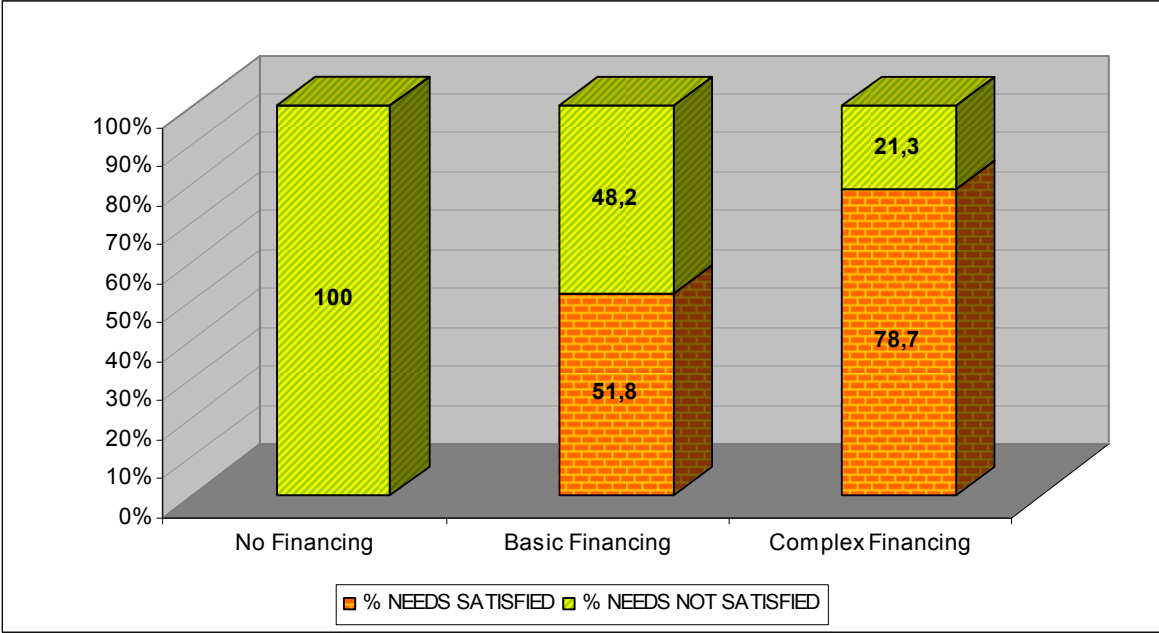
2 ) Using different types of housing financing and varying the mortgage conditions for each of the types of mortgage, it is possible that most of the study group can acquire housing.

- First the effects that are produced by using standard financing conditions as opposed to not using financing are analyzed. The affordability of housing with financing, under today's normal conditions (for the purposes of this study called the basic case), will allow a greater number of households in the study group to accede to housing. Taken as normal conditions are a loan for 80% of the price of housing in the present market, a 5% interest rate, a term for the loan of 25 years and a maximum of 30% of annual household income to repay the loan. Under these conditions, 51,8% of the study group would qualify for housing financing (without which they would have no possibility of purchasing a home). The resulting social benefit measured in terms of increase in consumer surplus would be 16.532 million Euros, which represents 13% of the GDP for the Community of Madrid in the year 2002.
- But nevertheless, 48,2% of the households would still be unable to afford housing, even with these normal financing conditions. However, it is possible to change the determinants of financing and their numeric values to explore the possibilities that exists for a greater number of households to acquire housing.

Graph 14 clearly illustrates the most important three situations that have been analyzed; access to housing without financing, with standard financing available in the market and with complex financing (changing several determinants simultaneously). Without financing, 100% of the group analyzed could not

purchase housing. With standard financing, 51,8 % of the needs would be covered and with complex financing 78,7 % of the needs could be covered.

**GRAPH 14**  
**PERCENTAGE OF THE NEEDS FOR HOUSING**  
**SATISFIED BY TYPE OF FINANCING**



It is possible to make a multitude of changes to the basic case and test their effects. The results from ten different simulations carried out under different assumptions are summarized in Table 8. It shows the number of households that can accede to housing, the perceived social price for every change and the social benefit derived from housing financing for each scenario.

It is possible to rank the various scenarios according to the results they produce and to observe their relative effectiveness.

The different changes produce a wide variety of results. For example, the French payment system of split terms only increases social benefit by 6,5%, while the simultaneous joint changes case (interest rate, term, system of amortization) produces a significant increase in the accessibility to housing permitting up to 78,7% of the group to purchase a home.

**TABLE 8**  
**SOCIAL BENEFIT AND CHANGES IN THE FINANCING DETERMINANTS**

	HOUSEHOLDS				PRICE OF HOUSING €	SOCIAL BENEFIT		
	N° OF HOUSEHOLDS	% ACCESS	INCREASE OVER BASIC CASE	% INCREASE OVER BASIC CASE		MILLIONS OF €	INCREASE OVER BASIC CASE	% INCREASE OVER BASIC CASE
<b>BASIC FINANCING:</b>								
French system of fixed payments, at 5% interest rate and 25 year term	<b>132.042</b>	51,8%			<b>168.136</b>	<b>16.532</b>		
French system of fixed payments with a reduction of 2 p.p. in the interest rate	<b>164.528</b>	64,6%	32.486	24,6%	<b>136.077</b>	<b>21.267</b>	4.735	28,6%
French system of fixed payments with a 5 year increase in the term	<b>145.343</b>	57,0%	13.301	10,1%	<b>154.148</b>	<b>18.471</b>	1.939	11,7%
Geometric progression system with an increase of 1% per annum	<b>146.931</b>	57,7%	14.889	11,3%	<b>152.564</b>	<b>18.702</b>	2.170	13,1%
Arithmetic progression system with an increase of 100 € per annum	<b>148.143</b>	58,1%	16.101	12,2%	<b>151.366</b>	<b>18.879</b>	2.347	14,2%
French system with 25 year term split into two periods of 10 and 15 years	<b>139.422</b>	54,7%	7.380	5,6%	<b>160.210</b>	<b>17.607</b>	1.075	6,5%
Payment system with digital sum amortization	<b>176.585</b>	69,3%	44.543	33,7%	<b>125.769</b>	<b>23.025</b>	6.493	39,3%
Geometric progression system with an increase of 10% per annum	<b>157.353</b>	61,8%	25.311	19,2%	<b>142.575</b>	<b>20.221</b>	3.689	22,3%
French system of fixed payments without amortization in the first 3 years	<b>185.647</b>	72,9%	53.605	40,6%	<b>118.474</b>	<b>24.345</b>	7.813	47,3%
<u>Changing several basic financing conditions:</u>								
Geometric progression system with an increase of 2% per annum Interest rate reduced by 1 p.p. (from 5% to 4% per annum) Term increased by 5 year to 30 years	<b>200.408</b>	78,7%	68.366	51,8%	<b>107.323</b>	<b>26.497</b>	9.965	60,3%

In Table 9, all the scenarios are ranked in ascending order of effectiveness, that is, the number of households which are able to purchase housing. All the changes would improve housing financing and therefore increase social well-being.

**TABLE 9**  
**RANKING OF EFFECTIVENESS OF CHANGES IN THE FINANCING DETERMINANTS**

RANKING FROM LOWEST TO HIGHEST	FINANCING SCENARIO	SOCIAL BENEFIT OF HOUSING FINANCING (MILLIONS OF €)
1st	French system of fixed payments, at 5% interest rate and 25 year term	16.532
2nd	French system with 25 year term split into two periods of 10 and 15 years	17.607
3rd	French system of fixed payments with a 5 year increase in the term	18.471
4th	Arithmetic progression system with an increase of 100 € per annum	18.587
5th	Geometric progression system with an increase of 1% per annum	18.702
6th	Geometric progression system with an increase of 10% per annum	20.221
7th	French system of fixed payments with a reduction of 2 p.p. in the interest rate	21.267
8th	Payment system with digital sum amortization	23.025
9th	French system of fixed payments without amortization in the first 3 years	24.345
10th	<u>Changing several basic financing conditions:</u> Geometric progression system with an increase of 2% per annum Interest rate reduced by 1 p.p. (from 5% to 4% per annum) Term increased by 5 year to 30 years	26.497

Obviously, the changes in the values of the parameters used (interest rate, term of the loan, ratio of the progression) will produce changes in the rankings.

In cases where adjusting the financing conditions were to produce expenses to the public sector, it is possible to subsequently do a cost-benefit analysis to assist the responsible authorities in selecting the most cost effective measures.

As an example of how this methodology could be use, let us look at a problem of the following nature: the housing authorities are faced with a "*waiting-list*" of 254.796 households that need housing and have to decide which measures will work best to reduce or to eliminate this waiting-list.

Each of the past changes has produced a different effect and they can all be ranked to observe to what extent each one could reduce this theoretical waiting-list.

#### **4. CONCLUSIONS AND RECOMMENDATIONS**

Through changes to the relevant determinants and the quantification of their effects, it is abundantly clear the array of possibilities that this methodology can offer. It allows one to look for types of housing financing and loan conditions that make it possible to increase the well-being of society through housing financing.

The increase in social well-being derived from housing financing through changes to the determinant conditions does not necessarily mean that interest rates have to be subsidized: there are other ways of obtaining this increase of social well-being, for example, lengthening the term of the loan or modifying the system of amortization, as is shown in the graphs and tables included in this article.

It is therefore a valid methodology to look for solutions through financing to meet the housing needs of different groups in varying situations, simply by changing the underlying assumptions. It is possible to use it for any group; instead of applying it to young people looking to buy their first house, it can be applied to a group such as immigrants, or any other group that requires housing. It is possible to vary the type of housing to conform to what society considers suitable; smaller or larger units, more expensive or less expensive, etc. This methodology is applicable not only to financing new housing, but also to older existing housing or renovated housing. Besides owner occupied housing, it is equally applicable to rental housing or any other type of tenancy.

Whatever the case may be, the same methodology can be used to determine what housing financing strategy will produce the greatest social benefit. It can also be used by managers in both the public and private sector to aid and assist in their decision making.

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