PROJECTION OF DEMOGRAPHIC DEMAND FOR HOUSEHOLDS: Application of a Headship Rate Method based on Age-Period-Cohort Model

Gustavo Henrique Naves Givisiez[1]
Eduardo Luiz Gonçalves Rios-Neto[2]
Elzira Lúcia de Oliveira[1]

Introduction

There is no doubt that home ownership is part of the collective imagination of the Brazilian population. Brazilian poor and middle classes consider home ownership as one of the most important indicators of social status. Home ownership reflects the social status of the inhabitants until nowadays, besides evidencing independence, financial stability and perspectives of transferring assets to the descendants.

In the 70s, one of the greatest dreams of the Brazilian middle class was to own a household and be rid of rent payment. Bolaffi (1977) considered home ownership, together with food and clothing, as the most important investment in order to constitute an asset, besides being subjectively correlated to economical success and higher social status. The acquisition of such assets is still in the aspiration list of a significant share of the Brazilian population, although its relative importance has decreased compared to education, health care and private retirement planning. Such decrease in the relative importance did not result from the ability to buy and own a house, but mostly from the deficiency in the other services that were previously provided by the Government (JUNQUEIRA and VITA, 2002).

Although housing is currently a widely discussed issue in Brazil, the majority of the housing quantitative studies include issues such as housing deficit and assessment of the housing stock. The demographic demand for households, considered as the need of new housings resulting from the demographic dynamics in a population, has not been usually included in

[1] PhD Student at CEDEPLAR – Federal University of Minas Gerais. Brazil
[2] PhD at Berkeley University and Full Professor from the Demography Department at CEDEPLAR - – Federal University of Minas Gerais. Brazil

such studies. Estimates of the future demographic demand according to housing deficit criteria would certainly represent an improvement on housing deficit studies.

The present paper suggests a methodology for projecting housing demand based on housing needs in the past according to categories of housing deficit in the Metropolitan Area of Belo Horizonte, Minas Gerais, Brazil. The headship rate method will be used to project the housing demand. An innovative feature in this study is the use of age-period-cohort model for estimating headship rates. Besides, headship rates in 1970, 1980, 1990 and 2000 are projected according to categories of housing deficit and, from these, household flow (increase and decrease of housing units) and determination of housing stock.

The next sections describe method antecedents, literature review, methodologies and results. The last section of this paper includes some implications for public policies.

Antecedents

Housing demand reflects cultural differences that might be vastly divergent between countries or social classes. Regarding the Brazilian middle class, housing demand depends mostly on the life cycle stages, whereas in poorer social groups the greater demand is connected to reposition of the already existing housing stock. The more vulnerable population is not able to make such demand more effective due to hindrances such as the income structure, less accessibility to the Government line-of-credit programs and the lack of an effective housing policy (FUNDAÇÃO JOÃO PINHEIRO, FJP, 2001).

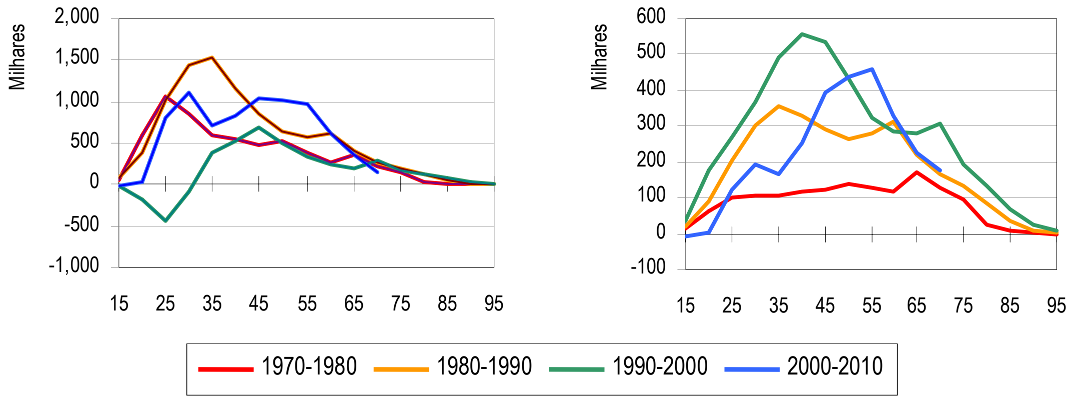
The housing flow[3] is negative after 64 years of age in Spain (RODRIGUEZ, CURBELO and MARTIN, 1991), i.e., as a consequence of the high institutionalization of the elderly in that country, the housing stock tend to decrease after that age. Conversely, the maximum number of new housing units in Brazil is seen in the groups of 35 year-old men and 55 year-old women, and the loss of housing units was only observed for men with 95 years old or more (RIOS-NETO, OLIVEIRA and GIVISIEZ, 2003). Additionally, it should be pointed out that the standard and the levels of female household flow are markedly different from those seen

[3] The flow of housing formation is the difference between the number of housing units in two specific dates and represents the formation of new households based on age-specific headship rates. This value is negative when the total of housing units decrease in the studied period.

for the male households, in which an expressive increase in the number of housing units can be observed between 2000 and 1990 for the former (GRAPHS 1 and 2).

Graphs 1 and 2
Housing flow, by age group and period. Brazil, 1970-80, 1980-90, 1990-2000, 2000-2010

GRAPH 1 Male — GRAPH 2 Female



Source: Rios-Neto, Oliveira and Givisiez, 2003.

Housing deficit

The quality of households clearly reflects the social inequality in Latin America. A habitable housing should fulfil minimal building and conservation requirements. Although demographic censuses are not designed exclusively for the estimation of housing needs, they are useful in quantifying inappropriate households and have been improved in terms of assessing family arrangements and household features (DINIZ and CAVENAGHI, 2004).

Housing deficit would be easily determined by subtracting the total of dwellings from the total of families that require a residence (DINIZ and CAVENAGHI, 2004). Precisely, it is consensual that each family unity[4] should have a house. Nevertheless, difficulties arise as a result of the criteria and definitions used by censuses in defining families and dwellings, which might not coincide with the effective housing deficit. Therefore, if housing stock is considered as solely the occupied households, the more complex problem of quantifying the housing needs is only in part assessed. This empiric option, however, limits the domestic

[4] In sociological, anthropological and demographic literatures, the reflection about family is considerably rich and complex (Cavenaghi and Goldani, 1993; Medeiros and Osório, 2000; Lazo, 2002).

groups and ignores the dwelling necessities of such groups. Many studies proposed to assess housing shortage in a defined housing stock, conventionally called as *housing deficit*.

Dwelling necessities are obvious and indubitable in the case of the homeless and of improvised houses[5]. Nevertheless, these figures are not so worrying in Brazil, where a greater problem relates to the disordered occupancy of the urban surface area and the precarious occupancy in squatter settlements. Other buildings might need investments for improvement or repairing, even if they are located in city central areas that have excellent urban infrastructure. Many methodologies of estimating housing deficit that consider the use purposes of the households have been proposed in order to solve these problems.

Deficit can be understood by a more immediate and intuitive notion, i.e., the needs of building new housing units in order to solve both social and specific housing problems that are detected at a specific time. In such methodologies, the concept of housing deficit (FJP, 2001) generally comprises two different segments: *necessity to increase stock* and *necessity to adequate stock*. *Necessity to increase stock* refers to housing units that have no habitable conditions, due to precarious construction or poor structure conditions, or yet because more than one family live in it (presence of subfamilies). Therefore, *Stock Increment* is comprised of those housing units that must be added to the housing stock because they do not exist or because they must be substituted due to precariousness. On the other hand, *necessity to adequate stock* reflects the problems related to the life quality of the inhabitants. It is not related to housing stock dimension, but to internal features of a particular stock. Thus, the concept of *Housing Inadequacies* considers those housing units that do not need rebuilding, but on the other hand demand investments, no matter if public investments (public services) or private investments (repair and additions).

A previous study from Vasconcelos and Cândido Júnior (1996) (cited by DINIZ, 2004) presents three components of the deficit calculation: i) Deficit due to composite household, or households with more than one family; ii) deficit due to housing precariousness, characterized by improvised and rustic dwellings; and iii) deficit due to deficient housing, characterized by housings without piped water and not connected to a public sewage disposal system.

[5] Definition of improvised housing: housing unit with one or more persons in a non residential place (like store, plants) without exclusive destinations to housing. Furthermore, buildings being constructed, train wagons; tents, trailers, grottos, etc., and units situated under bridges or viaducts are also considered improvised housings.

The Instituto Nacional de Estadística y Censos (INDEC) in Argentina considers within the criteria to define dwellings with inadequate basic needs (NBI) at least one of the following conditions of inadequacy: i) excessive density; ii) the so-called unsuitable households, such as rent rooms, precarious housings and others; iii) households lacking a bathroom; iv) households with school-aged children (6 to 12 years old) that are not going to school; v) households with inhabitant density of four or more people per room and which householder had not completed the third grade of the elementary school. Although items IV and V do not correspond directly to the basic concept of deficit, they would be useful for social policies that envisage vulnerable households (DINIZ and CAVENAGHI, 2004).

The Instituto Brasileiro de Geografia e Estatística (IBGE) considers as adequate permanent private households with up to 2 persons per room, general water supply, general sewage disposal system or septical tank, and garbage collection by cleaning services. Furthermore, it considers intermediate criteria to characterize semi-adequate and inadequate households, so that inhabitant density is considered together with public services of water supply, sewage disposal and garbage collection. Such classification is more useful in the urban area and is more indicated for the evaluation of deficit due to the basic services of sewage; it is not so adequate in assessing the formally so-called household needs (DINIZ and CAVENAGHI, 2004).

The SEADE Foundation calculated the housing deficit in São Paulo State, Brazil, based on the data generated by the Research of Life Conditions (Pesquisa de Condições de Vida, PCV). This is a survey performed at each four years based on sampling of households, which gives a very extensive analysis of the life quality of the population. Although PCV was not designed to measure housing deficit, it can also be used with such purpose, since a wide-ranging appraisal of housing types is made (GENEVOIS and COSTA, 2001).

In order to solve these problems, many methodologies have been proposed to estimate housing deficit, depending on the available database and for which purpose the generated data will be used.

Headship Rate

The headship rate method for housing projection presupposes that the existing number of housing units in a population equals the number of heads of household in the same population. The number of heads of household is controlled by diverse sociodemographic attributes and may be easily obtained from the data generated by Demographic Censuses. Thus, the necessary input to estimate headship rates in many categories is obtained. Generally, the definition of head of household is based on a hierarchy of main supplier as well as age, and a tradition of matriarchy or patriarchy is usually maintained. The initial stock of housing deficit will be calculated according to the hypothesis that each head of household corresponds to the need of one dwelling.

Headship rate (${}_nT_x$ – EQUATION 1) is defined as the percentage of head of household by age group (CURBELO, 1991). It should be noted that the headship rate multiplied by the corresponding population contingent [${}_nN_x(t)$] results in the number of households by age group. This procedure allows to analyze the dynamics of the housing stock since it establishes for each period (i) the total housing stock and the stock per age group; and (ii) the quantification of housing inflow and outflow that feed the housing stock. Consequently, the evolution of the population and modifications in the age structure are key variables for the analysis of the potential demand.

$$ {}_nT_x = \frac{{}_nn_x(t)}{{}_nN_x(t)} \qquad \text{EQUATION 1} $$

Where

${}_nT_x(t)$	Headship ratio in the age group from x to x+n years old in year t, age as of the last birthday
${}_nN_x(t)$	Population in the age group from x to x+n years old in year t, age as of the last birthday
${}_nn_x(t)$	Total of heads of household in the age group of x to x+n years old in year t, age as of the last birthday

The projection of housing demand using headship rates has been most frequently used methodology in the recent years. A reasonable projection of the total number of households in the future may be obtained when an adequate projection by age and sex is made. This methodology has some advantages over other methodologies, as it reflects expected changes in the population age structure and sex. Since population projections reflect the past and future trends of fertility, mortality and migration, the method may indirectly reflect these three components of population changes.

On the other hand, this methodology does not consider the dynamics of formation, growth, contraction and dissolution of households and is not able to reflect such dynamics in the future housing stock. The number of housing units in the future still depends on numerous interrelated factors, such as personal choices, individual and social behavior changes. Besides, it depends on socioeconomic attributes of the future heads of household as well. The formation of a new household depends on variables such as income, employment and housing units that can be supplied. The methodology of headship rates does not consider all these variables, once it is an essentially demographic method. Nevertheless, the method might express to a reasonable extent the needs of new housing units considering the demographic dynamics of the family cycle.

Methodology

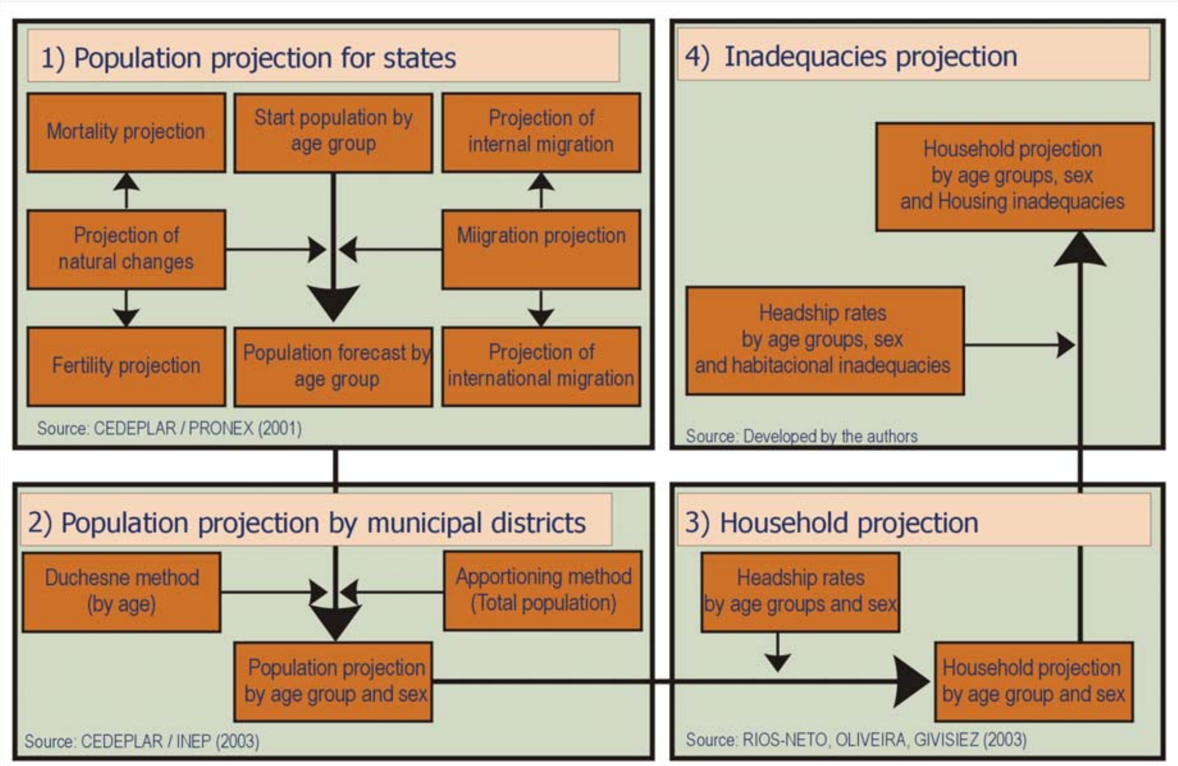
FIGURE 1 represents schematically the procedures of projecting the household demand according to the headship rate methodology, which includes specifically the housing projection as well as the population projection.

One method that might be used to perform a population projection (Item 1, FIGURE 1) is the Method of Demographic Components. In this procedure, the population of a determined age group is projected to the end of the next quinquennial, followed by a projection from that year to the end of the next quinquennial and so forth until the final period of the projection. The method was used to project populations per State in the projection performed by CEDEPLAR (CEDEPLAR, 2001).

Projection methods for small areas (Item 2, FIGURE 1) were used to decompose the data per state into smaller terrestrial units. The method AiBi, also known as Apportionment Method or projection of the participation in growth, was proposed in 1959 by Pickard. A population is projected based on the contribution of a small area to the expected absolute growth of the population in a greater area (WALVOGEL, 1998, p. 40) and was used by CEDEPLAR (2003) to estimate the total population of Brazilian municipal districts. On the other hand, the method of cohort relationships from Duchesne uses the data from two Demographic Censuses and population projections by sex and age groups related to a higher division that includes all smaller areas considered – in that case, the Brazilian States.

The most typical projection of the household demand (Items 3 and 4, FIGURE 1) is based on a population projection using a constant rate. Considering that the projection of age structure and of population growth is part of the demographic projection assumptions, the only error source of importance in the demand projection would be the maintenance of a constant headship rate. *A priori*, it is impossible to assure that variations in the headship rates do not contribute significantly to the variation. Thus, housing flows were decomposed into three effects: population size, age structure and rate. Only when decomposition was done, it is, only when the three components were individually measured, a conclusion could be drawn as whether it would be more sensible to keep a constant rate in order to estimate a future household demand or it would be advisable to project a rate according to a time trend.

FIGURE 1



Source: Elaborated by the Authors.

The total housing stock in year t can be calculated by EQUATION 2, so that the housing stock can be further decomposed according to the headship rates ($_n\boldsymbol{T}_x^t$) and the age structure ($_n\boldsymbol{E}_x^t$) of the population. Besides, EQUATION 3 can be used to calculate the total variation of the stock.

$$\boldsymbol{H}^t = \sum_{x=0}^{\omega} {_n\boldsymbol{H}_x^t} = \sum_{x=0}^{\omega} {_n\boldsymbol{T}_x^t} * {_n\boldsymbol{N}_x^t} = \boldsymbol{N}^t * \sum_{x=0}^{\omega} {_n\boldsymbol{T}_x^t} * {_n\boldsymbol{E}_x^t} \qquad \text{EQUATION 2}$$

$$\Delta H = H^t - H^{t-10}$$

$$\Delta H = \sum_{x=0}^{\omega} ({_nT_x^t} * {_nE_x^t} * N^t - {_nT_x^{t-10}} * {_nE_x^{t-10}} * N^{t-10}) \qquad \text{EQUATION 3}$$

Where	
$\boldsymbol{H}^{t-10}$	Total of housing stock in year t-10
$\Delta\boldsymbol{H} = \boldsymbol{H}^t - \boldsymbol{H}^{t-10}$	Total variation in the housing stock between year t and year t-10
$\boldsymbol{H}^t$	Total of housing stock in year t
$_n\boldsymbol{H}_x^t$	Housing stock, with heads of household between x and x+n years old, age as of last birthday, in year t
$_n\boldsymbol{T}_x^t$	Headship rate, with heads of household between x and x+n years old in year t, age as of last birthday
$_n\boldsymbol{N}_x^t$	Population of individuals between x and x+n years old in year t, age as of last birthday
$\boldsymbol{N}^t$	Total population in year t
$_n\boldsymbol{E}_x^t$	Percentage of individuals from the total population between x and x+n years old in year t, age as of last birthday

Decomposition was performed considering the structures at the beginning and at the end of the variation period and is shown in TABLE 1. It can be seen that the major variation in the housing stock results from a change in the size of the population. Such decrease in the relative participation of the population size reflects the decelerated population growth rate. The behavior of the age structure participation in the total variation of housing stock reflects the instability to which the age structure of the Brazilian population has been submitted to since that the fertility rate became slower. The headship rate, on its turn, has a negative participation of 1.92% and 0.53% in the periods 1980-1990 and 1990-2000, respectively, and a positive participation of 10.28% in the period 1970-1980. Therefore, it can be assumed that, if a constant rate were to be used to estimate the housing stock, the number of needed households would be overestimated in the periods of negative participation, whereas the number would be underestimated in the period of positive participation. In view of the significant changes in the female headship rates in the 90's and the variations resulting from the changes in the fertility rate, marked modifications in the profile of the headship rates and in their effects are expected. Overestimated and underestimated inputs result in equally significant numbers regarding investment estimates, both in the public perspective and in the private perspective.

TABLE 1
Decomposition of the variation in housing stock by period, in absolute and percentage (%) values, according to effects of population size, headship rate and age structure. Brazil, 1970, 1980, 1990 and 2000.

Period	**1970-1980**		**1980-1990**		**1990-2000**	
Effect	**Absolute**	**Percentage**	**Absolute**	**Percentage**	**Absolute**	**Percentage**
Population	6,732,726	88.49%	11,388,014	91.41%	6,113,532	83.92%
Headship rate	781,930	10.28%	-238,859	-1.92%	-38,780	-0.53%
Age	94,046	1.24%	1,308,399	10.50%	1,210,409	16.61%
Total	**7,608,702**	**100.00%**	**12,457,553**	**100.00%**	**7,285,162**	**100.00%**

Source: Demographic Censuses from 1970, 1980, 1991 and 2000 (IBGE).
Note: Standardized by age structure and headship rate structure at the end of the period.

Therefore, in order to obtain more precise estimates of housing demand, it would be advisable to project some conditions of headship rates so that the errors resulting from changes in the rate can be minimized. The chosen methodology to project these rates was the Age-Period-Cohort model. Rios-Neto and Oliveira (1999) used a similar methodology to project the rate of economically active population (PEA) and the activity rate.

Headship rates in the perspective age-period-cohort

The use of a demographic method to estimate the household demand is justified by the differential demands for different age groups and by the fact that differential demands will result as all individuals from a population pass through the stages of the life cycle. As a general rule, individuals are born in established households inhabited by a head of household and other persons somehow related to the head. Individuals may constitute a new household as a consequence of migration for studying or working and, in that situation, they usually move to households that most of the times are already established and have also a head of household. Student houses ("repúblicas"), very common in Brazil, are a good example. Migration due to work may also be to households that are already established. Nevertheless, new households may be formed as a result from the division of households constituted by more than one family or by divorce and separation, and also by the constitution of a new family separated from the original household of both members, independent if it is by marriage or other type of union.

The individual is associated to a cohort that may also significantly influence the rhythm of new household formation. Specific birth cohorts may share as common characteristic the fact of being very numerous, or yet may live through cultural changes related to the age at marriage. It may share adverse experiences that shape the reproductive behavior as well and to which the mean size of families is conditioned, besides sharing other experiences that might have some effect on the demand for new households.

Time period is another dimension involved in the decisions taken by an individual. It somehow reflects the influence of the economic scenario on individual demands. Recession scenarios, characterized by low economic activity, high unemployment rates and other factors conditioned by macroeconomic policies, may have a significant impact on the formation of new households. During unfavorable economic scenarios, individuals may postpone the decision of establishing a new family, or may live in the same household after getting married. These unions may constitute a share that do not represent an immediate demand for new households.

The analysis of demographic events such as birth, marriage and migration tells the history of the individuals since their birth until their death, including all stages of the life cycle. Such history involves not only age changes concomitant to the biological process of aging; the individuals are integrated to a particular society at a particular period of time as well. People affect and are affected by the events of their era, and most of the times, they are the reason of such events. Individuals write their own history during their lives and the history of the social changes that imprint a mark characteristic to all individuals from the same period of time. Therefore, the analysis of the demographic processes cannot ignore the period and cohort and should consider these in addition to age.

Although age is the first variable considered in the analysis of social changes, to disregard the effects of period and cohort in the interpretation of the demographic processes is the same as ignoring two important sources of variation that are involved in the process. Therefore, the analysis of demographic processes or social changes may involve three different levels: (i) cross-section analysis (period effects); (ii) longitudinal analysis (age effects) and (iii) time lag.

It is possible to calculate headship rates in a particular period or for a particular cohort depending of the interactions among the three dimensions: age, period and cohort. A model age-period (AP) permits to calculate headship rates specific for each period. An age-cohort model (AC), on the other hand, permits to calculate the rates for each cohort. Nevertheless, a complete age-period-cohort model (APC), since it configures an identity, permits to decompose the relative importance of each of the dimensions that involve the demographic process only if based on some empiric strategies.

In an estimated APC model, if the component P is fixed, the combined effect AC will produce an estimate of the period headship rate. If the component C is fixed, the combined effect AP will produce an estimate of the cohort headship rate. On the other hand, the coefficients estimated for A, P and C would produce the single impacts of these vectors on the household headship rates.

One of the advantages of estimating an empiric model for specific headship rate is the possibility to extrapolate forecasts of the rate behavior based on the parameters estimated by an equation of the model APC. Empirical evidences indicate for the potential use of this estimate model in projective techniques (RIOS-NETO and OLIVEIRA, 1999).

Projection using the model Age-Period-Cohort (APC)

The model age-period-cohort is proposed in order to estimate the future demand of the needed housing stock. The model permits to estimate patterns of headship rates considering the isolated and combined effects of the three dimensions. It is then possible to establish projection scenarios for the headship rate in the future using the estimated patterns and therefore estimate the housing stock that does not depend on the rate effect, which might result in underestimation or overestimation of the demand, as previously described.

Many researchers use the models of age-period-cohort, and cross-tables display data as age by period, cohort by period or cohort by age. Once the parameters are estimated, the problem is to establish future trends for the headship rates based on these parameters. The projection of headship rates based on scenarios derived from the coefficients estimated by the model APC permit to calculate more accurately the future demand for new households.

One of the configuration structures of the model APC is the multiple cross-section that makes use of age by period, or a matrix I x J, in which the spacing of the age categories I is equal to spacing between periods. Therefore, the K matrix diagonals correspond to the birth cohorts, so that K=I+J-1. The basic model is focused in one parameter associated to the response variable, resulting in a conventional linear model.

Thus, $\theta = E(Y)$, where E is the expected value for Y, treated as an aleatory variable, or $\theta = \log(P/(1-P))$, where p is the probability of Y=1, $p = pr(Y=1)$ and Y is a dichotomous randomized variable. It is possible to express θ as a linear function of the effects of age, cohort and period (EQUATION 4).

$$\theta_{ijk} = f(\alpha_i, \pi_j, \gamma_k) = \mu + \alpha_i + \pi_j + \gamma_k$$

EQUATION 4

So that $\alpha^{\prime s}$ represent the age-associated effects, $\pi^{\prime s}$ are the period effects and the $\gamma^{\prime s}$ are the cohort effects. EQUATION 4 is subjected to the following restriction:

$$\sum_{I=1}^{I} \alpha_I = \sum_{J=1}^{J} \pi_J = \sum_{K=1}^{K} \gamma_{K=0}$$

EQUATION 5

The above mentioned restriction is important because it configures an identification problem, since A (age) = P (period-year) – C (cohort – year of birth). The usual solution found in the literature is the imposition of one or more linear restrictions on any independent variable. A possible solution, adopted in the present study, is to consider the two coefficients of the older cohorts of the series as equal, which is an acceptable presupposition when there are no substantial changes in the past.

In the model APC, the data are tabulated as in a contingency table, in which the rows represent the ages, the columns represent the periods and each cell of the table represent the progression of a determined cohort between the age and the period. The components age, period and cohort are considered in topologic models as category variables. Therefore, the periods (P) were identified from 1 to 4, in inverse chronological order. Age (A) was identified from 1 to 9, representing the decennial year groups per decade in decreasing age order, i.e., 9 represents the youngest age group (15-24 years); 8 represents the next youngest age group (25-34 years) and so forth. Cohorts (C) were identified according to the contingency table (TABLE 2). In that case, the youngest cohort was identified as 1 and the oldest as 9, which is the total cohort categories. In summary, the intended model to be estimated comprises 4 period categories, 9 age categories and 9 cohort categories.

It can be thus assumed that the parameters for any cohort, period or age pairs are equal. In this study, it was considered that the two oldest cohorts have equal coefficients.

To estimate APC coefficients, i.e., to estimate the effects of age, period and cohort on the profile of the headship rates, a logistic regression model was used, which is one of the generalized linear models. Cohort indicators may be identified from the following matrix when demographic censuses are used:

TABLE 2
Cohort Matrix by age and period

Period Age		1970 4	1980 3	1990 2	2000 1
15-24	6	C_4	C_3	C_2	C_1
25-34	5	C_5	$C_{4,}$	C_3	C_2
35-44	4	C_6	C_5	C_4	C_3
45-54	3	C_7	C_6	C_5	C_4
55-64	2	C_8	C_7	C_6	C_5
65+	1	C_9	C_8	C_7	C_6

Parameters were estimated using the generalized linear models with the *logit* function and binominal distribution, for the three indicators that were considered. The *logit* model was chosen because the structures of the analyzed indicators are proportions varying from 0 to 1. Linear functions may extrapolate the adjusted values beyond such limits, which might result in problems when rates are projected.

Generalized linear models "are an extension of the traditional linear models that permit the population mean to be a function of a linear predictor by means of a non-linear link function. They also permit that the distribution of the response probability to be a member of an exponential family of distribution" (RIOS-NETO and OLIVEIRA, 1999).

The response variable of the model is independent for i = 1, 2..., and has a probability function that is a member of the exponential family. Since this study used the *logit* function as link function and a binomial distribution, the parameter μ from the binomial distribution is related to the linear predictor by η = log(μ/1-μ). Therefore, the predicted value is obtained by:

$$\log\left(\frac{\mu}{1-\mu}\right) = x_a^{'}\beta$$

Considering that μ is the expected value for the analyzed indicators and *t* is the population that is subjected to the risk (total of persons at age a) and considering that the interpretive variables are age, period and cohort, the final age-period-cohort model has the following structure:

$$\log\left(\frac{\mu/\mathrm{t}}{1-\mu/\mathrm{t}}\right) = \alpha + \beta^{A}X^{A} + \beta^{P}X^{P} + \beta^{C}X^{C}$$

Where: α is the constant and β the parameters of age, period and cohort, respectively.

The use of the method in two stages is able to project headship rates of the municipal districts, in a first stage, and decompose it in two categories of housing inadequacy, in a second stage.

Estimation of the housing deficit

The concept of deficit used herein tries to estimate the housing needs exclusive for households, and the needs of urban infrastructure services were not included. This concept considers that there is a proportion of a given housing stock that comprises a specific deficit, which is based on compatible criteria from the used database[6]. The criteria adopted considered those households that must be added to the stock, characterized by improvised households and households with subfamily (*Necessity to Increase Stock*); and those that need repairing, characterized by lack of bathroom and excessive density of inhabitants (*Necessity to Adequate Stock*).

---

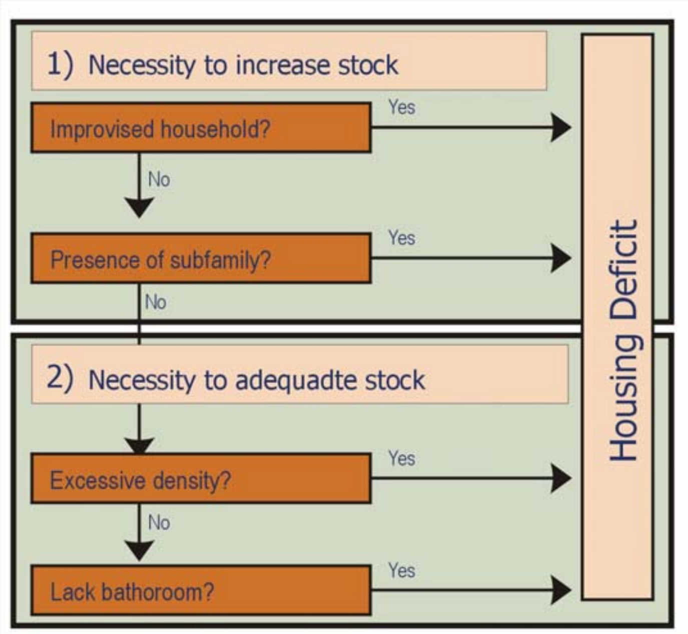
[6] IBGE – Demographic Censuses from 1970, 1980, 1991 and 2000

To estimate the subfamilies, each family[7] counted in the census was not understood as a potential housing demand, since that, as pointed by Alves (2004) “considering every subfamily as housing deficit is to ignore that the concept of family used by IBGE has an operational, and not sociological, function”. Conversely, it should be noted that the composition of a household, as well as the first job and marriage, is a significant and desired event by the majority of the population, even when the fulfillment of this dream is postponed due to economic, social or cultural reasons.

The solution was to cross the information of subfamily with number of persons per bedroom. Therefore, for the purposes of the present study, deficit was assumed as any household with subfamily and with inhabitant density per bedroom higher than three. In order to make the criteria coherently compatible, if a subfamily had been detected in a previous stage, a household was regarded as having excessive density of inhabitants when only the members of the main family were considered as inhabitants of the household. FIGURE 2 shows the criteria used in the present study.

[7]IBGE considers as families, in private households, the person that lives alone; the group of people that are related to the head of the household by blood or by domestic dependence; and the people related by communal rules.

FIGURE 2



Source: Developed by the Authors

Results

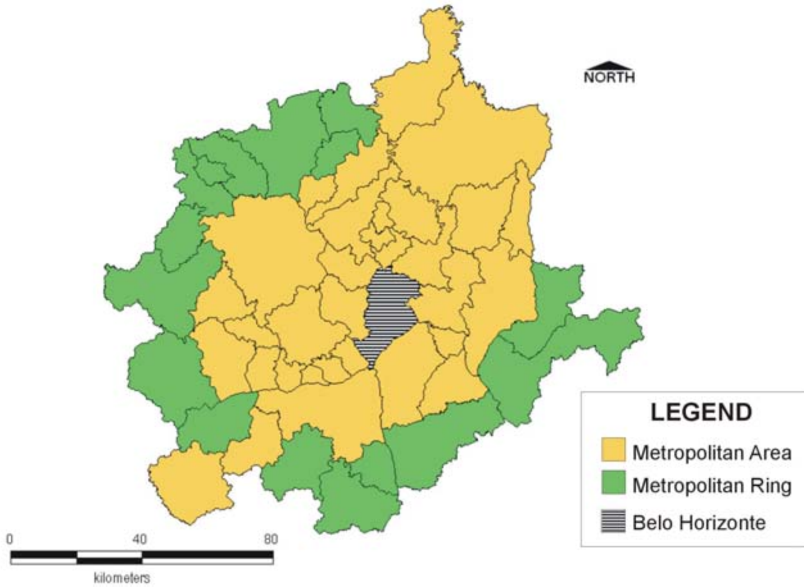
Belo Horizonte is situated in the southeast region of Brazil and it is the third principal economic pole of country. It is the fourth most populous city in the country, with 2,238,526 inhabitants (TABLE 3), and the capital of the state of Minas Gerais. The city of Belo Horizonte integrates the planning space composed by diverse cities that have similar economic characteristics and production, delimited by the state government for planning and intervention of public policies. The metropolitan ring are the cities that are not part of the metropolitan region, even though they are located around it. The metropolitan ring was defined from the demographic census of 2000 with objective to organize the administrative political division and studies for the future expansion, occupation and use of the geographic space (FIGURE 3). Tables presented in the subsequent sections had been organized according to this geographic distribution: (i) Metropolitan Area: the city of Belo Horizonte and others cities of the metropolitan area (90% of the total population); (ii) Belo Horizonte: the capital of Minas Gerais state (46% of the total population); (iii). Metropolitan Ring: the cities of the metropolitan ring (10% of the total population) and (iv) Total: All the cities of the region (iv = iii + i).

TABLE 3
Absolute and percentage (%) population by region, per period. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000

	Region	1970		1980		1991		2000	
		Absolute	%	Absolute	%	Absolute	%	Absolute	%
i	Metropolitan Area	1,719,490	88.3%	2,676,352	90.0%	3,515,542	89.9%	4,349,654	90.2%
ii	Belo Horizonte	1,235,030	63.4%	1,780,839	59.9%	2,020,161	51.7%	2,238,526	46.4%
iii	Metropolitan Ring	227,295	11.7%	296,800	10.0%	394,565	10.1%	470,085	9.8%
iv	**Total**	**1,946,785**	**100.0%**	**2,973,152**	**100.0%**	**3,910,107**	**100.0%**	**4,819,739**	**100.0%**

Source: Demographic Census 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

FIGURE 3
Belo Horizonte Metropolitan Area and Metropolitan Ring



Source: IBGE, 2002a

Housing deficit

The estimated deficit values based on the used census database are shown in TABLE 4 and GRAPH 3. The percentage of households ranked as deficient according to these criteria decreased gradually in the analyzed period, from 37.3% 1970 to 8.7% in 2000. The factor that influenced such decrease mostly was the lower percentage of households with extreme density, followed by the fact that households without an exclusive bathroom were almost eliminated. Additionally, TABLE 5 shows the total of households according to the number of inadequacies. The data demonstrate that the number of households with two or more inadequacies is progressively decreasing as well.

In Brazil, as in other Latin American countries, the process of demographic transition has achieved an advanced stage in the last three decades. The number of housing units has grown faster than the population, as a result of the progressive decrease in the size of the Brazilian families. "The percentages of subfamilies and people living alone have increased. Subfamily included familiar (related to the head) as well as non-familiar (non-related). Thus, the density of inhabitants per household has decreased, but the number of families living together has increased" (DINIZ and CAVEHAGHI, 2004). Obviously, such effect has resulted in a decreased inhabitant density in the households.

TABLE 4

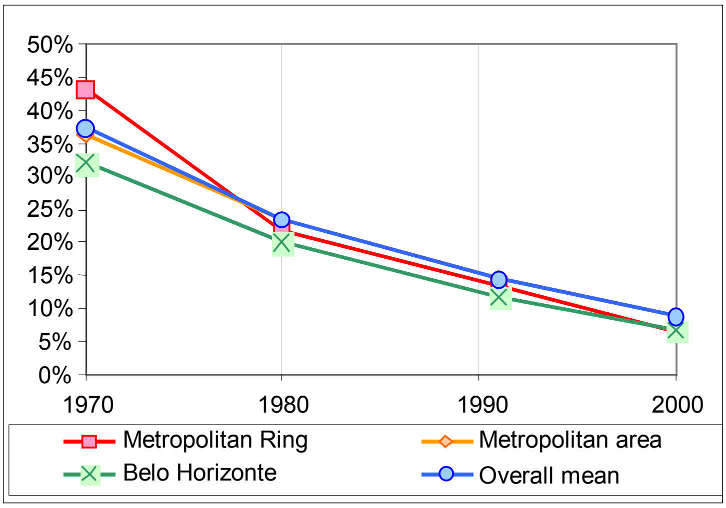
Absolute and percentage (%) values of deficient households by period and type of necessity. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000

	1970		1980		1991		2000	
Type of necessity	**Absolute**	**%**	**Absolute**	**%**	**Absolute**	**%**	**Absolute**	**%**
Increment	*7,326*	*2.0%*	*9,503*	*1.5%*	*19,152*	*2.0%*	*17,946*	*1.4%*
Improvised	309	0.1%	1,769	0.3%	4,156	0.4%	4,670	0.4%
Subfamily	7,017	1.9%	9,503	1.5%	14,995	1.6%	13,276	1.0%
Adequacy	*130,076*	*35.9%*	*140,623*	*22.4%*	*118,792*	*12.7%*	*97,547*	*7.5%*
Density	95,517	26.4%	119,604	19.1%	100,278	10.7%	91,524	7.0%
Bathrooms	47,992	13.3%	28,597	4.6%	26,705	2.8%	7,978	0.6%
Deficit	*135,029*	*37.3%*	*147,367*	*23.5%*	*134,748*	*14.4%*	*113,396*	*8.7%*
Total	**362,101**	**100.0%**	**627,803**	**100.0%**	**937,238**	**100.0%**	**130,1255**	**100.0%**

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

GRAPH 3

Household deficit percentage (%) by period and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000



Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

TABLE 5
Absolute and percentage (%) values of households by period, according to number of inadequacies and sex of the head of household. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000

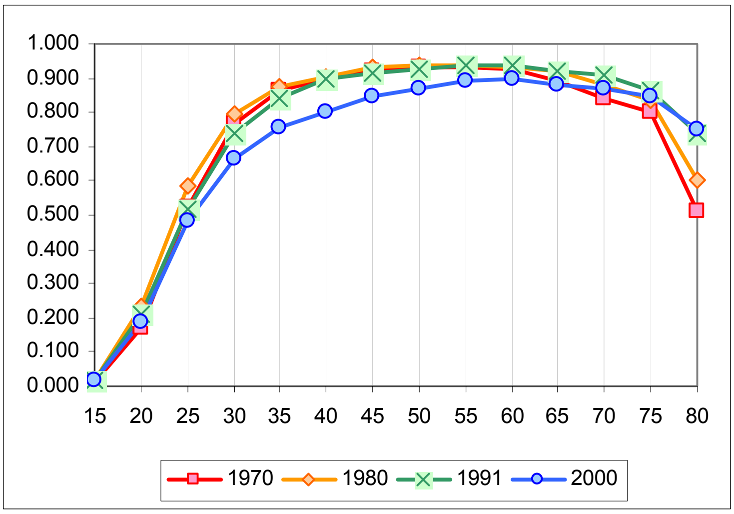
Sex of the head	Number of inadequacies	1970		1980		1991		2000	
		Absolute	%	Absolute	%	Absolute	%	Absolute	%
Male	No	184,019	50.8%	388,691	61.9%	621,996	66.4%	842,985	64.8%
	One	103,505	28.6%	118,910	18.9%	102,048	10.9%	82,386	6.3%
	Two	13,361	3.7%	8,603	1.4%	8,782	0.9%	2,573	0.2%
	Three	161	0.0%	74	0.0%	119	0.0%	9	0.0%
Female	No	43,053	11.9%	91,675	14.6%	180,494	19.3%	344,874	26.5%
	One	15,914	4.4%	18,212	2.9%	21,457	2.3%	27,006	2.1%
	Two	2,053	0.6%	1,542	0.2%	2,317	0.2%	1,384	0.1%
	Three	35	0.0%	22	0.0%	24	0.0%	39	0.0%
Total		362101	100.0%	627729	100.0%	937,238	100.0%	1,301,256	100.0%

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Headship rates and flows

This section presents the headship rates between 1970 and 2000, the projection of the headship rate in 2010, and the combined projection of rates and populations. Male headship rates are shown in GRAPH 4. It is possible to visualize the decrease in the headship rate for the age group from 25 to 45 years old between 1970 and 1990. Comparing 2000 with 1990, the decrease was more marked for the age group from 25 to 65 years old and there was an increase for the group between 65 and 85 years old.

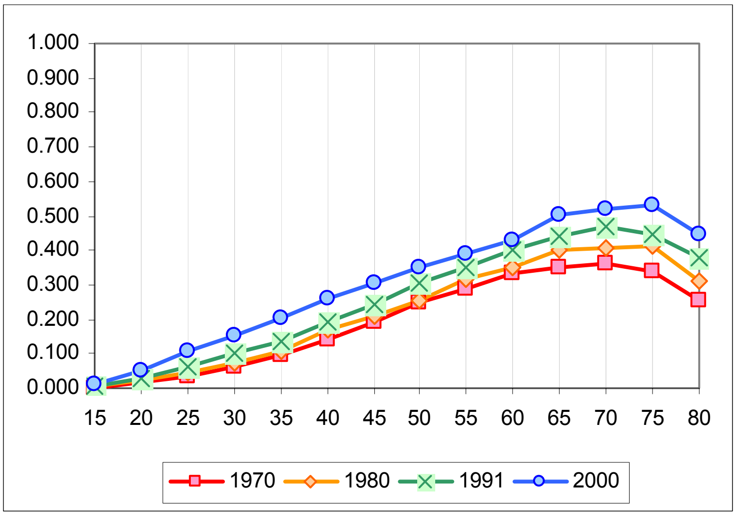
GRAPH 4
Male headship rates by period and age group. Belo Horizonte Metropolitan Area and Greater Metropolitan Ring, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000



Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Considering the female headship rate in the same period, there was a consistent increase at each decade, with an evident peak at approximately 70 years of age (GRAPH 5). Such increase in the female headship rates may be explained by circumstances involving behavior changes in relation to feminine autonomy and labor force participation. Part from this increase can also be attributed to the increase in the number of divorces and separations that result in the formation of a new household in which the woman is the head of the household and undertakes the main responsibility in raising the children.

GRAPH 5
Female headship rates by age group and period. Belo Horizonte Metropolitan Area and Greater Metropolitan Ring, Minas Gerais, Brazil. 1970, 1980, 1991 and 2000



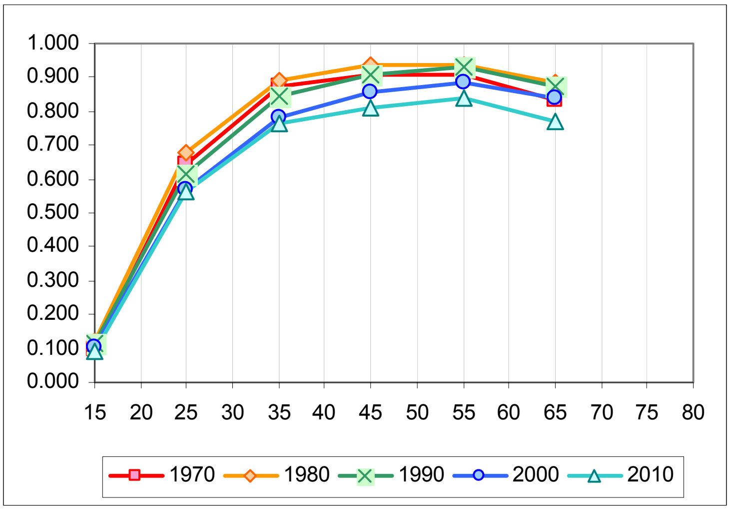
Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Projection of the headship rates

Male and female headship rates estimated and projected for 2010 using the Model APC are shown in GRAPHS 6 and 7. The analysis of the explicative power of the variables (Age, Period and Cohort) on the response variable indicated that the Model Age-Period (AP) is sufficient to explain the observed trends in the graphs. It is worth noting the marked effect of the more recent periods (1991 and 2000) on the male and female headship rates, mainly for the older age groups in such periods. Female headship rates showed a continuous increase along the years; there is, however, a marked increase between 1990 and 2000, a trend that was reproduced in the projected rate for 2001. On the other hand, male headship rates decreased in the course of the years and a higher reduction is seen in 2000 for the groups between 25 and 55 years old. Nevertheless, the male headship rate, projected for 2020, indicates for a greater decline for the age groups with more than 35 years. It is believed that the recent variations in the demographic profile of the Brazilian population have influenced the trends of the model. It is possible that studies concerning populations closer to demographic stability should better adopt more conservative models in which only age is considered as explicative variable.

GRAPH 6

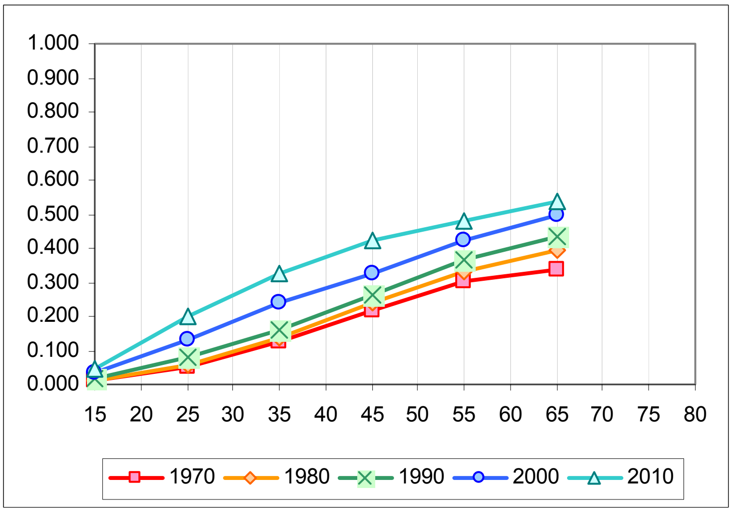
Projected and estimated male headship rates, by age and period. Belo Horizonte Metropolitan Area and Metropolitan Ring, Minas Gerais, Brazil. 1970, 1980, 1991, 2000 and 2010



Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

GRAPH 7

Projected and estimated female headship rates, by age group and period. Belo Horizonte Metropolitan Area and Metropolitan Ring, Minas Gerais, Brazil. 1970, 1980, 1991, 2000 and 2010



Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Housing stock projection

The housing stocks estimated and projected according to the headship rate model are shown in TABLE 6. As expected, the absolute number of male households are significantly higher than the number of female households, throughout the evaluated period. Nevertheless, the analysis of the proportion of male and female households from the total of each geographic stratum shows that the percentage of female households increased from 16.8% in 1970 to 33.5% in 2010, when considering the total number of households. Conversely, the percentage of male households decreased from 83.2% in 1970 to 66.5% in 2010. It worth noting that the percentage of female households in Belo Horizonte increased from 18.1% in 1970 to 40.7% in 2010.

TABLE 6
Absolute numbers of households estimates and projected, by period, according to sex of the head of household and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

Period	Metropolitan Area		Belo Horizonte		Metropolitan Ring		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
1970	263,825	53,889	187,603	41,463	34,482	6,609	298,298	60,157
1980	462,523	100,823	307,335	75,074	50,677	9,979	513,201	110,395
1990	630,113	179,277	365,489	122,367	71,863	16,380	701,956	195,178
2000	832,156	342,115	421,788	207,395	92,800	29,930	924,954	370,748
2005	953,665	463,825	455,073	269,742	105,384	39,938	1,054,092	435,423
2010	1,068,161	594,941	487,039	334,274	115,650	51,490	1,184,242	597,392

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

The estimated flows between the periods evidence the growth in the demand for female households (TABLE 7). In absolute numbers, the total flow of male households decreased in 1980-1990 when compared to 1970-1980, whereas the flow is slightly higher in 1990-2000than in the decennial 1970-1980. The projected flow of the period 2000-2010 is only 36,289 housing units higher than that of the previous period. The increasing behavior of the absolute flow along the years clearly demonstrates the increase in the demand for female households. It is noteworthy that the female household flow in the decennial 1990-2000 is twice higher than the flow in 1980-1990.

TABLE 7
Absolute flow of households estimates and projected, by period, according to the sex of the head of household and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

Period	Metropolitan Area		Belo Horizonte		Metropolitan Ring		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
1970-1980	198,699	46,934	119,733	33,611	16,196	3,370	214,903	50,238
1980-1990	167,590	78,453	58,153	47,293	21,185	6,401	188,755	84,784
1990-2000	202,043	162,838	56,300	85,028	20,937	13,550	222,999	175,570
2000-2010	236,005	252,826	65,250	126,879	22,850	21,560	259,288	226,644

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

The estimation of the household parcel that constitute the housing deficit is presented in TABLE 8. Obviously, as seen in the case of the estimated housing stock, male households are a greater part of the deficit than the female households, when absolute numbers are considered. Nevertheless, the proportion of female household deficit increases slower than the proportion of the female household stock. On the other hand, the proportion of the male household deficit decreases slower than the proportion of the male household stock. In other words, the flow of female households contributes less to the deficit increase than the flow of male households (see TABLE 9).

TABLE 8
Absolute housing deficit, by period, according to the sex of the head of household and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

Period	Metropolitan Area		Belo Horizonte		Metropolitan Ring		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
1970	101,169	15,683	63,645	10,495	15,708	2,296	116,857	17,914
1980	116,272	18,038	64,981	11,607	11,493	1,765	127,764	19,764
1990	102,413	22,236	48,741	12,288	11,071	2,109	113,425	24,304
2000	78,688	26,680	30,754	12,905	6,383	1,785	85,073	28,442
2005	78,602	31,941	28,486	14,321	6,113	2,202	83,610	26,945
2010	73,524	33,843	24,888	13,807	5,395	2,450	77,679	30,276

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

TABLE 9
Percentage of households and housing deficit, by period, according to the sex of the head of household. Total area, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

Period	Total Stock		Total Deficit	
	Male	Female	Male	Female
1970	83.2%	0.168%	86.7%	13.3%
1980	82.3%	0.177%	86.6%	13.4%
1990	78.2%	0.218%	82.4%	17.6%
2000	71.4%	0.286%	74.9%	25.1%
2005	70.8%	0.292%	75.6%	24.4%
2010	66.5%	0.335%	72.0%	28.0%

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

The absolute flows of housing deficit between the periods are shown in TABLE 10. Absolute male flows are negative after 1980-1990, as a reflection of the decrease in the male contribution to the housing demand. Conversely, feminine flows are positive and reflect the increase in the relative participation of women in household headship.

TABLE 10
Absolute flow of housing deficit, by period, according to the sex of the head of household and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

	Metropolitan Area		Belo Horizonte		Metropolitan Ring		Total	
Period	Male	Female	Male	Female	Male	Female	Male	Female
1970-1980	15,103	2,356	1,336	1,112	-4,215	-531	10,908	1,850
1980-1990	-13,859	4,198	-16,240	681	-422	344	-14,339	4,540
1990-2000	-23,725	4,444	-17,987	617	-4,687	-324	-28,352	4,139
2000-2010	-5,164	7,163	-5,866	902	-988	665	-7,394	1,834

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Finally, TABLE 11 presents the ratio housing deficit/housing stock (by sex). The proportion of the male deficit is higher than the proportion of female deficit in all geographical spaces presented. This is partly due to the major percentage of men as heads of the household and partly due to the lower decrease rate of male contribution to the housing deficit (see TABLE 9).

TABLE 11
Percentage housing deficit, by period, according to the sex of the head of household and region. Belo Horizonte Metropolitan Area, Minas Gerais, Brazil. 1970, 1980, 1991, 2000, 2005 and 2010

	Metropolitan Area		Belo Horizonte		Metropolitan Ring		Total	
Period	Male	Female	Male	Female	Male	Female	Male	Female
1970	38.3%	29.1%	33.9%	25.3%	45.6%	34.7%	39.2%	29.8%
1980	25.1%	17.9%	21.1%	15.5%	22.7%	17.7%	24.9%	17.9%
1990	16.3%	12.4%	13.3%	10.0%	15.4%	12.9%	16.2%	12.5%
2000	9.5%	7.8%	7.3%	6.2%	6.9%	6.0%	9.2%	7.7%
2005	8.2%	6.9%	6.3%	5.3%	5.8%	5.5%	7.9%	6.2%
2010	6.9%	5.7%	5.1%	4.1%	4.7%	4.8%	6.6%	5.1%

Source: Demographic Censuses 1970, 1980, 1991 and 2000 (IBGE)
Note: Data elaborated by the Authors

Final Considerations and Implications

In housing studies, Santos (1999) states that "there is some divergence in the literature related to the role that the State Government should play in housing matters". Nevertheless, "the asset dwelling has particularities that justify an action from the State Government", from which it should be cited: (i) housing is a valuable asset and its commercialization depends on long-run financing; (ii) housing is a basic necessity from the human being; and (iii) the civil construction industry responds for a significant parcel of the jobs offered and therefore, population income (SANTOS, 1999). The Brazilian Constitution, based on the Constitutional Amendment n. 30 (Emenda Constitucional Nº 30, 2000), instituted the Funding to Combat and Eradicate Poverty (Fundo de Combate e Erradicação da Pobreza). The resources are used in "complementary actions for feeding, ***housing***, education, health care, family income supplementation and other programs with relevant social meaning, that make efforts to improve life quality" (BRASIL, 2000). In other words, the issue "housing", despite its importance to the vulnerable populations, is targeted by few quantitative studies in Brazil.

Although there is a progressive decrease in the number of deficient households, a reasonable number of degraded households will still exist in the short run. Furthermore, the improvement in female households is smaller than in male households despite the fact that women contribute less to the deficit.

Data presented in TABLE 5 evidenced that the number of households with two or more inadequacies has also progressively decreased. According to the criteria used herein, there were approximately 113,000 deficient households in 2000 (TABLE 4). At least 17,000 from these should be added to the occupied household stock (improvised and with subfamilies), whereas in 97,000 housings the internal structure should be repaired or additions should be made (excessive density and lack of bathroom). Considering that there were 105,669 (14%) vacant households in the region in 2000 and disregarding the household percentage for the rent market, it should be expected that the deficit would be eliminated.

Household improvement by repairing, additions and construction conclusions is a point of the proposals that is focused on the individual and his/her house. The direct line of credit makes it possible to repair depreciated or inadequate buildings, and to construct and finish new households. Since the higher percentage of the deficit is related with the low-income population (FJP, 2002), specific lines of credit would be a powerful tool in deficit eradication and minimization.

Different social policies must be integrated, since isolated public policy decisions, i.e., decisions taken based solely on the needs of an specific area may have reduced efficacy due to the inter-relationship among the diverse social areas. Generally, individuals in a vulnerable social position are excluded not only from one primary necessity (health care, dwelling, feeding, security and education), but are, most of the times, in need of every requisites that imprint dignity to the human life. An example would be a housing policy that privileges the construction of public housing units without an organic planning of the housing demand together with the demand for other social services. The construction of public housing units neglecting other social problems may lead to serious problems in the public security. The same logic may be followed when public security policies are disconnected from policies for education or for reduction of poverty. The long-term efficiency of security policies is dependent on education, health care and labor force policies. The benefits that should be achieved by public intervention are optimized by an integrated social policy. An unmistakable example is the current managing model of the Brazilian health care services, which gives priority to programs that promote health and prevent diseases.

This model evidences the great importance of local policies in increasing the efficacy of social programs, since these local policies permit a great interaction with the assisted community. In this specific case, the intermediaries of the relationship between the Government and the population are community agents of the health care system and the staff of the project Family Health (Saúde da Família). Such intermediation between State Government and population permits to better identify community demands and could also intervene in other programs and policies. For example, the socioeconomic data of the assisted individuals could help to assure better efficacy of policies for the labor force and for education. Indeed, regarding social policies, experience indicates that the local management of resources may also assure that the main beneficiary has access to the resources that are made available by public institutions.

Besides implications for public policies, the assessment and characterization of the demographic housing demand has great implications for the market. Further studies that assess the growth of demographic housing demand controlled by the sociodemographic features of the heads of the household and the spatial distribution of the income of the municipal districts, as well as the at which age individuals pass through the main transitions of the life cycle would provide data that can be used as essential information for market segmentation and directing the actions of housing entrepreneurs and other entrepreneurs related to the different demands of the life cycle.

References

ALVES, José Eustáquio Diniz. As caracterísiticas dos domicílios brasileiros entre 1960 e 2000. Textos para Discussão. Escola Nacional de Ciências Estatísticas. Rio de Janeiro IBGE. 2004 n. 10 2004

BOLAFFI, Gabriel. A casa das ilusões perdidas: aspectos sócio-econômicos do Plano Brasileiro de Habitação. São Paulo: Centro Brasileiro de Análise e Planejamento. 1977

BRASIL. Fundação Instituto Brasileiro de Geografia Estatística. Base de informações por setor censitário. FIBGE: Rio de Janeiro, 2002a

BRASIL. Fundação Instituto Brasileiro de Geografia Estatística. *Micro dados da Amostra domiciliar do Censo Demográfico 2000*. FIBGE: Rio de Janeiro, 2002.

BRASIL. Fundação Instituto Brasileiro de Geografia Estatística. *Micro dados da Amostra domiciliar do Censo Demográfico 1991*. FIBGE: Rio de Janeiro, 1993.

BRASIL. Fundação Instituto Brasileiro de Geografia Estatística. *Micro dados da Amostra domiciliar do Censo Demográfico 1980*. FIBGE: Rio de Janeiro, 1982.

BRASIL. Fundação Instituto Brasileiro de Geografia Estatística. *Micro dados da Amostra domiciliar do Censo Demográfico 1970*. FIBGE: Rio de Janeiro, 1972.

CENTRO DE DESENVOLVIMENTO E PLANEJAMENTO REGIONAL (CEDEPLAR), Belo Horizonte. *Projeção populacional por sexo e grupos de idades qüinqüenais, das Unidades da Federação, Brasil, 1990-2020*: Atualização. Trabalho realizado no âmbito do Projeto "Dinâmica Demográfica, Desenvolvimento Regional e Políticas Públicas" (PRONEX/CEDEPLAR/UFMG, 41/96/0892). 2001. (Documento eletrônico).

CENTRO DE DESENVOLVIMENTO E PLANEJAMENTO REGIONAL (CEDEPLAR), Belo Horizonte. *Projeção populacional por sexo e idade simples, dos municípios brasileiros, Brasil, 2000-2010*. Trabalho realizado através de convênio firmado com o Instituto Nacional de Pesquisas Educacionais (INEP) 2003. (Documento eletrônico).

RODRIGUEZ, Julio; CURBELO, Jose Luis; MARTIN, Victoria. Una aproximación a las necessidades de vivienda em España. Revista Española de financiacion a la vivienda. Madrid: Banco Hipotecario de España. n. 14-15. Marzo/1991.

RIOS-NETO E OLIVEIRA, A, Aplicação de um modelo de idade-período-coorte para a atividade econômica no Brasil metropolitano. Pesquisa e Planejamento Econômico. Rio de janeiro, v. 29, n. 2, p. 243-272, ago. 1999

Diniz 2004 As características dos domicílios brasileiros entre 1960 e 2000. *Textos para discussão*. Rio de Janeiro: ENCE. 2004

FUNDAÇÃO JOÃO PINHEIRO, Belo Horizonte. Déficit habitacional no Brasil 2000. Belo Horizonte: FJP, 2001. 203 p.

GENEVOIS, Marie Louise Bulhões Pedreira; COSTA, Olavo Viana. Carência habitacional e déficit de moradias: questões metodológicas. São Paulo em perspectiva. N. 15 v. 1 2001.

JUNQUEIRA, Anna Cecília; VITA, Marcos. Os desejos da classe média. Veja. Abril: São Paulo, ed. 1739, ano 35, n. 7, p. 98-105, 20 fev. 2002.

RIOS-NETO, Eduardo L. G.; OLIVEIRA, Ana Maria Hermeto. Aplicação de um modelo idade-período-coorte para atividade econômica no Brasil metropolitano. Pesquisa de planejamento econômico, v.29, n.2, ago. 1999

RIOS-NETO, OLIVEIRA e GIVISIEZ 2003. Um modelo para estimar e projetar a demanda por habitação no Brasil: 1970-2010 por UFs, Regiões Metropolitanas do DF, Recife e Curitiba. IPEA: Brasília. 2003. (Relatório do pesquisa)

Santos, Cláudio Hamilton M. Políticas federais de habitação no Brasil. 1964/1998. Texto para discussão. IPEA, Rio de Janeiro, n.654, jl. 1999.

VASCONCELOS, José Romeu de; CÂNDIDO JÚNIOR, José Oswaldo. *O problema habitacional no Brasil*: déficit, financiamento e perspectivas. IPEA, Rio de Janeiro, n. 410, abr. 1996 (Textos para discussão)

Waldvogel, B. C. (1998) Técnicas de Projeção Populacional para o Planejamento Regional. Belo Horizonte: UFMG/CEDEPLAR (Estudos Cedeplar 01).

BANCO DE DESENVOLVIMENTO DE MINAS GERAIS. Minas Gerais do Século XXI. Belo Horizonte: Rona Editora, 2002

BERCOVICH, Alicia; PEREIRA, Nilza Martins. Unidad de empadronamiento. ¿hogar, vivienda o família? Ventajas y desvantajas delenfoque del censo brasileño. CEPAL – Séries Manuales. Santiago do Chile: División de Población, CELADE, junio de 1999

BONGAARTS, John; BURCH, Thomas K; WACHTER, Kenneth W. *Family demography: methods and their applications*. Oxford: Oxford University Press. 1987. 365p. ISBN 0198295014 : (Enc.)

FUNDAÇÃO JOÃO PINHEIRO, Belo Horizonte. Déficit habitacional no Brasil. Belo Horizonte: FJP, 1995. 146 p.

RETHERFORD, Robert D.; CHOE, Minja Kim. Statistical models for causal analysis. New York: John Wiley & Sons

UNITED NATIONS. Departament of Economic and social affairs. Statisitic Division. Handbook on population and housing census editing. New York: United Nations. Studies in Methods Serir F No. 82 Disponível em: <http://unstats.un.org/unsd/publication/SeriesF/SeriesF_83rev1e.pdf> Acessado em: 25 de novembro de 2004

CAVENAGHI, S.M, GOLDANI, A. M. Fecundidade e família: os tamanhos das famílias e das crianças no Brasil. ABEP, São Paulo, REBEP, v. 10, n.1/2, jan/dez, 1993, p. 107-134.

MEDEIROS, M. OSÓRIO, G.O. Mudanças na composição dos arranjos domiciliares no Brasil – 1978 a 1998. ABEP, Campinas, REBEP, V.17, n. 1/2, jan/dez, 200, p. 67-85

LAZO, Aída, C. G. V. Nupcialidade nas PNADs-90: um tema em extinção? Brasília e Rio de Janeiro, Texto para discussão nº 889, Ipea, junho de 2002